Cognitive Impairment and Eight-Year Mortality in the Kangwha Cohort of the Older People

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Abstract

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The relationship between cognitive impairment and mortality was examined in a community residents population sample of 1,599 women and 1,150 men aged 65 years or over in Kangwha County, Korea in 1994-2002. In addition, we separately examined the relationship between high blood pressure and cognitive impairment. The cognitive function of 2,749 respondents was assessed by using the 30-point Mini-Mental State Examination (MMSE) in 1994. No cognitive impairment was defined as a score of 24-30 points on the Mini-Mental State Examination, mild cognitive impairment was defined as a score of 18-23 points, and severe impairment was defined as a score of 0-17 points.

Cox proportional hazards models were conducted to examine the association between cognitive impairment and increased risk for mortality. When compared with cognitively unimpaired subjects, those cognitively impaired subjects were older, had poorer functional status, elevated blood pressure and were not as well educated.

After control for multiple potential confounders, in both men and women severe impairment remained predictor of increased mortality; the relative risk was 1.5(CI 1.10-2.04) and 1.3 (1.02-1.65) for men and women, respectively. Among men mild impaired remained significantly; the relative risk was 1.3 (CI 1.02-1.60).

In multiple logistic regression analyses, high systolic blood pressure was related to cognitive impairment among women and high diastolic blood pressure was marginally related to cognitive impairment in both men and women.

We found that cognitive impairment is a significant predictor of mortality as well. Early detection of impaired cognition and attention to associated health problems could improve the quality of life of these older adults and perhaps extend their survival.

Key words: cognitive function; mortality rate; risk factors; hypertension; dependence on daily living; functional capacity; older residents

I. INTRODUCTION

1. Cognitive Function and Mortality

There is a growing literature demonstrating that cognitive function measured in the elderly is a strong, independent predictor of subsequent mortality (26-30). Recent studies among noninstitutionalized populations, employing brief screening tests, indicate that 20% or more of the elderly population may be cognitively impaired. Three or four times as many persons have mild or moderate impairment (72-74). There is a greater prevalence of cognitive impairment among the older old, those with less education, and minorities (75-77).

Cognitive impairment represents a major public health burden; it has adverse psychosocial and economic consequences for affected persons and their families (1-3) and is a risk factor for increased home health care use, (4) hospitalization (5-7), nursing home entry (8-12), and mortality. As the older population continues to grow, the personal and societal burden of cognitive impairment will become an increasing public health concern in developed and developing countries.

The relation between cognitive function and mortality is observed using a variety of measures including the Mini-Mental State Examination, selected subscales of the Wechsler Adult Intelligence Scale-Revised, and various other tests of verbal and nonverbal abilities.

The Mini-Mental State Examination (MMSE) has become a widely used method for assessing cognitive mental status both in clinical practice and in research (1-4). As a clinical instrument, the MMSE has been used to detect impairment, follow the course of an illness, and monitor response to treatment. As a research tool, it has been used to screen for cognitive disorders in epidemiologic studies of community dwelling and institutionalized populations (7-11) and to follow cognitive change in clinical trials (12-16).

Most of the data demonstrating an association between cognitive impairment and mortality have been gathered in studies that compared persons with and without dementing disorders. In population-based investigations, dementia diagnoses confer an increased mortality risk (16-23). In some studies, the elevated risk is observed primarily or exclusively among those respondents with the most marked cognitive deficits (19, 23). These findings are consistent with observations of clinical samples, which have found significant associations between indicators of dementia severity and shortened survival among patients with Alzheimer's disease (24-27). Some of the excess mortality is probably caused by dementing diseases and their complications, but an association has been found even when demented subjects are excluded, retaining those with sub-clinical cognitive impairment (61).

Resent studies indicate that nondementing cognitive impairment is more prevalent than all dementia forms summed together. In a mixed (community and institutional) sample of more than 10.000 elders aged 65 years and over, Graham et al. (79) from the Canadian Study of Health and Aging found that the prevalence of cognitive impairment with no dementia was 16.8 percent, while all dementias together amounted to 8 percent. Other authors (80-82) have indicated that the condition is associated with poorer survival when compared with normal cognition.

These results raise the question of whether variations in cognitive performance among the elderly who are not necessarily suffering from dementia have any prognostic significance with respect to survival. In population-based studies of representative elderly cohorts that have addressed the issue, aged persons evincing severe cognitive deficits do appear to have an elevated mortality risk when compared with cognitively intact persons (10, 13-19). However, it is not clear whether less severe cognitive dysfunction is also predictive of impending death. Some investigators have reported that mild but measurable cognitive difficulties are strongly associated with a shortened life span (16, 18, 19), but others have found either no association (10, 13, 17) or modest associations only (14, 15). Moreover, the issue of whether variation within the upper range of the cognitive spectrum is related to mortality generally has not been addressed. One exception is the report by Liu et al. (15), which, in a 10-year follow-up of a subsample of participants in the population-based Framingham Heart Study, did not find that superior performance on a battery of neuropsychological tests conferred any survival advantage.

There is mixed evidence about common psychiatric disorders as predictors of mortality. Most of the work has been done with depression or with scales of neurotic symptoms. Controlling for physical health status is very important when studying psychiatric disorders and symptoms, because physical ill health and disability are known risk factors for depression.

Although a portion of the relation between cognitive function and mortality may be explained by the presence of chronic diseases that affect cognitive function (31, 32), the fact that cognitive function measures remain significant, independent predictors of mortality after accounting for a wide range of health, functional status, and behavioral measures suggests that the inverse relation between cognitive function and mortality in elderly persons is not entirely explained by organic disease.

Several theories have been put forward to explain to association of cognitive impairment and increased mortality. It has been suggested that this association may reflect neurological changes (22). Alternatively, intact cognitive function is needed to remember to take required medications, practice sound preventive care, and eat properly. Reduced perceptual speed may reflect a general aging of the central nervous system that results in reduced adaptive capacity and an increased susceptibility to death from various causes (23). Perhaps low cognitive performance is an indicator of a specific organ disturbance produced by diseases not directly affecting the brain, such as metabolic and neurochemical disorders, toxicities or a systemic disease (24).

Most studies relating cognitive functioning to mortality have only included small numbers of the oldest – old. Yet poor cognitive performance may have less prognostic significance among older individuals than younger individuals, as discussed in a recent article (25). In the very old, cognitive performance may be more susceptible to external factors such as motivation, sleep deprivation, transient sensory or motor difficulties, or the strain of long interviews than in their younger counterparts, and thus less likely to be predictive of mortality.

In this dissertation we report findings of prospective data on the association between cognitive impairment and mortality in a large sample of older residence in the community. Baseline measures of cognitive impairment were assessed as mortality risk factors by means of both univariate and multivariate statistical procedures while controlling physical health (limitation in activities of daily living and self-rated health) and health behaviors.

