An Overview of the Korean Longitudinal Study on Health and Aging

**Objective** The Korean Longitudinal Study on Health and Aging (KLoSHA) was developed to estimate the prevalence, incidence and progression of common geriatric diseases; 2) to determine the risk factors for common geriatric diseases and to develop preventive strategies by managing potentially modifiable determinants; 3) to investigate the influence of common geriatric diseases on the quality of life and general health status; 4) to evaluate the levels of health and functional status of Korean elderly persons.

**Methods** The KLoSHA was designed as a population-based prospective cohort study on health, aging and common geriatric diseases of Korean elders aged 65 years and over. The baseline study of the KLoSHA was conducted from September 2005 through September 2006 in Seongnam. Follow-up studies will be performed at 4-year intervals without an endpoint.

**Results** At the baseline study, 992 subjects (714 randomly sampled elderly subjects aged 65 years or over, 278 volunteers aged 85 years or over) were enrolled and completed the study. Prevalences and risk factors of common geriatric disorders in Korean elders were estimated, and the normative data of neuropsychological measures, general health parameters, and laboratory tests were drawn.

**Conclusion** The KLoSHA may not only provide comprehensive epidemiological data on the health status and common geriatric disorders of Korean elders, but also may stimulate comprehensive multidisciplinary and interdisciplinary researches on aging and geriatric disorders and contribute to policy formulation and planning of health management programs and social services in Korea.

**KEY WORDS:** Korean, Longitudinal study, Health, Aging, Cohort, Epidemiology.
Netherlands\(^4\) and the Canadian Study on Health and Aging (CSHA) in Canada,\(^5\) have contributed to our understanding of aging and the etiology of geriatric illness, and have led to specific recommendations for intervention. However, the subjects of these longitudinal studies were restricted to Caucasians with the inclusion of some African Americans. Although there was one study called the Honolulu Asia Aging study (HAAS)\(^6\) on the aging of Asians, the subjects were confined to men and the scope was not as comprehensive as other longitudinal studies on aging. There were a couple of longitudinal cohort studies on aging in Korea: the Kwangju Epidemiological Study for the Elderly (KESEL)\(^7\) and the Ansan Geriatric Study (AGE study). However, only dementia and geriatric psychiatric disorders were focused in the KESEL, and the assessments were not sophisticated in the AGE. Although the AGE had the broader scope on aging than the KESEL, all the assessments for morbidity were performed with the checklists without comprehensive laboratory tests.

Therefore, we developed the Korean Longitudinal Study on Health and Aging (KLoSHA) to get comprehensive information of common geriatric disorders including prevalence, incidence, natural history, and risk factors and to establish a comprehensive database of general health and functional status in Korean elders.

**Study Objectives**

The KLoSHA was designed as a population-based prospective cohort study of the health, aging and common geriatric diseases in Korean elderly aged 65 years and over. The baseline study of the KLoSHA started in September 2005 and the follow-up studies will be continued at 4-year intervals without an endpoint like the BLSA.

The core objectives of the KLoSHA are as follows: 1) to estimate the prevalence, incidence and progression of common geriatric diseases; 2) to determine the risk factors for common geriatric diseases and to develop preventive strategies by managing potentially modifiable determinants; 3) to investigate the influence of common geriatric diseases on the quality of life and general health status; 4) to evaluate the levels of health and functional status of the Korean elderly and to track the changes in these characteristics over time; 5) to establish a uniform database for subsequent studies, and to plan and evaluate interventions.

The baseline study of the KLoSHA concentrated on determining the prevalence and risk factors of common geriatric disorders, and establishing a comprehensive database on the general health and functional status of community dwelling Korean elderly.

The major target geriatric disorders of the KLoSHA are neuropsychiatric disorders such as dementia, late-life depression, alcohol use, and sleep disorders, cerebrovascular disorders such as stroke and transient ischemic attack, cardiovascular disorders such as hypertension, orthostatic hypotension, and arrhythmia, endocrine disorders such as diabetes mellitus, hypothyroidism and the metabolic syndrome, renal and urological disorders such as chronic renal disease, benign prostate hypertrophy and urinary incontinence, musculoskeletal disorders such as osteoarthritis, allergic disorders such as asthma and allergic rhinitis. The major target health-related parameters of the KLoSHA were general health and functional status including the aging-susceptible functions such as cognition and balance, health-related habits such as exercise, diet, smoking, alcohol use, and leisure activities, health-related environment such as socioeconomic status and social support system, and subjective recognition of health and functional status.

**Study Design**

**Subjects**

The Institutional Review Board of the Seoul National University, Bundang Hospital (SNUBH) approved this study in August 2005, and the baseline study was conducted from September 2005 through September 2006 in Seongnam city. Seongnam is one of the biggest satellite cities of Seoul, Korea. The total population of Seongnam was 931,019 in 2005, and 61,730 (6.6%) of the population was aged 65 years or older.

The subjects the KLoSHA consists of two different cohorts: randomly sampled elderly aged 65 or older (Sample-RE) and volunteered oldest old aged 85 or older (Sample-OO).

