うに配慮した食事調査票の開発，(5) 亜熱帯圏のアジア諸国との比較が可能な食事調査票の開発などが重要となろう[36]。

沖縄の食事が長寿性にどのように関連しているかを明らかにするためには，科学的に検証された事実を客観的に集め整理し，それにもとづいて判断するという Evidence-based な人間栄養学に立脚したアプローチが必要となろう[17-38]。

本研究は，平成 8-10 年度厚生省厚生科学研究費補助金長寿科学研究事業による「沖縄の長寿者の健康要因」班(班長: 柊山幸志郎)の研究の一環として実施した。本調査研究にご協力いただいた対象者の方々および具志川村，仲里村役場の関係各位に深謝いたします。また貴重な助言を頂きました国立がんセンター研究所佐々木敏博士，東京大学医学部片桐あかね博士に感謝いたします。

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A New Comprehensive Study on Aging - the National Institute for Longevity Sciences, Longitudinal Study of Aging (NILS-LSA)

Hiroshi Shimokata, Fujiko Ando, and Naoakira Niino

A new comprehensive longitudinal study of aging, the National Institute for Longevity Sciences, Longitudinal Study of Aging (NILS-LSA) started in November 1997. The participants of this study will be 2,400 residents aged 40 to 79 years who were age- and gender-stratified random samples selected from the NILS area. All participants provided written informed consent after a detailed explanation of the study. They will be examined at the NILS-LSA Examination Center every two years. Their first wave examinations will be finished by the end of March 2000. The examined variables number over 1,000, including clinical evaluations, medical examinations, anthropometry, body composition, physical functions, physical activities, psychological assessments, nutritional analysis and molecular epidemiology. By the end of September 1999, 1,643 men and women had completed their first wave examinations.
J Epidemiol, 2000 ; 10 : S1-S9.

aging, epidemiology, longitudinal study, method

INTRODUCTION

The life expectancy of the Japanese population is the longest in the world. Both the absolute number and relative percentage of the elderly population in Japanese society is rapidly increasing [1]. In 2020, the percentage of the elderly population in Japan will be the largest in the world. Along with these changes, various medical and care-giving problems for the elderly patient have arisen. Longevity science, with the goal that all of elderly people can live a long life with physical and mental health should be promoted in Japan.

Human aging is associated with many factors, including not only physical and physiological factors but also social and psychological factors. Thus, research into human aging requires many kinds of examinations and specialists in various areas. In addition, human aging research requires long-term study in which the same subjects are measured repeatedly to observe age-related changes [2-7]. However, the number of researchers and budget for studies on gerontological and geriatric epidemiology are limited. It has been very difficult in Japan to start and to continue a large-scale and comprehensive longitudinal study of aging, despite a rapid increase in the elderly population.

In 1995, a new national research institute of aging in Japan, the National Institute for Longevity Sciences (NILS) was established and in 1997 the NILS-LSA (NILS-Longitudinal Study of Aging) started [8]. The participants in the NILS-LSA are 2,400 randomly selected men and women aged 40 to 79 years from the NILS area. They will be examined every two years. Six to seven participants are now examined every day at the NILS-LSA examination center. The aging process is assessed by detailed questionnaires and examinations including clinical evaluation, body composition and anthropometry, physical functions, nutritional analysis, and psychological assessments. The data from the study will be useful to investigate the causes of geriatric diseases and health problems in the elderly such as depression, mental disturbance, restriction of ADL, low nutrition and physical activity. The data will also be useful to prevent these diseases and health problems in the elderly.

PROGRESS OF THE NILS-LSA

In 1990, projects of "Comprehensive Research on Aging and Health" were started by the Ministry of Health and Welfare to

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promote longevity sciences in commemoration of the 60th year in the reign of Emperor Showa. A research group for a longitudinal study on aging was organized as one of these projects. Indices on aging were evaluated, the methodology for the longitudinal study was assessed, and many problems in actual longitudinal follow-ups using existing cohorts were analyzed by this research group in order to start a new comprehensive longitudinal study of aging in Japan. A pilot longitudinal study on aging started in 1992. A manual of the many procedures used in the study was published in 1996 [9].

In July 1995, the National Institute for Longevity Sciences (NILS) was established as the leading national research center for aging and geriatric research in Obu city in the suburbs of Nagoya. In 1996, the Laboratory of Long-term Longitudinal Studies was established in the Department of Epidemiology to start a new longitudinal study of aging in Japan.

Various equipment necessary for geriatric research, such as magnetic resonance imaging (MRI) and peripheral quantitative computed tomography (pQCT) were set up in the NILS, and a special examination center for longitudinal study was established in the Chubu National Hospital. Physicians, psychologists, nutritionists, epidemiologists, and exercise physiologists were assigned to the Laboratory of Long-term Longitudinal Studies and the Department of Epidemiology.

In October 1997, a trial run of the examinations led by local volunteers started, and in November 1997, the NILS-LSA began as a large-scale and comprehensive longitudinal study of aging in Japan. Every day, six or seven participants were examined at the NILS-LSA Examination Center. By the end of September 1999, 1,643 men and women had completed their first examinations. By the end of March 2000, examinations of 2,400 participants will be completed. After that, all participants will be examined every two years. The total number of examined variables is over 1,000, including various areas of gerontology and geriatrics such as medical examinations, anthropometry, body composition, physical functions, physical activities, psychological assessments, nutritional analysis and molecular epidemiology.

AIMS AND OBJECTIVES OF THE NILS-LSA

The main purpose of the study is the systematic observation and description of the process of aging in humans: (1) to quantify normal and successful aging as well as to clarify the occurrence and processes of geriatric diseases; (2) to determine reference values in the normal aging process by longitudinal observation. Normal aging is an ideal aging process that is not influenced by specific diseases.

There are many additional objectives as follows: (1) to find early markers for age-related diseases; (2) to clarify molecular genetic factors in aging and geriatric diseases; (3) to find factors associated with longevity; (4) to examine the effects of life-style, stress, life events and disease on the aging process; (5) to separate normal aging and age-related diseases; (6) to assess the effects of age on progressive changes in various diseases; (7) to determine predictors of age at death and disease risk factors as well as institutionalization and loss of independence; (8) to include various tests applied to the same subjects to determine whether aging is a physiologically and psychologically interactive and continuous processes or the end result of multiple independent processes; (9) to examine regional differences in factors of longevity and the relationship among life-style, aging and disease in Japan; (10) to examine race differences by international comparative study; (11) to assess social and economic changes with age in the elderly; (12) to develop indices of biological age; (13) to prepare the general population for research of clinical and social medicine.