2. High Blood Pressure and Cognitive Function

In gerontological research, hardly any topic has attracted as much interest as cognition and its development during aging. Abilities, which to a large extent rely on perceptual speed and are independent of acculturation, are considered the most vulnerable in relation to aging (100). The age-related cognitive changes do not generally become obvious until an individual has reached his or her late seventies (101). In the presence of disease, age-related cognitive decline becomes accentuated (102). It has been proposed that in elderly healthy individuals, part of the variance of cognitive decline that has been ascribed to normal aging instead can be related to differences in blood pressure levels (103)

During the last decades the association between blood pressure and intellectual functioning has been the focus in many research projects. Many and large population studies have been conducted, but still the assumed association is not fully understood. The Honolulu-Asian Aging Study found mid-life elevated blood pressure associated with lower late life cognitive function. These findings were confirmed Kilander and colleagues who, in a large Swedish study, found hypertension related to decreased cognitive function when measured 20 years later (43).

High blood pressure is an important risk factor for vascular disease, including stroke, in the elderly (33-34). Because vascular disease can lead to dementia (35, 36), this suggests a possible association between elevated blood pressure and increased risk of dementia. However, the findings of cross-sectional, population-based studies of blood pressure and cognitive function in the elderly have varied greatly. Some studies found higher rates of cognitive impairment associated with elevated blood pressure (37), others with low blood pressure (38), and other studies found little or no association (39).These results mirror the conflicting associations between blood pressure and cardiovascular disease mortality found in observational studies of the elderly.

Recent studies, both prospective and cross-sectional, support the link between blood pressure and cognition more strongly. The most important of these were based on the re-analysis of the Framingham data originally reported by Farmer et al (44, 45) and Elias et al. (46) Evidence was obtained for a negative association between blood pressure levels, when few, if any, participants were taking antihypertensive medication, and cognitive performance measured 12–14 years later. Higher blood pressure (both systolic and diastolic were analyzed separately) was predictive of lower performance on a composite neuropsychological performance score and measures of attention and memory (44–46). Few studies have addressed the problem with decreasing blood pressure among the elderly and the fact that cognitive function also shows age-related changes that might influence interpretation of the possible effect of high blood pressure on cognition. This is especially true for cross-sectional studies. The question whether high blood pressure, as a risk factor for cerebrovascular disease, causes cognitive decline, or whether the observed decline of blood pressure in the elderly is the effect of cerebrovascular damage, remains to be answered.

Interpretation of cross-sectional relationships between blood pressure and cognitive function is problematic because dementia itself may affect blood pressure through its effects on diet and weight less (40). Although several studies have reported on associations between hypertension and cognition, the covariance between blood pressure, other vascular risk factors and manifestations of vascular disease, such as ischaemic heart disease, carotid artery stenosis and peripheral arterial disease, as intermediates on cognitive functions have more previously been studies in the elderly.

Mixed results have been presented on the relationship between blood pressure level and cognitive function in previous studies (44–49). An early study found negative correlations between blood pressure level and several cognitive scales, but without considering the adjustment for age, education or antihypertensive therapy (47). Two other small studies (48, 49) showed scant evidence for a longitudinal association. Data from the Framingham cohort suggested that blood pressure level may be associated with cognitive performance (in 2032 subjects from the Framingham Heart Study aged 55 and older), but only in subjects followed for a long period without antihypertensive therapy(44–46).

Another study showed that diastolic hypertension, but not systolic hypertension, was related to lower performance on a free-recall memory test in 2433 elderly subjects from the Iowa Aging Study (50). Similar findings were reported by a Swedish population-based cohort study of 70-year-old men, followed from 50 to 70 years of age, when cognitive functions were assessed by the Mini-Mental State Examination (MMSE) and the Trail-Making Test. High diastolic blood pressure (DBP) at baseline predicted later impairment of cognitive performance, even after excluding men with a previous stroke (51).

The diagnosis of hypertension seems to be associated with poor cognitive performance (49,52) and slower psychomotor performance in elderly hypertensive subjects not taking antihypertensive medication at the time of assessment (53), as well as in subjects with higher resting levels of increased DBP (54,55) and systolic blood pressure (SBP) (54). The mixed findings could also be explained by the fact that most studies have used only a few neuropsychological tests or composite tests often not controlled for possible confounding factors, such as education, gender, alcohol and smoking habits (46), or have used selected populations. Elevated blood pressure is also a risk factor for vascular dementia (56,57). One study showed that individuals who developed dementia between the ages of 79 and 85 years had higher systolic and diastolic pressures at ages 70 and 75 compared with patients who did not develop dementia. The authors suggested that previously elevated blood pressure might increase the risk of dementia, even Alzheimer's disease (58). The mechanism underlying hypertension-related cognitive changes are complex and are not yet fully understood, and few studies have included patients with antihypertensive treatment. The potential positive effect of blood pressure levels lower than 140mm Hg is still under debate (59).

Several theories seek to explain the association between hypertension and impaired cognitive function. One theory assumes that high blood pressure disturbs cerebral perfusion with altered metabolism as a consequence (62). Hypertension might also be a risk factor for clinically silent stroke (84) and it was shown in a prospective study that low cognitive function was associated with incident stroke after a mean follow-up period of 4.3 years (83). Hypertension may also be associated with leukoaraiosis, white matter lesions, which are related to poor cognitive function (84).

In this part of dissertation, we examined cross-sectionaly the relationship between high blood pressure and cognitive impairment among persons sixty five years or older residing in the community.

3. Objectives of Study

- To examine the mortality risk associated with cognitive impairment among older residents in the community

- To identify a set of predictors of mortality among older residents in the community, before any physical, biochemical, or image examination is performed, that could be collected on a routine standardized basis, to help the clinician define a patient follow-up strategy and the health planner make decisions regarding the care of older people

- To examine cross-sectionaly the relationship between high blood pressure and cognitive impairment among older residents in the community

II. METHODS

1. Study Population and Design

Data for this study came from the Kanawha cohort study. 'The Kangwha cohort' is a large longitudinal cohort data comprising 2,167 women and 1,434 men Kangwha residents aged sixty-five or more as of May 1994 to whom a personal health interview and a health examination survey were carried out. The interview and health examination completion rate was 72.1 % in males and 65.1 % in females respectively.

Information was collected on demographic characteristics included age and sex, cognitive function, medical history, health behaviors smoking and drinking behaviors, physical health status (limitation in activities of daily living and self-rated health), pulse, blood pressure, weight, height, and some other health related factors.

Twenty-eight well-trained interviewers accomplished data collection for a period of one month after one –week long training.

The follow-up of the Kangwha cohort was conducted biannually by death certificates, computerized citizenship registers searches, and death allowance registers in medical insurance companies, and household or neighbor interview surveys in person or by telephone lead to get a more than 95.0 % follow-up rate for the first six year observation period.

2. Measurements

Cognitive Function

The Mini-Mental State Exam (MMSE), an instrument widely used to screen for cognitive impairment, was administered at baseline. The MMSE assesses signs of dysfunction in orientation, registration, attention, calculation, recall, and language.

This measure several domains of cognitive function yielding a possible total score from 0(worst) to 30(best points). Persons with MMSE scores of less than 18 are defined as severely impaired, those with scores of 18 to 23 as mildly impaired and those with scores of 24 and above as unimpaired.