For establishing the Sample-RE, A simple random sample (N=1,118) was drawn from the roster of 61,730 persons aged 65 years or older who were resident on August 1, 2005, and invited to participate in the study by letter and telephone. All the subjects were Koreans. The sample was selected by a computer-generated list of random numbers. All of the sampled subjects were invited to participate in the study by letter and telephone and were fully informed regarding study participation by two research coordinators. Of the 1,118 subjects, 714 agreed to participate in the baseline study of the KLoSHA (a response rate of 63.9%). Among the 714 respondents, 301 (42.2%) subjects were men.

For establishing the Sample-OO, all the residents aged 85 or older in Seongnam (N=3,166) were invited using letter and telephone, and 272 subjects agreed to participate in the KLoSHA. We enrolled the Sample-OO in addition to the Sample-RE since the information on Koreans in this...
The Korean Longitudinal Study on Health and Aging

age group was very limited. So far, the population in this age group was small and showed a very low response rate in health-related researches in Korea.

In total, 992 subjects constituted the KLoSHA cohort at baseline. All the subjects were fully informed regarding study participation and provided written informed consents by themselves or by their legal guardians.

The follow-up studies will be performed on a 4-year interval, and thus the first follow-up study will be conducted from September 2008 to August 2009. The respondents of the baseline studies will be re-examined using identical procedures in the follow-up studies. Additional recruitment will be performed at each follow-up to increase sub-populations in areas of interest or to refresh the KLoSHA cohort as it ages. Considering the dropout rates in other cohort studies, we expect a dropout rate of approximately 20–25% in three years.

Assessment

In the baseline study of the KLoSHA, the participants were required to visit SNUBH, located in Seongnam on two occasions for comprehensive interviews and laboratory tests.

At the first visit, demographics and general health status were evaluated using standardized self questionnaires and interviews by three research nurses (Table 1). All the research nurses were certified as a dementia-specialized regular nurse, and took additional trainings for all the assessments used in the KLoSHA for three months before the start of the KLoSHA.

TABLE 1. Assessment of demography and general health status in the Korean Longitudinal Study on Health and Aging (KLoSHA)

<table>
<thead>
<tr>
<th>Demographic data, general health status, and medical history</th>
<th>Instruments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality of life</td>
<td>36-item Short-Form health survey (SF-36)</td>
</tr>
<tr>
<td>Social activity</td>
<td>Baltimore Longitudinal Study of Aging (BLSA) Activity questionnaire</td>
</tr>
<tr>
<td>Social support</td>
<td>The Medical Outcome Study (MOS) social support survey</td>
</tr>
<tr>
<td>Dietary history and weight</td>
<td>Nutritional Screening Initiative (NSI), BLSA Weight history questionnaire</td>
</tr>
<tr>
<td>Physical activity</td>
<td>BLSA Activities Questionnaire, Canadian Study of Health and Aging (CSHA) Community Questionnaire</td>
</tr>
<tr>
<td>Balance and gait</td>
<td>Activities-specific Balance Confidence scale (ABC scale), Performance-Oriented Assessment of Mobility problems in elderly patients (POMA)</td>
</tr>
<tr>
<td>Vision</td>
<td>Functional vision screening questionnaire</td>
</tr>
<tr>
<td>Hearing</td>
<td>Hearing Handicap Inventory for the Elderly-Short form (HHIE-S)</td>
</tr>
<tr>
<td>Activities of daily living</td>
<td>Korean Activities of Daily Living Scale (K-ADL), Korean instrumental Activities of Daily Living Scale (K-IADL), DCAP-IADL</td>
</tr>
<tr>
<td>Alcohol</td>
<td>Alcohol Consumption Amount Questionnaire</td>
</tr>
<tr>
<td>Smoking</td>
<td>The Fagerstrom Test for Nicotine Dependence (FTND)</td>
</tr>
</tbody>
</table>

TABLE 2. Assessment of common geriatric disorders in the Korean Longitudinal Study on Health and Aging (KLoSHA)