TARGET POPULATION AND IMPLEMENTATION OF THE STUDY

Research area

For the detailed and comprehensive examinations at the NILS, the research area was determined to be in the neighborhood of the NILS, that is Obu city (population 70,000) and Higashiura town (population 40,000) (Figure 1). This area is located in the south of Nagoya city, and is a big city bedroom town and also industrial area of the Toyota group, but still has many orchards and farms, having both urban and rural characteristics.

This research area is geographically located at the center of Japan, and the climate is almost average for Japan. We examined the representativeness of the area via national postal questionnaire of prefecture-stratified random samples of 3,000 households from all prefectures in Japan, and showed that the life-style of this area was the most typical of all areas in Japan [10]. It is expected that the results of examinations in this area will represent the average in Japan.

Subjects

The subjects of the NILS-LSA were men and women residents of 40 to 79 years old. They were stratified by both age and gender, and randomly selected from resident registrations in cooperation with the local governments (Obu city and Higashiura town). The number of men and women is to be the same to test gender difference. Age at the base line is to be 40 to 79 years and the number of participants in each decade (40s, 50s, 60s, 70s) is to be the same. The total number of participants will be 2400, that is 300 men and 300 women for each decade. They will be followed up every two years (Figure 2).

Recruitment and follow up of volunteers will be much easier than with random samples. However, volunteers generally tend to be rich, highly educated, and interested in health. Observation of these volunteers would produce results for economically and socially upper class people who are very healthy and live long. Examinations in random samples are necessary

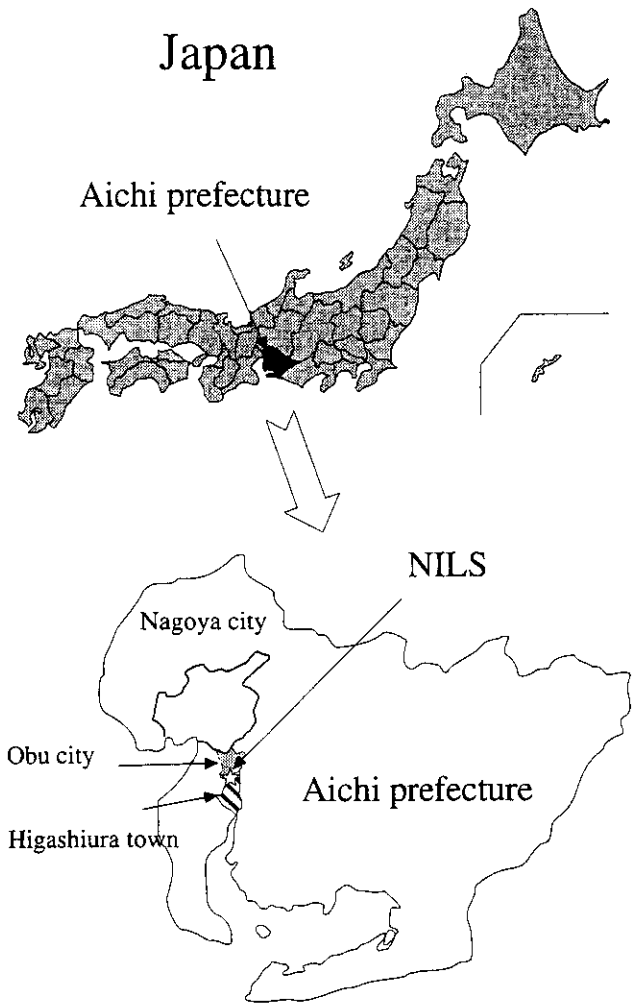

Figure 1. Research area of the NILS-LSA.

to observe the aging process of ordinary Japanese who live ordinary lives.

Implementation of the study

Selected men and women who are assigned to the next month's examination are invited by mail to an explanatory meeting that is held twice a month, once on Sunday and once on Monday (Figure 3). At the explanatory meeting, procedures for each examination and the importance of the continuation to follow up are fully explained. Participants are limited to those who understand all examination procedures and sign their names on a written form (informed consent).

The Department of Epidemiology of the NILS is taking the initiative for all examinations and investigations. All participants are examined from 9 am to 5 pm at a special examination center within a facility at the Chubu National Hospital located next door to the NILS (Figure 4). To examine 2,400 men and women in two years, that is 1,200 men and women per year, six or seven participants are to be examined each day, 4 days a

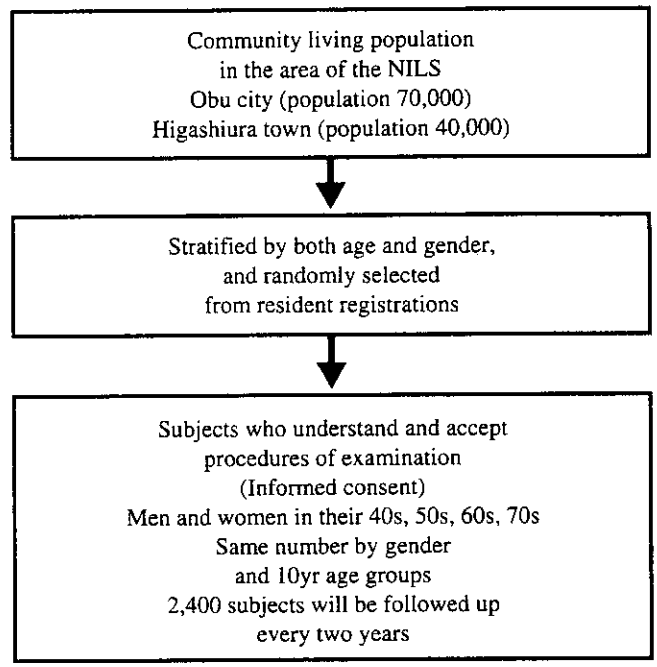

Figure 2. Selection of subjects in the NILS-LSA.