Although the MMSE is an easily administered and reliable tool to identify signs of cognitive impairment, scores do not provide clinical diagnoses (69). Cognitive impairment may result from a variety of medical conditions including dementia, depression, brain injury, and mental retardation (70).

Physical Health Status

The interview included structured questions about health characteristics- limitation in activities of daily living (ADL limitation), self-rated health and chronic diseases.

Limitation in Activities of Daily Living. The subjects would be classified as 'limited' in Activities of Daily Living if they received assistance to perform a given tasks as described previously (for example, bathing, dressing, toileting, transferring, continence, and feeding). The definition for limitation in ADL was similar to that of the original version of Kats ADL index (78).

Self-Rated Health Status. Participants were asked to assess their health at the time of the interview by asking them, ‘How would you rate your own health?’ (excellent/ good/ poor/ bad), ‘How would you compare your health with that of others of your age group?’ (better/same/worse), and subjective questions about hearing and visual acuity (good/bad).

In the analyses, the category ‘excellent’ was the reference group and the categories ‘bad’ and ‘poor’ were combined.

Health Behaviors

Health behavior concerning alcohol and smoking were asked for in a structured questionnaire. Subjects were asked whether they currently smoked or had ever smoked. According to the answers the following three categories were applied for tobacco use; never (=reference), former smoking and current smoking.

Alcohol consumption was categorized: never (=reference) and ever (1-3 drinks, 4-6 or more drinks per week, 1-4 drinks per month and 4-12 drinks per year) uses alcohol. Consumption was based on the participants’ report of alcohol consumption at the time of the interview.

Educational Level

Educational was assessed as the maximum educational level achieved. As in previous studies (71), the two categories of low educational level (never, seodang – Korean traditional school, elementary school, middle school level or less than 8 years of education) and high educational level (high school to university degree, or 8 or more years of education) were used in the analysis.

Blood Pressure and Hypertension

Arterial blood pressure was measured using a sphygmomanometer with the subjects in a sitting position after 5 minutes rest. Korotkoff phase 1 and 5 were used for recording systolic and diastolic blood pressure, respectively. Systolic pressure higher than 140 mm Hg and diastolic pressure higher than 90 mm Hg were defined as high systolic and diastolic pressure, respectively.

The cutoff points for high blood pressure were used in this study; hypertension stage I that defined as systolic of > 140 mm Hg, and diastolic of >90mm Hg, following the guidelines of The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure.

After measuring blood pressure, pulse rate per minute was taken. Blood pressure was measured twice. The mean of the first and second reading was calculated to establish the blood pressure value of each respondent.

Assessment of Mortality

Mortality was assessed over a period of 8 years after the baseline assessment of predictors. The data were analyzed using the Cox proportional hazards model. Survival data were obtained from the Mortality Register at Korean National Statistics.

3. Statistical Analyses and Approach

The Cox proportional hazards model was used to select the predictors of mortality. In selecting the best set of predictors, age, cognitive impairment, ADL limitation, self-rated health status, and education were included in all models.

During the analyses, individuals whose data were missed (816), and who are under sixty five years old (36) were excluded. Analyses were performed separately for women (n=1159) and men (n=1150). Mortality risk factors for mild and severe cognitive impairment were identified by multivariate Cox model.

A full-variable model was developed in which all significant variables from univariate models were included, but systolic and diastolic pressure were included separately. Age, cognitive impairment and ADL limitation was always the first variables added to the model. The effect of a potential risk factor for mortality was expressed as the relative risk (RR) of death; 95% confidence intervals that did not overlap 1.00 were considered significant.

The prevalence rates for high systolic and diastolic blood pressure were calculated separately in every category of each variable. Odds ratios and 95% confidence intervals were estimated from logistic regression model to evaluate the association between health conditions and high blood pressure.

All calculations were performed with a standard statistical software package. Demographic, health status, and social characteristics of the unimpaired and impaired groups were also compared. Differences among the groups were tested for significance with t tests (for continuous variables) or the chi-square test (for dichotomous variables).

III. RESULTS

1. Characteristics of Cognitively Impaired Group

The general characteristics of the study sample are shown in Table 1. The mean age in cognitively impaired and unimpaired subjects was 77.6 years and 73.2 years for men and 76.6 years and 72.6 years for women, respectively.

In both men and women the mean age, systolic blood pressure (SBP), low education, and limitation in activities of daily living (ADL limitation) were significantly higher in cognitively impaired respondents. ADL limitation and low education showed that the strongest relation with cognitive impairment in both men and women. Among women current smoking status was significantly high in cognitively impaired group.

The mean systolic blood pressure in cognitively impaired and unimpaired subjects was 141.4 mm Hg and 134.4 mmHg for men and 141.5 mmHg and 138.1 mmHg for women, respectively.

Between two groups that cognitively impaired and unimpaired there was no significant difference in diastolic blood pressure (DBP), alcohol consumption, antihypertensive treatment, chronic disease, and self-rated health status (table 1).

Table 1. General Characteristics in the Kangwha Cohort of the Older People

Characteristics		Men			Women		
		Cognitive impairment	Normal	t or X^2 value	Cognitive impairment	Normal	t or X^2 value
		Mean+SD	Mean+SD		Mean+SD	Mean+SD	
Age, year		77.6+6.3	73.2+5.3	6.5**	76.6+6.7	72.6+5.5	10.9**
SBP mm Hg		141.4+27.0	134.4+22.3	2.42*	141.5+25.1	138.1+23.9	2.43*
DBP mm Hg		81.5+13.2	79.1+12.5	1.79	81.0+14.0	81.0+12.7	0.11
		N (%)	N (%)		N (%)	N (%)	
Education, low		62 (68.1)	386 (40.9)	25.1**	385 (91.9)	787(78.6)	36.1**
ADL limitation	No	80 (88.9)	933 (98.5)	33.7**	393 (94.0)	1001 (99.5)	43.05**
	Yes	10 (11.1)	14 (1.5)		25 (5.9)	5 (0.50)	
Smoking status	Never	23 (25.2)	226 (23.9)	0.38	325 (77.9)	827 (83.1)	12.1**
	Past	15 (16.4)	180 (19.1)		19 (4.5)	16 (1.6)	
	Current	53 (58.2)	537 (56.9)		73 (17.5)	152 (15.2)	
Alcohol consumption	Never	59 (64.1)	650 (68.6)		48 (11.5)	118 (11.7)	0.02
	Ever	33 (35.9)	298 (31.4)		371 (88.5)	886 (88.2)	
Antihypertensive Treatment	No	14 (15.2)	125 (13.1)	0.31	94 (22.3)	224 (22.2)	0.003
	Yes	78 (84.8)	827 (86.9)		327 (77.7)	785 (77.8)	
Chronic disease	Never	52 (60.5)	574 (62.1)	0.09	227 (56.1)	593 (60.3)	2.08
	Ever	34 (39.5)	350 (37.9)		177 (43.8)	389 (39.6)	
Self-rated health	Good	38 (43.7)	351 (37.5)	3.23	177 (42.8)	415 (41.7)	0.19
	Fair	24 (27.6)	224 (23.9)		115 (27.8)	287 (28.8)	
	Bad	25 (28.7)	360 (38.5)		121 (29.3)	293 (29.4)	

Note. ** < 0.001; * < 0.05; SD- standard deviation; ADL= limitation in activities of daily living.