<table>
<thead>
<tr>
<th>Geriatric disorders</th>
<th>Instruments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dementia and cognitive disorders</td>
<td>Korean version of the Consortium to Establish a Registry for Alzheimer’s Disease assessment packet Clinical Assessment Battery (CERAD-K) CAB, CERAD-K neuropsychological assessment battery, Subjective Memory Complain Questionnaire (SMCQ), Seoul Informant Report Questionnaire for Dementia (SIRQD), Frontal assessment battery, Wisconsin card sorting test, Design fluency test, Pittsburgh Sleep Quality Index (PSQI), Epworth Sleepiness Scale (ESS), International restless legs syndrome study group rating scale</td>
</tr>
<tr>
<td>Late life depression</td>
<td>MINI International Neuropsychiatric Interview (M.I.N.I.), Korean version of the Geriatric Depression Scale (GDS-K), Hamilton depression rating scale, Korean version of Center for Epidemiologic Studies Depression Scale (CES-D)</td>
</tr>
<tr>
<td>Sleep disorders</td>
<td>The Pittsburgh Sleep Quality Index, Epworth Sleepiness Scale, International restless legs syndrome study group rating scale</td>
</tr>
<tr>
<td>Alcohol use disorder</td>
<td>M.I.N.I., Alcohol Use Disorder Identification Test (AUDIT-K)</td>
</tr>
<tr>
<td>Cerebrovascular disorders</td>
<td>Transient ischemic attack (TIA) and stroke interview form from Atherosclerosis Risk in Community study (ARIC), Questionnaire for Verifying Stroke-Free Status (QVFS), WOMAC, Disabilities of the Arm, Shoulder and Hand (DASH), Oswestry back pain questionnaire, Knee Society total knee (KSS)</td>
</tr>
<tr>
<td>Movement disorders</td>
<td>Unified Parkinson’s Disease Rating Scale (UPDRS), Screening questionnaire for Parkinsonism</td>
</tr>
<tr>
<td>Cardiovascular disorders</td>
<td>WHO angina questionnaire</td>
</tr>
<tr>
<td>Musculoskeletal disorders</td>
<td>Western Ontario and McMaster Universities (WOMAC), Disabilities of the Arm, Shoulder and Hand (DASH), Oswestry back pain questionnaire, Knee Society total knee (KSS)</td>
</tr>
<tr>
<td>Allergic disorders</td>
<td>Modified ISAAC questionnaire</td>
</tr>
<tr>
<td>Urological disorders</td>
<td>Korean version of international prostatic symptom score, Korean version of NIH-Chronic Prostatitis Symptom Index (NIH-CPSI), Incontinence Quality of Life (I-QOL)</td>
</tr>
</tbody>
</table>
At the second visit, all of the participants got a standardized clinical interview, physical and neurological examinations by four research physicians (Table 2). All the research physicians were neuropsychiatrists who finished the fellowship training program for geriatric psychiatry provided at SNUBH and were expertise in dementia research. One of them (KWK) was certified as a Clinical Dementia Rating (CDR) rater at the Memory and Aging Project of Alzheimer’s Disease Research Center, Washington University School of Medicine. In addition, comprehensive neuropsychological assessment (Table 2) and laboratory tests (Table 3) for evaluating general physical health status and the diagnosis of common geriatric disorders were performed. All the neuropsychological tests were administered by four neuropsychologists. Laboratory tests were performed by the Department of Laboratory Medicine, SNUBH. All assessments were done within a month of enrollment and the interval between the first and second visit did not exceed two weeks.

At each follow-up, the changes in health status and clinical measurements will be assessed by the same procedures used in the baseline study. Studies on osteoporosis and ischemic heart disease will be added from the first procedures used in the baseline study. Studies on osteoporosis and ischemic heart disease will be added from the first procedures used in the baseline study. Studies on osteoporosis and ischemic heart disease will be added from the first procedures used in the baseline study.

**Analysis**

The prevalence and incidence estimates will be estimated by gender (men, women) and age (65–69 years old, 70–74 years old, 75–79 years old, 80 years old or over) strata. Ninety-five percent confidence intervals for each estimate are derived using the exact methods for a binomial parameter. Standardized prevalence and incidence rates for older Koreans will be estimated using the direct standardization method, in which the prevalence and incidence rates are adjusted by age, or age and gender, or age and education to the total Korean population based on the 2005 national census.

The significance of various risk factors is calculated by logistical regression analysis where the odds ratio and 95% confidence intervals are calculated using multivariate analysis.

Additional statistics will also be performed according to the goals of the individual studies.

**Research Projects**

### Dementia and cognitive disorders

**Introduction**

Dementia is one of the most distressing and burdensome mental health problems in the older population. The prevalence of dementia rises sharply with age. The burden of dementia, for patients and their families as well as the community, is very high. The economic costs of dementia

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**TABLE 3. Laboratory tests in the Korean Longitudinal Study on Health and Aging (KLoSHA)**