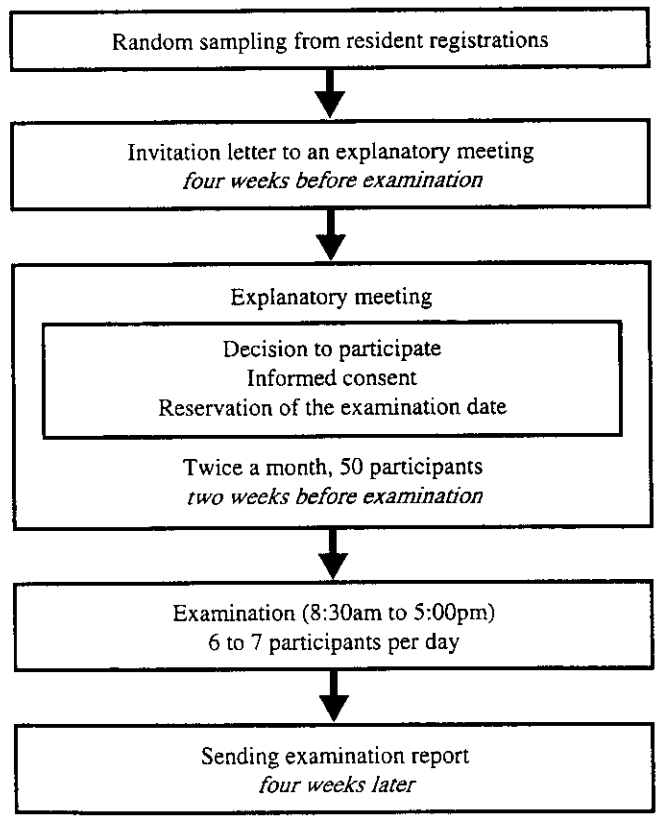

Figure 3. Examination schedule in the NILS-LSA.

week from Tuesday to Friday, 200 days year. Taking advantage of the fact that all participants can be examined at a center, detailed examinations including not only medical evaluations, but also examinations of exercise physiology, body composition, nutrition, and psychology can be tested. Each examination is to be extensive and most up-to-date, aiming at the

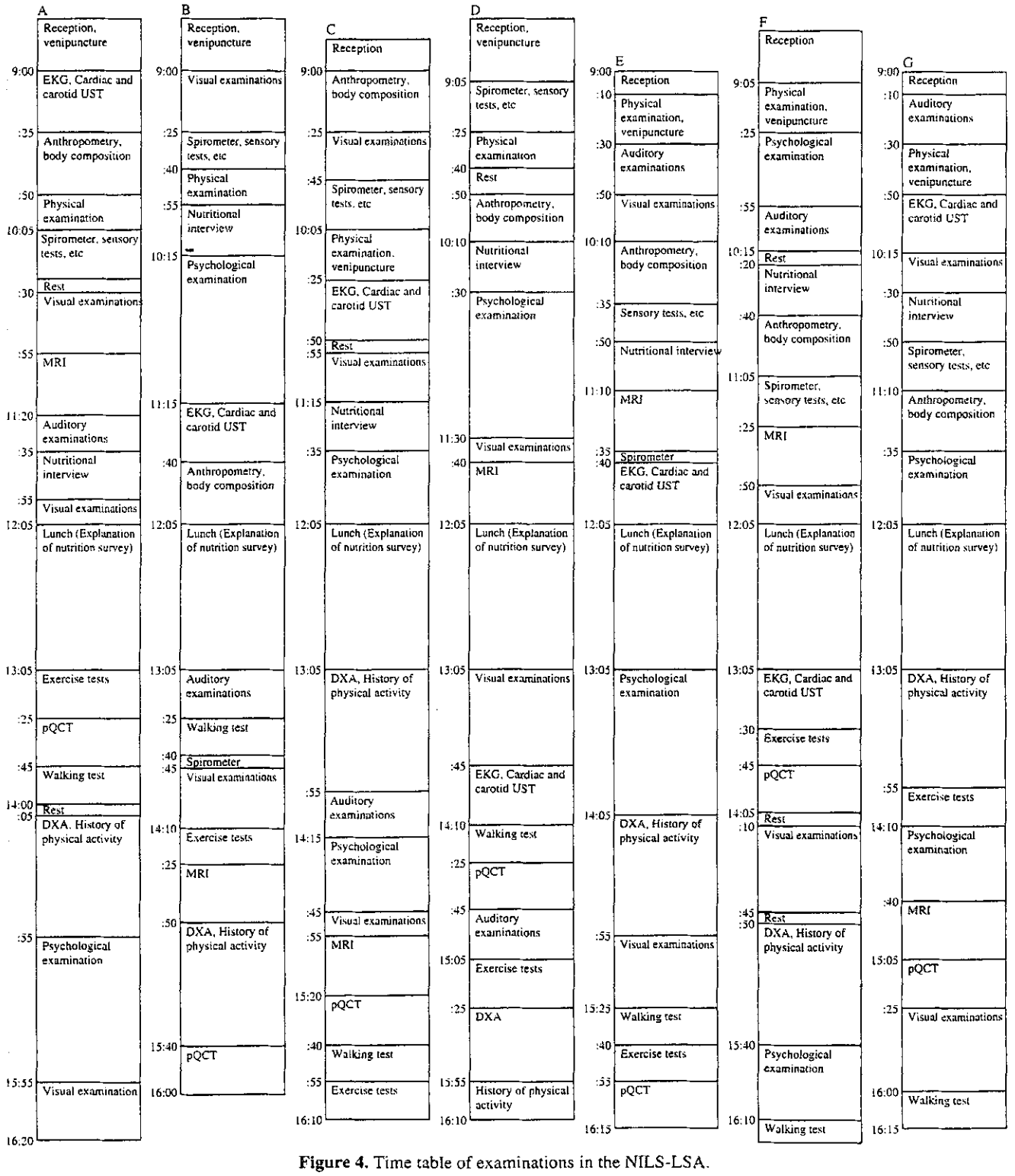

Figure 4. Time table of examinations in the NILS-LSA.

internationally highest level. The follow up period is to be up to 30 years, but we hope to get significant longitudinal results within 5 to 10 years. By the end of September 1999, 1,643 men and women had completed their first wave examinations.

Information from the examinations that will be helpful to manage the health of participants is returned to individual participants as a report from the NILS-LSA.

Informed consent

All participants are fully informed of the following items. Only subjects who understand and accept examination procedures, and sign their names to a written form to participate in the study (informed consent) are included. This informed consent includes; (1) purpose of the study; (2) detailed procedures for each examination; (3) predictable danger; (4) participation in the examinations totally depends on free will, without any enforcement, and refusal to participate has no disadvantage; (5) to keep secret personal data from the examination.

We are paying particular attention to genetic analysis and preservation of blood and urine samples for future examinations. The Ethical Committee of the Chubu National Hospital has already approved all procedures of the NILS-LSA.

EXAMINATIONS AND TESTS

The normal aging process is assessed by detailed examinations including clinical evaluation, sensory aging, body composition and anthropometry, physical functions, nutritional analysis, and psychological tests (Table 1).

Routine clinical evaluations

First of all, physical examinations including history taking, auscultation and blood pressure measurement are taken by a physician, and during the medical examination the doctor reconfirms every participants willingness to participate in examinations. Venous blood and urine samples are collected early in the morning after at least 12 hours' fasting.