2. Predictors of Mortality

The relationship between mortality and each baseline predictor variables, including cognitive impairment, was assessed initially by means of a Cox univariate proportional hazards model. Results are shown in Table 2. Statistically significant variables in univariate analyses were next entered into a multivariate Cox proportional hazards model to assess the independent contribution of each variable, controlling for the effects of others. Univariate and multivariate models were performed separately for men and women. During 8-year period 983 participants (39.8%) died.

Table2. Relative Risks of Death Calculated from Univariate Cox Proportional Hazards Models: 8-Year Follow-Up of the Kangwha Cohort

Risk Factor		Men		Women	
		RR	95% CI	RR	95% CI
Age (year)		1.1	1.07-1.10	1.1	1.08-1.11
Cognitive impairment		2.1	1.56-2.71	2.1	1.73-2.59
Education, low		1.3	1.03-1.49	1.6	1.20-2.09
ADL limitation		2.9	2.06-4.18	6.0	4.41-8.10
Smoking	Past	0.9	0.70-1.21	1.1	0.64-2.02
	Current	1.1	0.85-1.29	1.5	1.19-1.86
Drinking		0.9	0.75-1.09	0.8	0.61-1.12
Hypertension*		1.0	0.86-1.23	1.6	1.34-1.93
Chronic disease		1.3	1.10-1.58	1.2	0.95-1.38
Self-rated health	Average	1.0	0.78-1.28	0.9	0.73-1.20
	Bad	1.6	1.34-1.99	1.4	1.09-1.67

Note. RR=relative risk; CI=confidence interval; *Included antihypertensive treatment; ADL=limitation in activities of daily living.

In univariate model cognitive impairment was significantly associated with mortality risk; the relative risk was 2.1 (CI 1.56-2.71) and 2.1 (CI 1.73-2.59) for men and women, respectively. In both men and women age, low education, limitation in activities of daily living (ADL limitation) and self-rated health status were significantly associated with increased mortality. Additionally, among men chronic disease, among women hypertension and current smoking status were significantly associated with mortality in univariate model (table 2).

Table3. Relative Risks of Death for Sex from Multivariate Cox Proportional Hazards Model.

Risk Factor		Men		Women	
		RR	95% CI	RR	95% CI
Age		1.1	1.08-1.12	1.1	1.07-1.10
Cognitive impairment	Mild	1.3	1.02-1.60	0.9	0.73-1.19
	Severe	1.5	1.10-2.04	1.3	1.02-1.65
Education, low		0.8	0.68-1.01	1.1	0.81-1.43
ADL limitation		1.5	0.96-2.33	2.7	1.86-3.83
Chronic disease		1.2	1.01-1.47	0.9	0.78-1.15
Self-rated health	Average	1.1	0.86-1.44	0.8	0.65-1.10
	Bad	1.7	1.40-2.20	1.4	1.08-1.70
Smoking	Past	0.9	0.66-1.20	1.1	0.63-2.05
	Current	1.1	0.86-1.20	1.3	1.03-1.69
Hypertension*		1.0	0.83-1.21	1.4	1.12-1.66

Note. RR=relative risk, CI= confidence interval, ADL=limitation in activities of daily living; *Included antihypertensive treatment.

A multivariate Cox proportional hazards model was performed separately for men and women when the cognitive impairment status was divided into mild and severe subgroups. Results are shown in Table 3.

In both men and women, severe cognitive impairment was significantly associated with an increased mortality risk; the relative risk was 1.5(CI 1.10-2.04) and 1.3 (1.02-1.65) for men and women, respectively. Mild cognitive impairment was only significant among men; the relative risk was 1.3 (CI 1.02-1.60) in the multivariate model (table 3). Thus, even when demographic, health, and social factors are controlled severe cognitive impairment remains an important mortality risk in both genders.

Other significant risk factors of mortality for men were chronic disease, for women were limitation in activities of daily living, current smoking status and hypertension. Age and self-rated health were significant risk factors for both men and women. But the relative risk for low education was no longer significant in the multivariate model. Among men, limitation in activities of daily living was marginally significant (table 3).

Age Stratified Analyses

Multivariate Cox proportional hazards models were performed for age stratification groups that younger then 73 and older then 73 years old. Results are listed in Table 4.

In the stratified analyses, among men cognitive impairment was marginally associated with both age groups; the relative risk was 2.01 (CI 0.96-4.18) and 1.38 (CI 0.98-1.94) for younger then 73 and for older then 73 years old respectively. Among women, cognitive impairment was significantly associated with both age groups; the relative risk was 1.70 (CI 1.05-2.73) and 1.40 (CI 1.08-1.80) for younger then 73 and for older then 73 years old respectively (table 4).

Self-rated health status was significantly associated with both age groups.in women and men. Among women, limitation in activities of daily living was significantly associated with both ages. Among men, ADL limitation was significantly associated with only for people aged younger then 73 years. Chronic disease was marginally significant for people those aged older than 73 years among men. Current smoking status was marginally significant people aged younger than 73 years among women (table4).

Table4. Relative Risks of Death for Sex and Age Stratification from Multivariate Cox Proportional Hazards Model.

Risk Factor	Men				Women			
	<73		>73		<73		>73	
	RR	95% CI	RR	95% CI	RR	95% CI	RR	95% CI
Cognitive impairment	2.01	0.96-4.18	1.38	0.98-1.94	1.70	1.05-2.73	1.40	1.08-1.80
ADL limitation	5.62	2.38-13.25	1.24	0.64-2.42	7.57	1.02-1.24	3.59	2.26-5.69
Education, low	1.04	0.70-1.52	0.80	0.63-1.03	0.95	0.58-1.55	1.02	0.69-1.51
Smoking Past	1.00	0.56-1.80	0.79	0.54-1.17	0.00	0.00	1.19	0.62-2.29
Current	1.14	0.73-1.77	1.10	0.82-1.48	1.63	0.95-2.81	1.15	0.85-1.55
Drinking	1.07	0.71-1.62	1.12	0.87-1.45	1.03	0.58-1.55	0.81	0.53-1.22
Chronic disease	1.07	0.74-1.54	1.27	0.99-1.62	0.76	0.50-1.17	0.94	0.73-1.21
Self-rated health Average	1.09	0.67-1.76	1.11	0.80-1.54	0.90	0.47-1.72	0.95	0.68-1.33
Bad	1.59	1.06-2.37	1.69	1.28-2.23	2.01	1.23-3.29	1.46	1.08-1.95

Note. RR=relative risk; CI=confidence interval; ADL=limitation in activities of daily living.

3. Cognitive Impairment and Hypertension

In this part of study, we examined cross-sectionaly the hypothesis which provides us significant association between high blood pressure and cognitive impairment. Statistical procedures those analyzing the association between high blood pressure and all baseline predictor variables were similar to the previous section.