<table>
<thead>
<tr>
<th>Groups</th>
<th>Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete blood count (CBC)</td>
<td>White blood cell (WBC), red blood cell (RBC), hemoglobin (Hb), hematocrit (Hct), red cell distribution width (RDW), platelet count (PLT), platelet distribution width (PDW), WBC differential count, Erythrocyte Sedimentation Rate (ESR)</td>
</tr>
<tr>
<td>Coagulation panel</td>
<td>Prothrombin time (PT), activated Partial Thromboplastin Time (aPTT), fibrinogen</td>
</tr>
<tr>
<td>Liver function test</td>
<td>Cholesterol, total protein albumin, total bilirubin, alkaline phosphatase, glutamic oxalacetic transaminase (GOT), glutamic pyruvic transaminase (GPT), Gamma glutamyl transferase (GGT)</td>
</tr>
<tr>
<td>Renal panel (Serum)</td>
<td>Sodium, potassium, chloride, CO2, blood urea nitrogen (BUN), creatinine</td>
</tr>
<tr>
<td>Lipid panel</td>
<td>Triglyceride, high-density lipoprotein (HDL)-cholesterol</td>
</tr>
<tr>
<td>Serologic test</td>
<td>Lactate dehydrogenase (LDH), creatine phosphokinase (CPK), glucose, Hb A1C, Hbs Ag, Anti-HBs Ab, Venereal Disease Research Laboratory (VDRL), Vitamine B12, Folate, C-reactive protein (CRP), rheumatoid factor, Prostate specific Ag (PSA), oral glucose tolerance test (fasting blood sugar (FBS), PP30, PP60, PP90, PP120)</td>
</tr>
<tr>
<td>Thyroid function test</td>
<td>Free thyroxine (FT4), triiodothyronine (T3), thyroid stimulating hormone (TSH)</td>
</tr>
<tr>
<td>Iron panel</td>
<td>Iron, total iron binding capacity (TIBC), Transferrin</td>
</tr>
<tr>
<td>Genetic test</td>
<td>Apo E genotype</td>
</tr>
<tr>
<td>Urinalysis</td>
<td>Stick, microscopy</td>
</tr>
<tr>
<td>Radiographs</td>
<td>Chest postero anterior (PA), both knee anterior posterior (AP), both knee skyline, both shoulder AP, both hand AP, lumbar spine lateral, hip AP, urogram with views of both hips*, Dual energy X-ray absorptiometry* (DXA)</td>
</tr>
<tr>
<td>Sonographs</td>
<td>Transcranial doppler (TCD), transrectal ultrasound (TRUS)</td>
</tr>
<tr>
<td>Electrocardiography (ECG)</td>
<td></td>
</tr>
</tbody>
</table>
are enormous and will continue to increase with the rising prevalence of the disease. The prevalence of dementia in persons 65 and older has been reported to be 3.6% to 10.3% in Western countries, 1.8% to 4.6% in China, 3.7% to 6.7% in Japan, and 9.5% to 10.8% in Korea. As the clinical features and treatment are different depending on the type of dementia, it is important to distinguish between the various forms of dementia.

Mild cognitive impairment (MCI) refers to the boundary between normal aging and dementia, especially in Alzheimer’s disease (AD). Since the conversion rate to dementia of MCI was found to be consistently higher than normal elderly, the recognition of MCI is of increasing importance these days. Like dementia, MCI is also heterogeneous in clinical presentation and etiology. Thus, epidemiology, diagnosis, natural course, and intervention should be considered on the basis of the subtypes of MCI.

Until now, although there were several epidemiologic studies on dementia, those on MCI have not been performed on MCI. The main research aims are as follows: 1) to determine the prevalence, incidence and progression of dementia and MCI; 2) to investigate various risk factors associated with dementia and MCI; 3) to examine the outcome of MCI according to its clinical and etiological heterogeneity.

Methods

All subjects receive the standardized clinical interview, physical and neurological examinations according to the protocol of the Korean version of the Consortium to Establish a Registry of Alzheimer’s Disease (CERAD) assessment battery (CERAD-K) by 4 neuropsychiatrist with advanced training in neuropsychiatry and dementia research.

Dementia is defined according to the diagnostic features of dementia given in the Diagnostic and Statistical Manual of Mental Disorders, fourth edition (DSM-IV). AD is diagnosed according to the criteria of the National Institute of Neurological and Communicative Disorders and Stroke and the Alzheimer’s Disease and Related Disorders Association (NINCDS-ADRDA). The diagnosis of vascular dementia (VaD) is made according to the National Institute of Neurological Disorders and Stroke-Association Internationale pour la Recherche et l’Enseignement en Neurosciences (NINDS-AIREN) criteria. Probable and possible types of AD and VaD based on each diagnostic criterion are included. Demented patients that meet neither the AD nor VaD criteria are classified according to the DSM-IV criteria.

The diagnosis of MCI is made according to the criteria from the International Working Group on Mild Cognitive Impairment.

Late life depression

Introduction

Late life depression is one of the most prevalent psychiatric disorders and is associated with increased morbidity, mortality, medical illness, and dementia. Depressive illness is projected to be the second leading cause of disability worldwide in 2020. However, despite its prevalence and significance, late life depression is under recognized and undertreated due to its sub-syndromal features, complicated etiologies, and being mistaken as problems of aging. Only a minority of older people with depression in the community are referred for psychiatric care. Subthreshold depression is very common in the elderly population and associated with adverse clinical outcomes, increased use of medical and mental health services, an increased risk for future pronounced mood disorders, and increased social dysfunction and disability. However, the nosology of minor depression is poorly defined with no current consensus available. In addition, clinical features and etiology are known to be different based on the age at onset. Late-onset depression (LOD) shows a lower familial tendency and a higher rate of subcortical cerebrovascular pathology than does early-onset depression (EOD).