Life-style, medical history and prescribed drugs are examined by questionnaires. These questionnaires are checked by a physician at the medical examination. All drugs used during the previous two years are to be documented by participants; the physician confirms them at interview and codes drugs used during the last two weeks.

In addition to the usual blood and urine analysis, renal and liver functions, serum protein and lipids, and complete blood count, lipid peroxide, sex hormones and geriatric disease markers are also examined. Serum, DNA and urine samples are stored in deep freezers for future examinations. As for DNA analysis, genotypes which are related geriatric diseases such as Alzheimer's disease, arteriosclerosis, osteoporosis, benign prostate hypertrophy and diabetes mellitus are examined with the agreement of the participants.

Physiological examinations

For physiological examinations, a head MRI is taken for all participants and stored in an image database. Intracranial tumors and vascular lesions are checked and brain volume is estimated via a computerized trace of the MRI. Pulmonary functions are examined with a spirometer. Blood oxygen saturation is also checked with an oxymeter. Blood pressure is measured by a physician as well as with an automatic blood pressure manometer. Electrocardiograms are assessed by computerized automatic diagnosis and Minnesota codes of the diagnosis are stored in a database. Cardiac functions and intima-media thickness of the carotid artery are assessed by ultrasonic tomography. Peripheral vascular function is assessed using a digital plethysmogram.

Sensory aging

Sensory functions are profoundly associated with QOL in the elderly. Visual and auditory disturbance causes various difficulties in the daily lives of the elderly. Sensory aging, including visual and auditory functions will be examined in detail. As for visual acuity, both distant vision (5 m) and near vision (33 cm) are assessed. Kinetic visual acuity, stereoscopic vision, color perception, contrast sensitivity, visual field, and intraocular pressure are also examined. An anterior eye segment analysis system is used for the assessment of cataracts. Fundus photographs are taken with a Topcon fundus camera (TRC-NW5S). Autorefraction is done with the NIDEK-ARK700A. Refractive errors, in the spherical equivalent, are assessed.

Hearing acuity is assessed by pure-tone audiometry air conduction at 500Hz to 8000Hz in all participants and bone conduction in participants with hearing disturbance by air conduction. Middle ear function is also assessed by impedance audiometry. Peripheral skin sensory function is assessed using current perception thresholds at three different frequencies: 5, 250 and 2000 Hz. This is a non-invasive procedure to examine the function of three different sensory nerve fibers, that is A β fiber, A δ fiber, and C fiber. Cognitive sensory function at the parietal lobe of the brain is assessed by a skin discrimination test.

Body composition and anthropometry

Osteoporosis is one of the major geriatric diseases. Osteoporosis causes chronic lumbago and bone fracture that disturbs activity in daily life in the elderly. Bone mineral density is measured by dual X-ray absorptiometry (DXA). Four scans, including whole body, lumbar spine L2 to L4, right and left femoral bone neck, are taken. Moreover, bone density is also measured by high quality peripheral quantitative computed tomography (pQCT).

For anthropometry measurements, height, weight, abdominal depth, circumferences of waist, hip, thigh and upper arm and other parameters are taken. Using ultrasonic tomography, intrabdominal and subcutaneous fat thickness and muscle thickness are evaluated. Intra- and extra-cellular fluid is mea-

Table 1. Examinations and tests in the NILS-LSA.

1) Health-related questionnaire
   - Self-rated Health (SRH), Medical history, Clinical symptoms, Medical care, Lifestyle, Personal history (job, marriage, education, etc.), Menarche and menopause, Family history, Environment, Alcohol consumption, Smoking, Social and economic background

2) Routine clinical evaluations
   - Physical examination
   - Blood pressure
   - Blood chemistry
     - GOT, GPT, γ GTP, Total protein, Albumin, LDH, Alkaline phosphatase, Cholinesterase, Uric acid, Urea nitrogen, Creatinine, Calcium, Total cholesterol, Trigrlyceride, HDL-cholesterol, Lipid peroxide, Fasting glucose, HbA1c, Fasting insulin, Vitamin A, Serum sialic acid, Fe, Cu, Mg, Zn, free T3, free T4, TSH, Sex hormones (Total and free testosterone, Estradiol, DHEA-S and Sex hormone binding globulin)
   - CBC: Red cell count, White cell count, Hb, Hematocrit, Platelet
   - Urine analysis: Protein, Sugar, Urobilinogen, Ketone, pH, Occult blood, Nitrite

3) Sensory aging
   - Visual system
     - Visual acuity: near vision (33 cm), distant vision (5 m), Kinetic visual Acuity, Refraction, Visual field, Retinal camera, Intraocular pressure, Color perception, Stereoscopic vision, Contrast sensitivity, Quantitative test of lens opacity, Corneal cell number
   - Auditory system
     - Audiometry (air and bone), Middle ear functions (Impedance audiometry)
   - Skin sensory system
     - Quantitative sensory test (Neurometer), Skin discrimination test

4) Medical examinations
   - Automatic EKG analyzer
   - Cardiac ultrasonic tomography
   - Carotid artery sonography
   - Pulse wave (digital plethysmography)
   - Pulmonary functions (spirometer)
   - Blood oxygen saturation (Pulse oxymeter)
   - DXA (Dual Energy X-ray Absorptiometry)
     - Lumbar spine, Right and left femur neck, Total bone density, Body fat (total and segmental fat)
   - High Quality Peripheral Quantitative CT (pQCT)
   - Head MRI (Magnetic resonance imaging system)

5) DNA phenotype and disease markers
   - Alzheimer's disease
     - Apolipoprotein E phenotype, Protease phenotype, Peptidase activity and inhibitors, beta-amyloid peptide concentration accumulative beta-amyloid autoantibody, DLST phenotype, Mitochondria CCO
   - Stroke and arteriosclerosis
     - Angiotensin converting enzyme (ACE) phenotype, Platelet-activating factor acetylhydrase activity (PAF-AH) and phenotype
   - Osteoporosis
     - Transforming growth factor beta 1 (TGF-b1) phenotype, Osteocalcin, Bone alkaline phosphatase, Aminoterminal cross-links of type I collagen (urine)
   - Parkinson's disease
     - N-methyl transferase activity and phenotype
   - Obesity and diabetes
     - CCK-A receptor phenotype, beta 3-adrenaline receptor phenotype, Leptin,
   - Prostate hypertrophy
     - alpha-1 adrenaline receptor phenotype
   - Aging
     - Mitochondria 5178 phenotype

Table 1 (continue). Examinations and tests in the NILS-LSA.