The all predictor variables, including cognitive impairment, were first tested in a univariete logistic regression model. All variables in univariate analyses were next entered into a multiple logistic regression model to assess the independent contribution of each variable, controlling for the effects of others. Univariate and multivariate logistic regression models were performed separately for men and women.

Table 5 shows all the variables that were tested for their association with high systolic and diastolic blood pressure in univariate analyses among women. There was significant association was observed between high systolic blood pressure and cognitive impairment; the odds ratio was 1.4 (CI 1.11-1.77). High diastolic blood pressure was only marginally associated with cognitive impairment; the odds ratio was 1.2 (CI 0.93-1.48).

Of the participants, 54.4% were 73 years of age or older. People aged 73 years and older had higher prevalence of high systolic blood pressure than correspondent control groups. About 30% of subjects were classified as having cognitive impairment, and 3.7% had limitation in activities of daily living (ADL limitation) (table 5).

People with cognitive impairment were more likely to have high systolic and diastolic pressure than those without cognitive impairment.

The similar pattern was seen for ADL limitation, that is, the prevalence of high blood pressure was higher in the group with ADL limitation than in the group without ADL limitation (table5).

Table5. Prevalence and Univariate Odds Ratio for High Systolic and Diastolic Blood Pressure among women

Variable	No. of Sub	High Systolic Pressure (>140mm Hg)			High Diastolic Pressure (>90mm Hg)		
		Pre (%)	OR	95%CI	Pre (%)	OR	95%CI
Age <73	729	49.9	1.0		38.8	1.0	
>73	870	57.4	1.4	1.10-1.64	38.6	1.0	0.81-1.21
Cognitive impairment No	1009	50.4	1.0		36.6	1.0	
Yes	421	58.9	1.4	1.11-1.77	40.3	1.2	0.93-1.48
ADL limitation							
No	1522	53.2	1.0		37.7	1.0	
Yes	60	73.3	2.4	1.35-4.32	61.6	2.7	1.56-4.51
Chronic disease							
No	903	51.2	1.0		35.2	1.0	
Yes	631	57.2	1.3	1.03-1.55	43.2	1.4	1.13-1.72
Self- rated health							
Good	464	50.2	1.0		32.5	1.0	
Average	442	50.9	1.0	0.78-1.29	38.2	1.2	0.93-1.59
Bad	649	58.5	1.4	1.08-1.72	42.9	1.5	1.16-1.89

Note. Because of missing value for some risk factors, numbers of subjects do not always add up to 1599; OR=odds ratio; CI= confidence interval; ADL= limitation in activities of daily living; *Included antihypertensive

Chronic disease, self-rated health status and ADL limitation were significantly associated with both high systolic and diastolic blood pressure. Age was significantly associated with only high systolic blood pressure (table 5).

To assess the independent association of each variable with high blood pressure, all variables in Table 5 were entered simultaneously into the multiple logistic regression models using forward stepwise procedure. The results are listed in Table 6 and they were not similar to those from univariate analyses.

Table6. Major Predictors for High Systolic and Diastolic Pressure: Odds Ratio and 95% Confidence Interval from Multiple Logistic Regression Model among women

Variable	High Systolic Pressure (>140mm Hg)		High Diastolic Pressure (>90mm Hg)	
	OR	CI 95%	OR	CI 95%
Age (year)	1.3	1.01-1.58	0.9	0.76-1.20
Cognitive Impairment	1.3	1.01-1.65	1.2	0.91-1.51
ADL limitation	2.1	085-4.96	2.3	1.07-5.05
Chronic Disease	1.2	0.93-1.44	1.3	1.02-1.60
Self-rated health Average	0.9	0.73-1.27	1.3	0.96-1.79
Bad	1.4	1.04-1.75	1.5	1.18-2.02

Note. OR=odds ratio; CI= confidence interval; ADL= limitation in activities of daily living; *Included antihypertensive treatment

Cognitive impairment was still significantly associated with high systolic blood pressure and marginally associated with high diastolic blood pressure; the odds ratio was 1.3 (CI 1.01-1.65) and 1.2 (CI 0.91-1.51) respectively. ADL limitation and chronic disease was no longer significantly related to high systolic blood pressure and they were significantly associated with only high diastolic blood pressure. Self-rated health status was remained significantly with both high systolic and diastolic blood pressure. Age was still significantly associated with high systolic blood pressure (table 6).

Table 7 shows number of subjects, prevalence and univariate odds ratio for high systolic and diastolic blood pressure among men. Of the participants, 56.1% were 73 years of age or older. People aged 73 years and older had higher prevalence of high systolic pressure, but lover prevalence of diastolic pressure than correspondent control groups. But there was no significant difference in prevalence of age. Overall, 9 % of subjects had cognitive impairment, 38.9% had a chronic disease and 3.9 % had limitation in activities of daily living.

Table7. Prevalence and Univariate Odds Ratio for High Systolic and Diastolic Blood Pressure among men.

Variable	No. of Sub	High Systolic Pressure (>140mm Hg)			High Diastolic Pressure (>90mm Hg)		
		Pre (%)	OR	95%CI	Pre (%)	OR	95%CI
Age <73	504	39.9	1.0		31.1	1.0	
>73	646	42.6	1.1	0.88-1.42	27.1	0.8	0.63-1.06
Cognitive impairment No	952	39.7	1.0		27.1	1.0	
Yes	92	50.0	1.5	0.98-2.33	35.9	1.5	0.96-2.35
ADL limitation No	1097	40.8	1.0		28.2	1.0	
Yes	43	53.5	1.7	0.90-3.07	44.2	2.1	1.09-3.73
Chronic disease No	673	38.8	1.0		25.5	1.0	
Yes	430	44.2	1.2	0.97-1.59	33.5	1.5	1.12-1.91
Self-rated health Good	417	43.2	1.0		28.1	1.0	
Average	264	41.7	0.9	0.68-1.26	28.0	1.0	0.70-1.37
Bad	435	39.0	0.8	0.64-1.09	29.9	1.1	0.80-1.43

Note. Because of missing value for some risk factors, numbers of subjects do not always add up to 1150; OR=odds ratio; CI= confidence interval; ADL=limitation in activities of daily living; *Included antihypertensive treatment

There was a marginally significant association between cognitive impairment and both high systolic and diastolic blood pressure; the odds ratio was 1.5 (CI 0.98-2.33) and 1.5 (CI 0.96-2.35) respectively. ADL limitation and chronic disease were significantly related only to high diastolic blood pressure. There was no significant difference in prevalence of self-rated health status (table 7).

To assess the independent association of each variable with high blood pressure, all variables in Table 7 were entered simultaneously into the multiple logistic regression models using forward stepwise procedure.

Table8. Major Predictors for High Systolic and Diastolic Pressure: Odds Ratio and 95% Confidence Interval from Multiple Logistic Regression Model among men.