The research aims are as follows: 1) to determine the prevalence and incidence of major depressive disorder, minor depressive disorder and subthreshold depressive disorder; 2) to examine the risk factors for the depression and to develop strategies for preventing depression; 3) to compare the phenomenology of the LOD with the EOD and their etiologically; 4) to examine the influence of depression on the quality of life, cognitive function and disability; 5) to investigate the clinical characteristics of subthreshold depression qualitatively and quantitatively compared to threshold depression such as major depressive disorder (MDD) and minor depressive disorder (MnDD).

Methods

Research psychiatrists will conduct the assessment with the mini international neuropsychiatric interview (MINI) version 5.0, depressive symptom checklist (DSC) of CERAD and 17-item Hamilton depression scale. In addition, the Korean version of Geriatric Depression Scale (GDS-K) and Center for Epidemiologic Studies Depression Scale (CES-D) are self-administered before the clinical interview. The quality of life of subjects is assessed using the 36 item short form (SF-36). MDD is diagnosed according to the DSM-IV criteria, and MnDD according to research criteria proposed in Appendix B of the DSM-IV criteria. Sub threshold depression is operationally de-
defined as follows. First, subthreshold depression will have two or more concurrent symptoms of depression by the DSM-IV with at least one being a core depressive symptom such as depressed mood or loss of interest. Second, a symptom is checked as positive if the depressive symptom is present for ‘more than half a day’ or ‘more than seven days during two weeks’ instead of ‘most of day’ or ‘nearly everyday during two weeks.’ Third, the subthreshold depression is associated with evidence of social and occupational dysfunction and fourth, if the subthreshold depression does not meet the criteria for the diagnosis of MDD or MnDD. A cut-off of 60 years is used to distinguish between EOD and LOD. This cut-off is arbitrarily chosen, but has been frequently used in studies of late-life depression.51

Stroke and transient ischemic attack

Introduction

Stroke is the second leading cause of death and a leading determinant of disability among the adult population of the world. Intracranial atherosclerosis is considered the leading cause of approximately 8% of all strokes in Caucasian patients. It is the most commonly found vascular lesion in Asian acute stroke patients, being responsible for one third of strokes reported in a Chinese population.52 Individuals with intracranial atherosclerosis have high rates of recurrent cerebrovascular ischemic events, coronary heart disease and death. Therefore, secondary prevention should be empirically provided in this group.

The research aims are as follows: 1) to determine the prevalence, incidence and progression of stroke and middle cerebral artery stenosis; 2) to investigate the interactions between various risk factors and new cases of stroke, and to develop prevention strategies; 3) to determine the risk factors associated with the progression of middle cerebral artery stenosis; 4) to examine the association between cognitive function, depression and middle cerebral artery stenosis.

Methods

All subjects will receive a standardized clinical interview, physical and neurological examinations according to standardized transient ischemic attack (TIA)/stroke form from the Atherosclerosis Risk in Communities Study (ARIC) and the CERAD-K. According to the World Health Organization (WHO) criteria, stroke was defined as “rapidly developing clinical sign of focal (or global) disturbance of cerebral function, with symptoms lasting 24 hours or more of leading to death, with no apparent cause other than vascular origin.” TIA was defined as “rapidly developing focal (or global) neurological signs and symptoms, resolved within 24 hours, with no apparent cause other than vascular origin”. MCA stenosis is diagnosed using TCD when the mean blood flow velocity (MFV) is at a circumscribed isonation depth >80 cm/s, with side-to-side differences of MFV >30 cm/s.

Parkinson disease

Introduction

Parkinson disease (PD) is one of the most common neurodegenerative disorders in the elderly population. Most epidemiological studies show that the prevalence of PD is much lower in East Asia and Africa but higher in the Europe and America.53 The prevalence of PD in Korea is not known.

The research aims are as follows: 1) to determine the prevalence of PD and 2) to establish a simple model questionnaire relevant for community screening.

Methods

PD is diagnosed clinically.54 A two-phase design is used. In phase 1, subjects are screened using a symptom-based questionnaire and in phase 2, those who screened positive are examined to confirm the diagnosis. The questionnaire includes 11 questions.55 The confirmation of the diagnosis is done using [123I]-FP-CIT SPECT, dopamine transporter imaging.56

Cardiovascular disease

Introduction

Disability and mortality due to cardiovascular disease (CVD) has now assumed an alarming proportion of medical disease around the world. Coronary artery disease (CAD) remains one of the major health problems not only in advanced countries, but also, is becoming a serious health issue in developing countries.

The prevalence of hypertension increases with age and is particularly high among individuals aged 65 years and over. There is good evidence that proper management of hypertension can reduce significantly the risk of stroke, cardiovascular events and mortality. However, about one-third to two-thirds of treated subjects with hypertension have uncontrolled disease.57 Since the elderly patients with hypertension have poor control of their hypertension, better strategies for the diagnosis and treatment of hypertension are needed.

The research aims are as follows: 1) to determine the prevalence and incidence of hypertension and coronary artery disease; 2) to assess the level of awareness, treatment and control of hypertension and to develop strategies to improve management of hypertension; 3) determine the...
risk factors and long-term complications associated with hypertension and coronary artery disease.