6) Body Composition
Body fat measurement
Air displacement (Bodpod), Impedance body fat measurement, DXA
Body fluid measurement (Bioimpedance spectroscopy)
Ultrasonic tomography
Intrabdominal fat, Muscle thickness, Subcutaneous fat thickness
Anthropometric measurements
7) Physical function
Exercise test system
Grip power, Sit-ups, Anteflexion, Static balance, Leg extension power, Static leg strength, Reaction time
10 m Walking test (pitch, stride, speed),
3D motion analyzer (four cameras and two force plates)
Balance test (stabilometer)
Physical activity (questionnaire)
Electric pedometer (7 days average)
8) Psychological tests
Interview
Cognition (MMSE, WAIS-R), Life events, Stress, Basic ADL (Katz Index)
Questionnaire
Depression (CES-D), Personality (Self-esteem, EPSI, Locus of control), Social environment (Social support, Social network), Family Relations, QOL (LSI-K, SWLS), Stress coping, Instrumental ADL, Death Anxiety
9) Nutrition analysis
Food and nutrition Intake
Nutrition Diary (3 days) using scales and disposable cameras
Food frequency questionnaire
Dietary habit questionnaire

sured via bioimpedance spectroscopy. Body fat is assessed by impedance measurement, air displacement and DXA.

Exercise examinations

Grip power, leg extension power, sit-ups and static balance, reaction time, and anteflexion are measured with a computerized automatic diagnosis system. Gait step length, pitch velocity are assessed by the 10m walking test system using four video cameras and two force plates. Physical activities are checked by detailed interview using job-specific questionnaire sheets. Seven day averages of physical activity are also measured with an electric pedometer.

Nutritional survey

Nutritional intakes are assessed by three day dietary records using scales. Scales are handed out to all participants to record the weight of all foods intake over three days. If it is impossible to weigh the food, size and approximate amount of food are noted. During lunchtime on the day of the examination, dieticians explain to each participant how to weigh foods and how to determine the size and approximate amount. Moreover, for more accurate assessment of food intake, disposable cameras are also handed out to all participants. Before and after each meal, participants take pictures of all food eaten to record what kind of foods and how much food were eaten, and how much food is not eaten. Using these dietary records and photographs, dieticians estimate actual food intake.

However, there are significant seasonal differences in daily food intake in Japan. Food intakes are also assessed by a food frequency and dietary habit questionnaire excluding seasonal differences. The average of amounts and frequencies of 166 representative foods eaten during the previous year are written. A dietician interviews the subjects to confirm the amounts and frequencies.

Psychological testing

All participants are interviewed by psychology specialists. Cognition and intelligence are assessed using the Wechsler Adult Intelligence Scale-Revised Short Form (WAIS-R-SF) in all participants and the Mini-Mental State Examination (MMSE) in participants aged 60 years and over. Life events and stress coping are also assessed by interview. Basic ADL is checked via the Katz index.

Depressive state using CES-D (the Center for Epidemiologic Studies Depression Scale), personality, self-esteem, social environment including social support, social network and family relations, life satisfaction scale (SWLS; Satisfaction with Life Scale) and QOL, stress coping, instrumental ADL and death anxiety are assessed using a questionnaire.

The examined variables number over 1,000, including vari-

ous areas of gerontology and geriatrics and these variables will be checked repeatedly every two years in the 2,400 participants. The staff of the NILS-LSA are full time researchers, researchers from hospitals and universities, research assistants such as administrators, clinical technicians, dieticians, psychologists, programmers and radiologists. The total number of staff is now 68.

FUTURE OF THE NILS-LSA

We will continue the NILS-LSA to investigate the natural course of aging and the changes that lead to disease. The first wave examination will be completed by March 2000. The participants will be examined every 2 years. The cohort of the NILS-LSA will be a dynamic cohort, that is, new subjects will participate in the study instead of those who will not attend their next examination. Participants who move out of the area are to be followed up by telephone interview or postal questionnaire. Medical records of the participants who die during follow-up will be checked to find out the cause of death.

The NILS-LSA includes collaborating studies with other research facilities in Japan and other countries as shown in Figure 5. Extensive tests and examinations should be repeated in longitudinal studies on aging. However, it is actually impossible to repeat many tests and examinations in multiple research facilities with the same protocols and methods. There are almost no comprehensive longitudinal studies on aging which have been followed up for a long period by multi-center collaboration in the U.S. or other countries.

However, cohort studies with common end points such as dementia and disturbance of ADL are also important for aging studies. A high number of subjects and cases during follow-up need to be obtained to get significant analysis results. We are going to start multi-center collaboration with common baseline examinations that relate to the end point of the follow-up.

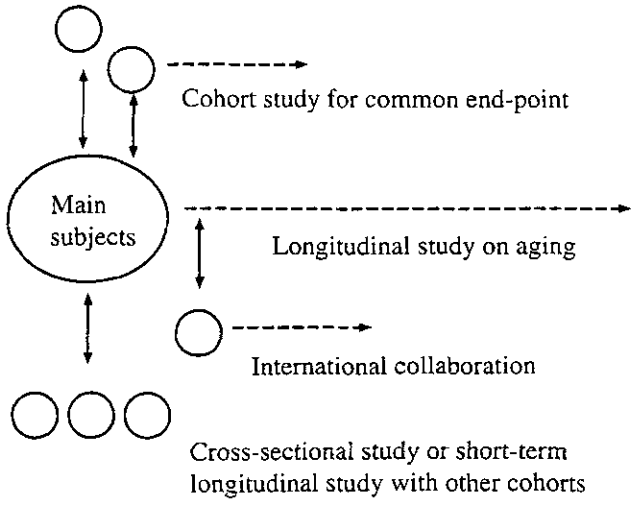

Figure 5. Future design of the longitudinal study with multi-center collaboration.

Comparative studies of the aging process accounting for regional and cultural differences between northern and southern areas, or between urban and rural areas, are also important. In these comparative studies, the number of common examinations and tests should be limited and measuring errors of each test and examination should be small. The study design should be a cross-sectional or short-term longitudinal study, considering the difficulties involved continuing and repeating the examinations in all facilities with same protocols. An international comparative study collaborating with the Baltimore Longitudinal Study of Aging (BLSA) at the National Institute on Aging (NIA) in the U.S. is also planned.

We are going to make the data of this study public through the Internet. We hope that the results from this large longitudinal study of aging can serve the development of health science on aging.