Variable		High Systolic Pressure (>140mm Hg)		High Diastolic Pressure (>90mm Hg)	
		OR	CI 95%	OR	CI 95%
Age (year)		1.1	0.85-1.42	0.8	0.60-1.06
Cognitive Impairment		1.4	0.85-2.14	1.6	0.98-2.59
ADL limitation		1.3	0.54-3.09	1.1	0.45-2.77
Chronic Disease		1.3	0.98-1.68	1.5	1.11-1.99
Self-rated health	Average	0.9	0.65-1.27	0.9	0.64-1.34
	Bad	0.8	0.59-1.08	0.9	0.70-1.34

Note. OR=odds ratio; CI= confidence interval; ADL= limitation in activities of daily living; *Included antihypertensive treatment

In the multiple logistic regression models, cognitive impairment was marginally significant with high diastolic blood pressure; the odds ratio was 1.6 (CI 0.98-2.59). Chronic disease was still significant correlate with high diastolic blood pressure and marginally associated with high systolic blood pressure; the odds ratio was 1.5 (CI 1.11-1.99) and 1.3 (CI 0.98-1.68) respectively. Other variables that age, limitation in activities of daily living, self-rated health status was not significant correlate with both high systolic and diastolic blood pressure (table8).

4. Cognitive Impairment and Mortality According to the Hypertension Status

We developed separate multivariate Cox models to assess the association of cognitive impairment and mortality according to the hypertension status. Analyses were performed separately for men and women. Among women, cognitive impairment was significantly associated with increased mortality in both normal and hypertension groups; the relative risk was 1.5 (CI 1.04-2.09) and 1.5 (CI 1.08-1.96) respectively (table 9).

Table 9. Relative Risks of Death Calculated from Multivariate Cox Proportional Hazards Model; Stratification according to the Hypertension Status among women

Risk Factor		Normal		Hypertension	
		RR	95% CI	RR	95% CI
Age (year)		1.1	1.05-1.11	1.1	1.06-1.10
Cognitive impairment		1.5	1.04-2.09	1.5	1.08-1.96
Education, low		1.4	0.82-2.44	0.9	0.59-1.25
ADL limitation		4.7	1.99-11.03	3.3	1.94-5.55
Smoking	Past	0.6	0.18-1.90	1.5	0.68-3.26
	Current	1.3	0.86-1.88	1.3	0.90-1.86
Drinking		1.2	0.67-1.92	0.6	0.39-1.03
Chronic disease		0.9	0.64-1.26	0.9	0.68-1.20
Self-Rated Health	Average	0.9	0.56-1.48	0.9	0.62-1.35
	Bad	1.9	1.29-2.79	1.3	0.93-1.81

Note. RR=relative risk; CI=confidence interval; ADL=limitation in activities of daily living.

Age and ADL limitation was significantly associated with increased mortality in both groups that normal and hypertension. Self-rated health status was significantly associated with mortality in normal group but marginally associated with hypertension group. Other variables that low education, smoking status, drinking and chronic disease were not significant in both groups (table 9).

Among men, cognitive impairment was significantly associated with increased mortality in normal group and marginally significant in hypertension group; the relative risk was 1.6 (CI 1.03-2.47) and 1.5 (CI 0.90-2.21) respectively (table10).

Table10. Relative Risks of Death Calculated from Multivariate Cox Proportional Hazards Model; Stratification according to the Hypertension Status among men

Risk Factor		Normal		Hypertension	
		RR	95% CI	RR	95% CI
Age (year)		1.1	1.07-1.12	1.1	1.05-1.11
Cognitive impairment		1.6	1.03-2.47	1.5	0.90-2.21
Education, low		0.8	0.65-1.10	0.9	0.69-1.30
ADL limitation		0.9	0.35-2.05	3.4	1.77-6.46
Smoking	Past	0.9	0.58-1.30	0.8	0.46-1.26
	Current	1.1	0.78-1.48	1.2	0.79-1.67
Drinking		1.2	0.90-1.58	1.0	0.75-1.50
Chronic disease		1.3	0.99-1.69	1.1	0.79-1.49
Self-Rated Health	Average	0.9	0.61-1.27	1.5	0.96-2.19
	Bad	1.5	1.09-1.98	1.8	1.27-2.62

Note. RR=relative risk; CI=confidence interval; ADL=limitation in activities of daily living.

Self-rated health status and age was significantly associated with increased mortality in both groups that normal and hypertension. ADL limitation was significantly associated with mortality only in hypertension group. There was marginally significant association between chronic disease and mortality in normal group. Other variables that low education, smoking status and drinking were not significant in both groups (table10).

IV. DISCUSSION

1. Cognitive Impairment and Mortality

We reported the findings of a survival analysis examining the relationship between cognitive impairment and mortality risk among older community residents. These results indicated that severe cognitive impairment was associated with an increase in risk of mortality. Furthermore, mild impairment was also found to be predictive of an increased risk of mortality, which has not always been found in other studies. Even after controlling for confounding effects of demographic and health status, these findings remained robust.

These findings are in agreement with previous research showing that the greatest risk was for persons with severe cognitive impairment (30). Perhaps the relationship between severe cognitive impairment and mortality is a marker of a global decline in health (86). However, severe cognitive impairment may result from complex neuropathological changes (87) and is symptomatic of a range of cerebrovascular disease and comorbid conditions (85). It is possible that medical conditions, particularly severity of disease, mediate the association between severe cognitive impairment and mortality but are unlikely to eliminate severe cognitive impairment as a significant predictor of mortality (85).

Several other community-based studies have examined the risk of mortality associated with mild cognitive impairment. Kelman et al reported an association, but Rozzini et al. (88) did not. Looking at the relationship bivariately. Gussekloo et al. (89) found that having mild cognitive impairment put persons at higher risk, but Shapiro et al. (10) did not.

Although results from previous studies are mixed with respect to the association between mild cognitive impairment and mortality (30, 85), this study found that mild cognitive impairment independently increases the risk of mortality in older men. But no significant effect on mortality risk was found for women with mild cognitive impairment. However, it must be stressed that a significant portion of women with mild cognitive impairment may not have had a dementing disorder. Also, even among women with mild impairment who did have a dementing disorder, our length or follow-up may not have been long enough to demonstrate differences in mortality among women with mild impairment even if this difference exists. Crearly, the screening data presented in this study cannot identify subjects with specific dementing disorders such as Alzheimer's disease.

Severe and mild impairment may be different conditions with different origins or different points along a continuum of cognitive decline. Although our data did not permit us to investigate this issue some individuals with mild signs of cognitive dysfunction may have had a disadvantaged social status or poor health early on that may have limited the expression of cognitive capacity or even stunted its development. On the other hand, mild cognitive impairment may also herald the emergence of dementing illness among those who are not disadvantaged. Strategies designed to lessen the impact of cognitive impairment on the functioning of elderly people require diagnosis of the reasons for the impairment.

In addition to cognitive impairment influencing mortality because they may be symptomatic of dementia or other nonbrain systemic pathologies that increase mortality risk, it also has been postulated that cognitive impairment itself may play a causal role in promoting death. Poor cognitive function of either long-standing or recent origin may interfere with the ability to recognize sings and symptoms of disease, to seek timely medical assistance, to adhere to a medication regimen, to prepare adequate meals, and to engage in other preventive health care behaviors (15, 16, 23). To the extent that this is true, the observed lack of an association between prevalent mild impairment and mortality is some what puzzling. However, it is possible that the health care needs of persons with prevalent (as opposed to incident) cognitive impairment may have been managed more effectively by family or other caregivers who were long aware of the need for such intervention, thus forestalling an adverse outcome.