Methods
All of the subjects will receive the standardized questionnaires on medical history, including history of hypertension, heart diseases and surgery on the cardiovascular system. Laboratory tests include blood chemistry, electrocardiograms and chest X-ray. Blood pressure is measured two times on one occasion with the subject in the sitting position, using a standard mercury sphygmomanometer. Hypertension is defined as a systolic blood pressure (SBP) \( \geq 140 \) or a diastolic blood pressure (DBP) \( \geq 90 \) mmHg, or both, or current use of antihypertensive medication.

The diagnosis of coronary artery disease is made if one or more of the following conditions are present: 1) previous definite diagnosis of coronary artery disease, such as history of myocardial infarction, presence of significant coronary lesions by coronary angiography; 2) typical angina pectoris, (typical chest pain brought on by exertion and relieved by nitroglycerine or by rest) ; 3) unequivocal elec-trocardiographic findings of myocardial infarction and/or ischemia.

**Diabetes, metabolic syndrome and hypothyroidism**

**Introduction**

One of the major causes of death in the elderly population is diabetes and the related complications such as cardiovascular events. These medical problems use a great deal of medical resources (over 50 billion dollars in 2000, USA). Nevertheless, there has been limited comprehensive longitudinal study of the elderly, not only in Korea, but also in the rest of Asia, focused on geriatric disease and risk factors related to metabolic and cardiovascular disease in the elderly.

The metabolic syndrome (MS) is a cluster of abnormalities that develop due to insulin resistance, and it is closely related to cardiovascular disease. Central obesity is a key factor, in the new International Diabetes Federation (IDF) definition of the metabolic syndrome: it has been identified as a common factor related to metabolic diseases, glucose intolerance, atherosclerosis, and insulin resistance. In particular, visceral fat accumulation plays a major role in the development of the metabolic syndrome and cardiovascular disease. Among the methods [dual energy x-ray absorptiometry (DEXA), ultrasonography, CT] used for measuring the visceral fat area, CT is the standard method used.

Subclinical hypothyroidism is a prevalent condition among the elderly. However, it is frequently overlooked. Subclinical hypothyroidism has also been suggested as a risk factor for atherosclerotic cardiovascular disease, and metabolic disorders such as hyperlipidemia, hypertension, low-grade inflammation and hypercoagulability.

The research aims are as follows: 1) to determine the prevalence and incidence of diabetes mellitus (DM), the metabolic syndrome and hypothyroidism; 2) to investigate the relationship between subclinical hypothyroidism and the metabolic syndrome; 3) to assess the association between dietary habits and the metabolic syndrome; 4) to determine the risk factors and long-term complications associated with obesity, DM, the metabolic syndrome, and hypothyroidism.

**Methods**

Anthropometric parameters are measured by the standard method. The waist circumference is measured at the narrowest point between the lower limit of the ribcage and the iliac crest. The body fat is measured by tetrapolar bioelectrical impedance analysis (Inbody 3.0®®, Biospace, Korea). The abdominal adipose tissue areas are quantified by a single scout CT scan (Somatom Sensation 16, Siemens, Germany). Plasma glucose levels are determined by the glucose oxidase method. Plasma insulin concentrations are measured by radioimmunoassay (Linco, USA). Total cholesterol, triglyceride, high-density lipoprotein (HDL) - and low-density lipoprotein (LDL) cholesterol are measured enzymatically using an autoanalyzer (Hitachi 747, Hitachi, Ltd., Tokyo, Japan). Serum thyroid stimulating hormone (TSH) and free thyroxine (FT4) measurements are determined by the Roche Elecsys Modular Analytics E170 (Elecsys module) device using an electrochemiluminesence immunoassay (ECLA) method.

**Osteoarthritis and osteoporosis**

**Introduction**

Osteoarthritis (OA) is a leading cause of disability among elderly Caucasians in Western societies but its occurrence in other populations is unknown, including in Asian countries where most people have habitual knee bending activities. OA is a complex multifactorial disease. The risk factors for OA are constitutional or genetic and depend on environmental factors such as joint usage.

There is a remarkable paucity of information as to whether the occurrence of OA differs across racial groups or geographic regions. To date, limited information is available concerning OA among the Korean population. Major differences in the racial or geographic distribution of a disease often provide valuable clues about potential etiologic factors.

Osteoporosis is associated with decreased bone strength,
which is a consequence of bone density and quality. The incidence of osteoporosis in postmenopausal women continues to increase in progressively aging populations. Currently, it is estimated that over 200 million people worldwide have osteoporosis. The reduction in bone strength associated with this disease markedly increases the risk of skeletal and nonskeletal fractures, and the consequent pain and loss of function adversely affect the quality of life. In the United States and the European Union, about 30% of all postmenopausal women have osteoporosis, and it has been predicted that more than 40% of them will suffer one or more bone fragility fractures during their remaining lifetime. Many prospective studies have shown that there is a significant correlation between low bone mineral density (BMD) and fracture frequency.