ACKNOWLEDGMENTS

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Nutritional Assessments of 3-Day Dietary Records in National Institute for Longevity Sciences - Longitudinal Study of Aging (NILS-LSA)

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Food and nutrient intake of NILS-LSA participants 40 to 79 years of age were assessed through 3-day weighed dietary records by gender and age. The results were as follows. The intake of fats and oils, meats and beverages tended to decrease, but fruits increased with age in both males and females. Regarding nutrient intake, energy, protein, fat, and cholesterol showed a decrease as individuals aged. The nutrient intake in the 70 to 79 yr group was significantly lower than other age groups of both genders. The total dietary fiber and vitamin C intake increased. Salt intake exceeded 10g/day in every group. The percentage of energy from fat to total energy was higher than 25% in most age groups. The proportion of fatty acids was almost appropriate in all groups. *J Epidemiol*, 2000 ; 10 : S70-S76.

nutritional survey, 3-day dietary record, aging

INTRODUCTION

The National Institute for Longevity Science - Longitudinal Study of Aging (NILS-LSA) started in 1997. The NILS-LSA assesses the aging process by epidemiological studies. It is said that many of the physiological and pathological changes associated with aging have important relationships with nutrition. There are many questions about the role of nutrition in the aging process [1-3]. Therefore, a series of studies on nutrition as well as medical, physical, psychological, and social problems has been conducted in the NILS-LSA.

In the nutrition survey, many methods have been devoted for measuring the common dietary intake [4, 5]. The dietary record (DR) has been one of the most reliable methods for nutritional assessment. Because the subjects were requested to weigh all food items before cooking them, the amount of macro and micronutrition should be relatively accurate. For this reason, the DR are often regarded as the "golden standard" for investigating food intake. In Japan, 3-day dietary records (3DR) had been adopted in the national nutrition survey (NNS) for a long time. However, the DR method is limited by the fact that individual food intake is highly varied from day to day. No method alone is sufficient for assessing the nutritional status of an individual or a group of individuals [5]. It is necessary to use several methods simultaneously to estimate the usual individual intake. Regarding the major dietary intake surveys conducted in United States, a 24-hour recall was followed up by self-administered 2- or 3-day records [2, 5].

In Japan, there are very few large-scale studies to assess using the DR and other methods. Therefore, we decided to use 3DR with a food frequency questionnaire (FFQ) in the NILS-LSA. The purpose of this study was to determine the distribution of food and nutrient intake using 3DR in the NILS-LSA.

Measuring the diet of the elderly has a special problem [6]. Elderly people sometimes show severe memory loss. Even when the memory is not impaired, elderly people are likely to take multiple types of nutritional supplements [5-8]. In food-consumption studies of elderly people, their application often requires special consideration [7]. Therefore, it is difficult to accurately assess nutrition of the elderly. Our data provide useful information on nutrition of elderly people.

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MATERIALS AND METHODS

Subjects

Between November 1997 and March 1999, 1,130 people in the neighborhood of the National Institute for Longevity Sciences center participated in the NILS-LSA. After excluding those without 3DR data, 1,038 subjects (531 males and 507 females, 40 to 79 years of age) underwent an analysis of food and nutrient intake.

Dietary Assessments

The 3DR was carried out on three continuous days (two weekdays and one weekend day). The food was weighed separately with a scale before being cooked or the portion sizes were estimated. The subjects took photos of the dishes before and after eating with a disposable camera. Dietitians used the photos to complete the data, and telephoned to resolve any discrepancies or to obtain further information when necessary. After completion, the records were reviewed and coded. Food was divided into 18 groups and the averages of the three day food and nutrient intakes were calculated according to the fourth edition of the Standard Tables of Foods Composition in Japan [9] and other sources [10-16]. The substituted food composition table for Japanese food developed by Sasaki et al. [17] was used to calculate any missing values of fatty acid composition.

Statistical Analysis

Data were given as means ± S.D.. The analysis was conducted separately by gender and age. Statistical comparisons among the groups were performed with Tukey's multiple comparison and trend test. All the statistical analyses were performed using the Statistical Analysis System, release 6.12 [18]. A $P<0.05$ value was considered significant.

RESULTS

The daily intake of the 18 food groups is shown in Table 1-1, and 1-2. For males, fats and oils, and seasonings and spices in the 70 to 79 yr group were significantly lower than in other age groups. The intake of fats and oils, meats, beverages, and seasonings and spices trended to decrease with age, whereas fruits and seaweed increased.

For females, fish and shellfish in the 50 to 59 yr group were significantly higher than in the other age groups, while fruits for the 40 to 49 yr group were significantly lower than for the other age groups. The age trend of females for some food groups was similar to that in males.

Table 2-1 and 2-2 shows the daily energy and nutrient intake

Table 1-1. Daily intake of food of the respective food groups in the NILS-LSA (g/day).

	Males				
Groups	40-49 yr (n=133)	50-59 yr (n=143)	60-69 yr (n=125)	70-79 yr (n=130)	P Value of Trend
Cereals	277±72	278±72	272±65	261±86	
Potatoes and Starches	71±46	70±48	80±54	72±50	
Sugars and Sweeteners	12±9	11±9	15±17	11±9	
Confectioneries	46±46	43±45	54±61	46±48	
Fats and Oils	14±7[d]	12±7[d]	12±6[ad]	9±6[abc]	<0.001
Nuts and Seeds	5±8[c]	6±11	10±22[ad]	6±7[c]	
Beans	90±56	98±58	95±62	90±54	
Fish and Shellfish	110±55	125±54	123±57	108±45	
Meats	97±48[cd]	90±46[d]	77±46[a]	66±37[ab]	<0.001
Eggs	61±32	62±31	64±26	57±28	
Milk and Dairy Food	150±133	149±131	149±139	165±124	
Vegetables	280±105[bc]	326±127[a]	322±134[a]	296±145	
Fruits	121±115[cd]	144±124[cd]	202±139[ab]	184±127[ab]	<0.001
Mushrooms	17±19[c]	22±19	24±21[a]	21±24	
Seaweed	7±11	7±7	7±8	10±15	<0.05
Beverages	1001±486[d]	1005±509[d]	878±426	734±368[ab]	<0.001
Seasonings and Spices	44±17[d]	43±17[d]	43±16[d]	35±15[abc]	<0.001
Prepared Foods	34±43	34±54	28±48	25±45	

Mean±S.D.

Figures in parentheses indicate the number of subjects.

a; Significantly different from the 40-49 yr group, $p<0.05$. Tukey's test for multiple comparisons.

b; Significantly different from the 50-59 yr group, $p<0.05$. Tukey's test for multiple comparisons.

c; Significantly different from the 60-69 yr group, $p<0.05$. Tukey's test for multiple comparisons.

d; Significantly different from the 70-79 yr group, $p<0.05$. Tukey's test for multiple comparisons.

Table 1-2. Daily intake of food of the respective food groups in the NILS-LSA (g/day).