The prevalence of cognitive impairment among the elderly, particularly mild impairment, coupled with forecasts for increasing numbers of older persons into the new century, points to the need to train health care professionals to recognize this disability and deal with its potentially negative health consequences.

In this present study, limitation in activity of daily living (ADL limitation) showed strongest association with cognitive impairment ($p < 0.001$)(Table1). The findings of our study confirm that cognitively impaired people are characterized by poor health status- ADL limitation and self-rated health status. ADL limitation, as measured by the ability to perform Kats ADL index, has been shown to be a predictor of mortality in old age; (90) this association was fully confirmed in our study. Those who had limitation in activities of daily living had a higher risk of dying than did those who without ADL limitation.

The independent association between self-rated health and mortality has been extensively demonstrated in the literature (91), and was confirmed in our study. It is also important to notice that, until the geriatric screens for cognitive function were introduced in the model, there was a significantly higher risk of dying in those rating their own health as ‘ worse than others of the same age’.

When men and women were analyzed separately, the general pattern of the results was the same, in that the variables selected came from cognitive function and the physical health domains. However, the specific variables selected from within these domains were different. For example, self-rated health was selected as a physical health predictor for men, while for women it was limitation in activities of daily living.

Educational level, amount of years spent in formal schools, is generally observed to be a significant predictor of cognitive performance level (67). In a large population study of cognitive correlates in an elderly community, poor cognitive function was associated with higher age, greater physical dysfunction, and lower educational and professional levels (68). Higher education attainment has also been hypothesized to build cognitive reserves that protect the brain from degenerative forces (27–30). In one study age and education were compared regarding predictive ability of cognitive impairment over a one-year time span. The findings indicated low education as more important in predicting negative changes in language skills and secondary memory whereas age was a more important predictor of negative changes in other cognitive domains (66). Low educational attainment has been found to have a substantial effect on the development of Alzheimer’s disease, socioeconomic status, nutrition, healthcare access, and healthcare behaviors including smoking and exercising (27, 28).

In our study low education showed strongest relationship with cognitive impairment ($p<0.001$) and it was a univariate predictor of mortality in both women and men, but was not selected in the multivariate model. However, low education was not predictive of mortality in the multivariate model; it could be a potential factor in explaining the association between cognitive impairment and mortality.

There have been different results regarding cigarette smoking and cognitive impairment. Some argued that cigarette smoking could increase the risk of cognitive impairment. Cervilla et al. (92) observed a relationship between cigarette smoking and cognitive impairment in a prospective study and pointed out that smokers had a higher risk for cognitive impairment. Dufouil et al. (93) found a negative correlation between cigarette smoking and cognitive impairment, but cessation of smoking could not prevent cognitive impairment. Ford and colleagues' (94) investigation suggested that both past and current smoking were associated with cognitive impairment and that it was more evident in men.

Our data suggest that current smoking status was significantly associated with cognitive impairment ($p<0.001$) and it was included as independent predictor of mortality in the multivariate analyses among women. But after age stratification the effect disappeared in the multivariate analyses. We did not find a significant relationship between past smoking and cognitive impairment in both men and women. Our results are in agreement with those of Cervilla et al, (92) who found that smokers had a higher risk for cognitive impairment.

2. Cognitive Impairment and Hypertension

We analyzed separately, the association between high blood pressure and cognitive impairment in cross-sectional design. Data were collected on a variety of prevalent medical conditions. The large sample size provides sufficient power to analyze many variables simultaneously. The findings of our study showed that cognitive impairment was significantly associated with high systolic blood pressure among women and marginally associated with high diastolic blood pressure in both men and women.

Other studies have reported similar relationships between cognitive impairment and systolic and diastolic blood pressure (51, 23). In the Honolulu-Asia Aging Study, elevated midlife systolic, but not diastolic blood pressure was associated with a higher risk of poor cognitive performance in later life (42). In community-based study, high SBP and DBP was a predictor of reduced cognitive function, with significant difference in learning (immediate recall and retention). The cases (aged 40-79 years) were defined as hypertensive if DBP > 100 mmHg or SBP >180 mm Hg or current drug treatment for hypertension was being used at the time of the interview (52). A study of 25 elderly patients with mild to moderate hypertension aged 62-78 years (hypertension being defined as DBP > 95 mm Hg with a SBP > 165 mmHg), and 25 age matched controls, found impairment in Digit Symbol, attention and Paired Associates tests in the hypertensive.

Recent studies have indicated that several factors influence cognitive functions. Age interacts with hypertension, and the effects on cognition are more pronounced in young than in middle-aged hypertensive (95). Moderate alcohol consumption in women, with adjustment for education, age, occupation and cardiovascular risk factors, was related to better cognitive functioning (96). Education and social class also influence the results of cognitive tests (97). Smoking, hyperlipidaemia, male gender and heat disease were reported to be risk factors for cognitive impairment (98).

We found that high systolic pressure was related independently to advanced age in women. However, age did not remain a significant correlate of high diastolic pressure when other variables were considered. The result is, to some degree, similar to the observation in various populations that diastolic pressure tends to decrease after the age of 65 (99).

The most convincing evidence of the relationship between hypertension and cognitive deterioration was derived from a prospective study in the 1960s, when antihypertensive treatment was still infrequent. An early longitudinal study (48) found negative correlations between diastolic blood pressure and several Wechsler Adult Intelligence Scale (WAIS) subscales, but did not adjust for age, education and antihypertensive therapy. The authors suggested that 'the basis for the cognitive decline associated with aging should be considered secondary to some pathologic process and not merely as a normal aging process'.

In studies on the relationship between blood pressure and cognitive function, the observation has been made that the relationship between elevated blood pressure and lower cognitive level is especially obvious in untreated individuals (62, 63, 64). It should therefore be probable that the use of antihypertensive medication would have beneficiary effects on cognitive function. In a comprehensive review of over 50 clinical studies on neuropsychological consequences of antihypertensive drug treatment, Muldoon and collaborators found that medication did not show hazardous effects on cognitive performance, nor was it obvious whether medication had specific effects on particular dimensions of cognitive performance (65). Prince (1997) found in his review of three prospective placebo-controlled trials that prescribing blood pressure lowering drugs for elderly individuals did not affect cognitive function. He proposed that the association lacking between drug therapy and positive outcomes on cognitive capacity could be explained by a too lengthy exposure to raised blood pressure for treatment to have any effect on cognition. These results may support the explanation for the cross-sectional association of high blood pressure and cognitive impairment that high blood pressure is probably an outcome of cognitive impairment. Unfortunately, we did not obtain detailed information about drug use in this survey so we were unable to address the effect of drugs.

In this study limitation in activities of daily living and self-rated health status were included as independent variables in the multivariate analysis. Health status factors such as limitation in activities of daily living and self-rated health status have been studied in relation to cognitive impairment. Our study indicated that people with at least one task limitation in Katz ADLs had great probability of having systolic pressure higher than 140 mm Hg and diastolic pressure higher than 90 mm Hg than those without functional limitation. It should be noted that these results were obtained when several common chronic diseases and cognitive function were taken into account. Our data showed that self-rated health status significantly related to high systolic and high diastolic blood pressure in women.