The research aims are as follows: 1) to determine the prevalence, incidence and progression of osteoarthritis and osteoporosis; 2) to determine the risk factors associated with osteoarthritis and osteoporosis; 3) to assess the determinants of the occurrence or progression of disabilities in subjects with osteoarthritis; 4) to examine the association between vertebral and proximal femur fractures and osteoporosis.

Methods
Radiographic evaluations include standing anteroposterior (AP), standing 45 degrees flexion posteroanterior, Merchant patellofemoral views of the knee, both hand AP, lumbar spine lateral, and hip AP. Urograms with views of both hips (tube-to-film distance 100 cm: beam centered to allow visualization of the L1 vertebra to the lesser trochanter) for assessing hip joints will be added at the second interval. All radiographic images will be digitally acquired by the picture archiving and communication system (PACS: Impax: Agfa, Antwerp, Belgium), and subsequent assessment with PACS software. Knee and hand radiographs are assigned grades using the Kellgren and Lawrence grading system, and hip radiographs will be assigned grades using the global qualitative grade. All the measurements are carried out by an orthopedic surgeon.

Osteoporosis is defined according to the WHO definition as a T-score of BMD less than −2.5SD compared with a healthy young population. BMD will be measured using DEXA of the hip or lumbar spine at the second interval.

Sleep disorders

Introduction
Changes in sleep timing and quality occur with normal aging. With aging, it becomes both more difficult to stay asleep at night and more difficult to stay awake during the day. The total sleep time in a 24-hour period appears to decline with advancing age, but a decrease in nocturnal sleep time is partially offset by increased daytime napping. It is not clear whether older people need less sleep but it appears that at least nocturnal sleep time declines with age.

Elderly persons frequently complain of poor sleep and are likely the largest consumers of hypnotics. In the Berlin Aging Study, a random sample of persons aged 70 to 100 years, 19.1% of the participants were taking some form of sleep medication. Snoring is extremely common in elderly men and women. The significance of snoring in the absence of any other findings is unclear, but most studies suggest it is not an independent risk factor for other disease or morbidity. The prevalence of sleep apnea has been estimated at anywhere from 27% to 75% in elderly men.

In individuals with the REM sleep-behavior disorder (RBD) the normal inhibition of motor tone during REM sleep is not present so that patients may act out their dreams. Given the unpredictable content of dreams, this can lead to extremely violent behavior. The true prevalence of this disease is unknown, but it is probably underdiagnosed. In a survey of 1,034 elderly subjects in Hong Kong 0.8% reported sleep-related injury and the prevalence of RBD was estimated to be 0.38%.

Restless legs syndrome (RLS) is frequently observed in the elderly, and secondary causes of RLS have been known to be more common in late-onset RLS patients. RLS is a prevalent disorder in the general population and occurs with increasing frequency and severity in the elderly. RLS has an impact on sleep quality and daily performance but often remains unrecognized or misdiagnosed.

The research aims are as follows: 1) to assess the general sleep quality and to determine the various risk factors associated with poor sleep quality; 2) to determine the prevalence and incidence of insomnia, sleep apnea, RBD and RLS; 3) to investigate the association of RLS with iron metabolism.

Methods
Sleep quality and disturbances over a 1-month time interval are assessed using the Pittsburgh Sleep Quality Index (PSQI). Nineteen individual items generate seven component scores: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. The Epworth sleepiness scale is also performed to measure the general level of daytime sleepiness.

The diagnosis of RBD is made according to the clinical
criteria of the second International Classification of Sleep Disorders (ICSS-II). Polysomnography is performed only in the subjects meeting the symptoms criteria of the ICSS-II.

Two trained psychiatrists in face-to-face interviews using four minimal criteria defined by the International Restless Legs Syndrome Study Group (IRLSSG) establish the diagnosis of RLS. The IRLSSG Severity Scale is also used for the subjects with RLS. Blood samples are obtained for laboratory tests including iron metabolism.

Allergic disorders and chronic airway disorders

Introduction

Allergic diseases such as asthma and allergic rhinitis are increasing worldwide. Asthma is a chronic inflammatory disorder of the airway that is associated with airway hyperresponsiveness and mostly reversible airway obstruction. The characteristic features of asthma are dyspnea, wheezing and cough. It is a complex disorder that is caused by both of genetic and environmental factors. Asthma is usually reversible with appropriate treatment but it may be associated with death. One report of domestic data suggested that the prevalence of asthma in the elderly was much higher than in the middle-aged. This data suggested that allergic disorders such as geriatric asthma become more common as the lifespan increases. However, the prevalence of allergic diseases in the elderly has not been well studied.

Aging is associated with a progressive decrease in lung function. Pulmonary function is an important indicator of respiratory and overall health. Because of aging, the individual reserve is diminished; however, this decrease varies between individual subjects. Many factors are involved in the overall decline of lung function. The prevalence of asthma in the elderly is estimated to be between 6 and 10%. The mortality due to COPD is increasing, especially among older subjects.