Groups	Females				
	40-49 yr (n=127)	50-59 yr (n=129)	60-69 yr (n=124)	70-79 yr (n=127)	P Value of Trend
Cereals	209±53	209±54	210±60	206±51	
Potatoes and Starches	66±44	65±45	71±50	74±61	
Sugars and Sweeteners	11±9	13±9	12±9	11±8	
Confectioneries	64±44	59±47	51±44	50±43	<0.01
Fats and Oils	11±6[cd]	12±8[cd]	9±6[ab]	8±6[ab]	<0.001
Nuts and Seeds	7±16	9±14	7±11	5±8	
Beans	70±48	80±47	81±53	79±48	
Fish and Shellfish	88±44[b]	110±54[acd]	95±42[b]	88±42[b]	
Meats	75±41[bd]	62±34[a]	65±43	54±35[a]	<0.01
Eggs	54±27	55±26	55±21	51±26	
Milk and Dairy Food	172±118	176±144	169±126	170±138	
Vegetables	247±95[bc]	287±100[a]	290±104[a]	275±95	<0.05
Fruits	129±98[bcd]	169±103[a]	196±128[a]	176±114[a]	<0.001
Mushrooms	21±21	23±20[d]	20±23	16±15[b]	<0.05
Seaweed	7±23	10±19	7±13	11±37	
Beverages	654±338	712±305[d]	703±326[d]	571±259[bc]	<0.05
Seasonings and Spices	35±12	37±14	37±15	33±13	
Prepared Foods	37±51[d]	23±42	22±43	21±44[a]	<0.05

Mean±S.D.

Figures in parentheses indicate the number of subjects.

a; Significantly different from the 40-49 yr group, $p<0.05$. Tukey's test for multiple comparisons.

b; Significantly different from the 50-59 yr group, $p<0.05$. Tukey's test for multiple comparisons.

c; Significantly different from the 60-69 yr group, $p<0.05$. Tukey's test for multiple comparisons.

d; Significantly different from the 70-79 yr group, $p<0.05$. Tukey's test for multiple comparisons.

by gender and age. The age trend was much clearer for nutrients than for daily food intake. For males in the 40 to 49 yr group, fat, and total fatty acid (TFA) were significantly higher than in other age groups, while total dietary fibers (TDF) were significantly lower. Energy, protein, fat, cholesterol and niacin in the 70 to 79 yr group were significantly lower. Energy, protein, fat, TFA, cholesterol, carbohydrate, vitamins E, B_1, and niacin trended to decrease with age, whereas TDF, ash, calcium, vitamin A, and vitamin C increased.

For females, energy, protein, fat, TFA, and cholesterol in the 70 to 79 yr group were significantly lower than in other age groups. The nutrients which showed a decreasing or increasing trend were fewer than in males.

The percentage of energy from protein, fat, and carbohydrate to total energy is shown in Figure 1. The percentage of energy from fat in females was higher than in males. The percentage of energy from fat decreased with age; it was more than 25% in younger age groups.

The proportion of fatty acid is shown in Figure 2. The average proportion of saturated fatty acid to monounsaturated fatty acid to polyunsaturated fatty acid was 31:39:30. There was not a huge difference among age and gender groups.

DISCUSSION

In the NILS-LSA, the intake of some foods or some nutrients showed a significant age difference. The National Nutrition Survey (NNS) has been conducted to obtain data on citizens' health condition, food and nutrient intake, and to clarify relations between nutrition and health in Japan [19]. Regarding the NNS in 1997 [19, 20], the intake of cereals, potatoes and starches, beans, fruits, and green vegetables increased with age. While the intake of fats and oils, milk and dairy food, meats and prepared foods decreased, the intake of energy, protein, and fat in the 70 to 79 yr group also decreased more than in other age groups. The NILS-LSA showed a similar age trend with the intake of nutrients to the NNS, but the intake of nuts and seeds, eggs and milk and dairy food was higher than in the NNS among every age group. As for longevity studies of aging, the Koganei study is one of the most famous in Japan [21, 22]. The intake of green vegetables, fruits and milk and dairy food were higher in the cross-sectional data of the Koganei study in 1991 than in the NNS in 1996 [23]. From the first half of the National Health and Nutrition Examination Surveys Ⅱ (NHANESs Ⅲ), Phase 1 (1988-1991), which was conducted in the U.S., the intake of energy, protein, fat, and cholesterol decreased with age, especially, the intake of energy decreased

Table 2-1. Daily energy and nutrient intake in the NILS-LSA.

Nutrients	Males				
	40-49 yr (n=133)	50-59 yr (n=143)	60-69 yr (n=125)	70-79 yr (n=130)	P Value of Trend
Energy (kcal)	2,303 ± 398[d]	2,320 ± 436[d]	2,256 ± 398[d]	2,030 ± 368[abc]	<0.001
Protein (g)	88.0 ± 18.7[d]	91.5 ± 16.9[d]	89.2 ± 17.2[d]	81.5 ± 19.2[abc]	<0.01
Fat (g)	67.6 ± 17.3[bcd]	62.4 ± 15.8[ad]	59.1 ± 17.2[ad]	52.6 ± 15.4[abc]	<0.001
TFA (g)	55.8 ± 15.3[bcd]	51.2 ± 14.3[ad]	48.5 ± 15.3[a]	44.1 ± 13.9[ab]	<0.001
Cholesterol (mg)	413 ± 155[d]	404 ± 164[d]	412 ± 149[d]	351 ± 133[abc]	<0.01
Carbohydrate (g)	303.0 ± 63.4	310.7 ± 64.0	316.1 ± 60.7[d]	292.1 ± 58.5[c]	<0.01
TDF (g)	14.9 ± 4.1[bcd]	17.0 ± 4.6[ac]	18.6 ± 4.7[ab]	17.3 ± 6.1[a]	<0.001
Ash (g)	21.9 ± 5.5[bc]	24.4 ± 5.9[a]	25.5 ± 6.0[ad]	23.5 ± 6.5[c]	<0.05
Calcium (mg)	586 ± 192[cd]	656 ± 210	667 ± 208[a]	681 ± 303[a]	<0.01
Iron (mg)	11.6 ± 2.7	12.8 ± 3.4	13.1 ± 3.0	12.2 ± 3.8	
Salt (g)	12.7 ± 3.5[bc]	14.1 ± 3.8[a]	14.7 ± 3.9[ad]	13.1 ± 3.6[c]	
Vitamin A (IU)	2752 ± 1585[c]	3226 ± 2208	3660 ± 3460[a]	3404 ± 2738	<0.05
Vitamin D (IU)	273 ± 253	343 ± 251	297 ± 241	276 ± 228	
Vitamin E (mg)	8.9 ± 2.6	9.4 ± 5.7[d]	9.2 ± 3.0[d]	8.0 ± 2.6[bc]	<0.05
Vitamin K (μ g)	452 ± 239[b]	542 ± 291[a]	517 ± 273	481 ± 289	
Vitamin B_1 (mg)	1.20 ± 0.35[d]	1.25 ± 0.36[d]	1.19 ± 0.33	1.07 ± 0.36[ab]	<0.01
Vitamin B_2 (mg)	1.69 ± 0.96	1.70 ± 0.44	1.69 ± 0.40	1.54 ± 0.41	
Vitamin B_6 (mg)	1.06 ± 0.32[bc]	1.22 ± 0.38[a]	1.27 ± 0.37[ad]	1.13 ± 0.39[c]	
Vitamin B_{12} (mg)	6.1 ± 6.0	6.5 ± 4.9	8.1 ± 9.2[d]	5.3 ± 4.4[c]	
Niacin (mg)	20.1 ± 5.7[d]	21.3 ± 5.9[d]	19.4 ± 6.0[d]	17.4 ± 7.1[abc]	<0.001
Vitamin C (mg)	127 ± 91[c]	146 ± 76[a]	155 ± 59[a]	145 ± 75	<0.05