Our prior hypothesis was that higher blood pressure would be associated with cognitive impairment. Our results support this hypothesis. But interpretation of cross-sectional relationships between high blood pressure and cognitive function is problematic. Whether our findings are due to chance alone or reflect a more complex relationship between blood pressure and cognition than previously appreciated remains uncertain. The relationship of blood pressure to cognitive function continues to deserve detailed investigation because of the great public health importance of cognitive impairment in cognition in later life and the need to identify potentially modifiable risk factors for this impairment. More definitive examination of this issue will likely require longitudinal population studies that include blood pressure measurement at multiple points, also incorporate substantially more detailed cognitive testing at multiple points.

Limitation

In considering the implications of these findings, it is essential to take into account the limitations of the data. Several limitations should be considered. First, the study was limited to the use of the MMSE as the assessment of cognitive status. It should be emphasized that the MMSE is not a diagnostic instrument; a low score indicates the need for more specific assessment through a complete clinical evaluation. The absence of a full clinical evaluation in the current study precludes estimation of the true rate of cognitive impairment in older people. Second, we cannot conclude about the declining of cognitive function due to its one point measurement. Third, we examined cross-sectionally the association between high blood pressure and cognitive impairment. We cannot determine the direction of the association between high blood pressure and cognitive impairment. Forth, our study evaluated primarily factors relevant to high blood pressure. A number of other factors, such as blood cholesterol level and body mass index, may also be related to high blood pressure. Because both high body mass index and high blood total cholesterol level has also been found to be related to increased mortality, it is important to know the relationship between high blood pressure and these two variables, especially in the older people. We cannot address these factors in the present study. Finally, we did not obtain detailed information about drug use in this survey so we were unable to address the effect of drugs. Only limited information was obtained about drug use.

V. Conclusion

The data from this population-based study indicate that cognitive impairment is a significant predictor of mortality among older residents in the community.

Our findings suggest that periodic screening for cognitive impairment among older people is warranted. Establishment of a baseline level of cognitive performance in the medical record should enhance the ability to detect subsequent cognitive impairment. Especially in the young elderly, such declines should alert health care providers and other caregivers to the possibility of an underlying illness and to explore potential interventions to reduce mortality risk.

Age, self-rated health status and limitation in activity of daily living are strong independent predictors of mortality in older people. Although age, sex, and education were important risk factors for cognitive impairment in elderly people, cigarette smoking played an important role in cognitive impairment.

Age and sex are risk factors for cognitive impairment, which cannot be altered, but cigarette smoking can be controlled in the population, so cessation of smoking could be considered as part of a strategy to reduce the incidence of cognitive impairment.

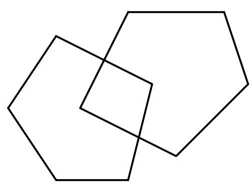
We found evidence to support the hypothesis that high blood pressure, especially high systolic blood pressure is associated with cognitive impairment in older residents in the community.

APPENDIX

General characteristics

Name	Item		Scales
AGE94	Age		Year (real number)
SBP94	Systolic pressure		mm Hg
DBP94	Diastolic pressure		mm Hg
EDD	Education		Never Seodang (Korean traditional school) Elementary school Middle school High school College University Non-response
SMOK	Smoking		1:Never 2:Former 3: Current
DRINK	Alcohol consumption		1:Ever 2:Never
HPTT	Antihypertensive Treatment		1:No 2:Yes
CHRDIS94	Chronic disease		1:Ever 2:Never
ADLX /Limitation in ADL/	ADLA	Bathing	1: too easy 2: easy 3: difficult 4: too difficult
	ADLB	Dressing	
	ADLC	Toileting	
	ADLDE	Transferring	
	ADLF	Eating	
	ADLG	Continence	1: good 2: fair 3: bad/poor
MINI /Cognitive impairment/	MINIA	Today	1-5
	MINIB	Address	1-4
	MINIC		0-1
	MINID		1-3
	MINIE		1-5
	MINIF		1-3
	MINIG		1-3
	MINIH		1-3
	MINII		0-1
	MINIJ		0-1
	MINIK		0-1
	MINIL		0-1
PRS	Self Rated Health		1:good 2:fair 3:bad/poor

Cognitive variables

	Item		score
MIBA	Orientation	What is the Year? Season? Date? Day? Month? Where are we State? County? Town/city? Floor? Address/name of building?	 1 1 1 1 1 1 1 1 1 1
	Regist ration	Name three objects, taking one second to say each, Then ask the patient all three after you have said them. Repeat the answers until the patient learns all three.	3
	Attent ion& Calcu lation	Serial sevens. Give one point for each correct answer. Stop after five answers. Alternative: Spell world backward.	5
	Recall	Ask for names of three objects learned in question. Give one point for each correct answer.	3
	Language	Point to a pencil and a watch. Have the patient name them as you point. Have the patient repeat 'No ifs, ands, or buts'. Have the patient follow a three-stage command; ' Take the paper in your right hand. Fold the paper in half. Put the paper on the floor'. Have the patient read and obey the following; 'Close your eyes'. Have the patient write a sentence of his or her own choice. (The sentence should contain a subject and an object and should make sense. Ignore spelling errors when scoring.) Enlarge the design printed below to 1 to 5 per side and have the patient copy it. (Give one point if all the sides and angles are preserved and if the intersecting sides form a quadrangle.) 	 2 1 3 1 1 1
	Total		30

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Abstract in Korean

강화노인인구 코호트에서 인지능력이상과 사망과의 관계

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연구대상은 강화지역의 1599명의 여성과 1150명의 남성으로 총 2749명이었다. 기초조사는 1994년에 이루어졌으며 2002년까지 8년 추적조사되었다. 사망과의 관계와 함께 인지능력과 혈압과의 관련성도 분석하였다. 인지능력 이상에 대해서는 30점 만점의 Mini-Mental State Examination(MMSE)를 이용하였다. 그 점수가 24-30점 이면 인지능력 정상, 18-23점이면 중등도 인지능력이상, 17점 이하이면 고도 인지능력이상으로 구분하였다. 통계분석은 생존분석을 이용하였다.

인지능력이상이 있는 사람은 정상인 사람들에 비하여서 평균연령이 높았고, 경제수준과 교육수준이 낮았으며, 혈압이 더 높았다. 인지능력이 있는 남자의 사망위험은 정상인 사람에 비하여서 1.5(95% CI, 1.10-2.04)배 더 높았고 여성의 사망위험은 1.3(95% CI, 1.02-1.65)배 더 높았다. 연령과 자가평가건강수준도 사망위험 증가와 관련이 있었다. 또한, 수축기 혈압과 이완기 혈압 모두 인지능력이상과 관련성이 있었다. 이러한 결과들을 통해서 노년의 수명연장을 위해서는 인지능력 이상의 조기발견을 통한 예방이 필요함을 제시한다.

핵심 단어: 인지능력, 사망률, 혈압, 일상운동능력(ADL)