The research aims are as follows: 1) to determine the prevalence, incidence and progression of allergic diseases and chronic airway diseases; 2) to determine the risk factors associated with allergic diseases and chronic airway diseases; 3) to assess the changes of pulmonary function with aging.

Methods

The prevalence of asthma, allergic rhinitis and atopic dermatitis is investigated using a modified questionnaire on allergy, the International Studies of Asthma and Allergy in Childhood (ISAAC). This questionnaire is a low-cost method and easily applied and has high sensitivity and specificity.

The skin prick test (SPT) with twelve common inhalant allergens is performed in all subjects. The SPT is considered a valid, safe, low-cost and easy-to-perform method to demonstrate IgE-sensitization towards aeroallergens. To ensure uniformity, the same skin puncture device is used in all subjects. The test is considered positive when the wheal is at least 3 mm larger than that of the negative control.

The pulmonary function and presence of chronic airway disease in the elderly is determined by spirometry which measures the air flow into and out of the lungs. Biannual spirometry measurements help to detect lung disease at an early stage when lifestyle changes and treatment may help prevent future problems.

Benign prostate hyperplasia and urinary incontinence

Introduction

Prostate-specific antigen (PSA) has been reported to be a surrogate for the total prostate volume (PV) from various studies on Caucasian populations. If the PVs of Korean men are smaller than are those of Caucasians, the relationship between PSA and PV in Korean men may also be different from those of the other races. Moreover, most previous reports on the PSA-PV correlation were from hospital-based studies that included only patients seeking management of lower urinary tract symptoms (LUTS). Several reports have also recently suggested a potential association between LUTS and the presence of the metabolic syndrome (MS).

Urinary incontinence is an important and common health care problem affecting the elderly population. Resistance to seek treatment may be due to the perception of incontinence as taboo or a misconception that it is part of normal aging. Without treatment, urinary incontinence may lead to serious psychological and social complications such as depression, anxiety, embarrassment, low self-esteem and social isolation.

The research aims are as follows: 1) to determine the prevalence, incidence and progression of benign prostate hyperplasia and urinary incontinence; 2) to investigate the correlation between PSA and PV in Korean men compared with other races; 3) to investigate the association between LUTS and the metabolic syndrome; 4) to determine the impact of urinary incontinence on the quality of life.

Methods

The demographics, physical examination, PSA and transrectal ultrasound are used to assess the correlation between the PSA and PV. Men with a PSA greater than 4 ng/ml or with suspicious findings on the transrectal ultrasound are
excluded to reduce the likelihood of including occult prostate cancer cases. Pearson’s correlation coefficient is used to analyze the relationship between the PSA and PV. Receiver operating characteristics (ROC) curves are constructed to evaluate the ability of the PSA to predict cutoff values for assessing prostate enlargement. The participants’ demographics, physical examination, various blood tests, International prostate symptom score (IPSS) and transrectal ultrasound are used to evaluate LUTS, prostate volume and the metabolic status.

The participants are divided into two groups: the metabolic group corresponding to the metabolic syndrome criteria and the non-metabolic group, characterized by men that did not meet the criteria. We compare the voiding symptoms, quality of life (QoL) and prostate volume between the two groups. We divide the symptom scores into storage and voiding symptoms and compare each symptom between the two groups.

The impact of urinary incontinence on the quality of life is assessed using the Incontinence Quality of Life questionnaire (I-QOL). This is a 22-item measure that uses a 5-point response and can be scored as an overall quality of life score or as three subscales: avoidance and limiting behaviors, psychosocial impact and social embarrassment. Higher scores indicate a better QoL.

**Chronic kidney disease**

**Introduction**

The prevalence of chronic kidney disease (CKD) is increasing and patients with CKD consume considerable health care resources. Longer survival of patients with CKD results in more comorbid hypertension and diabetes. Hypertension and diabetes, the main causes of progression of CKD to end-stage renal disease (ESRD), are becoming more common in the elderly and significantly contribute to the rising incidence of ESRD.

The research aims are as follows: 1) to determine the prevalence, incidence and progression of CKD; 2) to investigate the various risk factors associated with CKD; 3) to assess the status of control for blood pressure and blood glucose in patients with CKD.

**Methods**

The stage of disease based on the level of kidney function is assigned according to Kidney Disease Outcomes Quality Initiative Chronic Kidney Disease (K/DOQI CKD) classification. A Modified Modification of Diet in Renal Disease (MDRD) equation is used to estimate the glomerular filtration rate (eGFR) (ml/min/1.73 m² BSA) \= 186 \times [SCr]^{-1.154} \times [Age]^{-0.203} \times [0.742, \text{ if patient is female}].

**Conclusion**

The KLoSHA is the first comprehensive community-based longitudinal study on health and aging of Korean elders aged 65 years or over. This may not only provide comprehensive epidemiological data on the health status and common geriatric disorders of Korean elders, but also may stimulate comprehensive multidisciplinary and interdisciplinary researches on aging and geriatric disorders and contribute to policy formulation and planning of health management programs and social services in Korea.

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