Mean ± S.D.
Figures in parentheses indicate the number of subjects.
TFA; Total fatty acid
TDF; Total dietary fiber
a; Significantly different from the 40-49 yr group, $p<0.05$. Tukey's test for multiple comparisons.
b; Significantly different from the 50-59 yr group, $p<0.05$. Tukey's test for multiple comparisons.
c; Significantly different from the 60-69 yr group, $p<0.05$. Tukey's test for multiple comparisons.
d; Significantly different from the 70-79 yr group, $p<0.05$. Tukey's test for multiple comparisons.

remarkably [20,24].

For health reasons, it is important to assess the adequacy of nutrient intake compared to the Recommended Dietary Allowance (RDA). Some vitamins and minerals might be consumed less than the RDA in the USA [8,20,25] or in other countries [26,27]. In Japan, the intake of vitamins is almost at the level of the RDA, fifth edition [28], but the intake of calcium was still below the RDA [28], and iron intake of younger and premenopausal females is still insufficient. There is a serious concern regarding an increase of osteoporosis in a society composed largely of elderly people. Calcium intake is thought to be associated with bone mineral density, and sufficient calcium intake might reduce osteoporosis [2,20]. In the NILS-LSA, the calcium intake in the 40 to 49 yr group was still below the RDA [28], but other groups were above the RDA [28]. As for iron intake in the NILS-LSA, it was almost above the RDA [28] except in the 40 to 49 and 50 to 59 yr groups for females. In the Koganei Study, the intake of calcium and iron was almost satisfactory.

As for salt intake, an excess intake of salt is one of the risk factors of hypertension, which is a cause of cerebrovascular disease [2,19]. The intake of salt in the NILS-LSA was higher than the RDA [28] for every age gender group. Salt intake in the NNS in 1997 [19] was also higher than the RDA [28], suggesting that salt intake for Japanese exceeded more than 10g/day.

There were marked dietary changes during the period of high economic growth in Japan. During this period, the increase in fat consumption was the most significant among the major nutrients. The NNS in 1997 [19] warned that the excessive intake of fat was associated with lifestyle-related disorders, such as obesity, hyperlipidemia, coronary heart disease and cancer [2,3,20,28]. The proportion of energy from fat to total energy was higher than 25% in many age groups in the NILS-LSA. It exceeded more than 28%, especially in young age groups. Regarding the NNS in 1997 [19], the proportion of energy from carbohydrate to total energy trended to increase with age, but fat to total energy decreased. The tolerable upper level of fat intake by the RDA [28] is 25%. Fat intake in the 20 to 29,

Table 2-2. Daily energy and nutrient intake in the NILS-LSA.

Nutrients	Females				
	40-49 yr (n=127)	50-59 yr (n=129)	60-69 yr (n=124)	70-79 yr (n=127)	P Value of Trend
Energy (kcal)	1,839 ± 269[d]	1,838 ± 335[d]	1,783 ± 316[d]	1,665 ± 328[abc]	<0.001
Protein (g)	73.1 ± 12.8[d]	77.6 ± 16.3[d]	73.0 ± 16.1[d]	68.0 ± 14.9[abc]	<0.01
Fat (g)	58.0 ± 13.8[cd]	55.8 ± 17.0[cd]	50.7 ± 15.7[abd]	44.9 ± 13.1[abc]	<0.001
TFA (g)	48.0 ± 12.4[cd]	46.6 ± 15.4[d]	42.6 ± 13.7[ad]	37.1 ± 11.5[abc]	<0.001
Cholesterol (mg)	339 ± 115[d]	360 ± 142[d]	341 ± 142[d]	292 ± 123[abc]	<0.01
Carbohydrate (g)	250.6 ± 40.2	254.7 ± 52.3	257.5 ± 48.3	248.5 ± 54.1	
TDF (g)	14.1 ± 3.8[bc]	15.8 ± 4.6[a]	16.1 ± 4.3[a]	15.2 ± 4.3	<0.05
Ash (g)	19.3 ± 4.1[bc]	21.7 ± 5.0[ad]	21.6 ± 5.2[ad]	19.8 ± 4.5[bc]	
Calcium (mg)	581 ± 177	647 ± 231	644 ± 244	606 ± 229	
Iron (mg)	10.3 ± 2.5[c]	10.9 ± 2.8	11.4 ± 4.0[ad]	10.3 ± 2.5[c]	
Salt (g)	10.9 ± 2.7[bc]	11.9 ± 2.8[a]	11.8 ± 3.1[a]	11.1 ± 2.9	
Vitamin A (IU)	2777 ± 2216	2830 ± 3284	3632 ± 4661	2897 ± 1875	
Vitamin D (IU)	213 ± 169[b]	288 ± 243[a]	237 ± 178	231 ± 193	
Vitamin E (mg)	7.7 ± 3.7	8.4 ± 2.8[d]	7.9 ± 2.7	7.2 ± 2.3[b]	
Vitamin K (μ g)	414 ± 246[b]	521 ± 304[ad]	463 ± 245	397 ± 232[b]	
Vitamin B_1 (mg)	0.96 ± 0.24	1.03 ± 0.31	1.03 ± 0.34	0.94 ± 0.38	
Vitamin B_2 (mg)	1.42 ± 0.34	1.51 ± 0.43[d]	1.53 ± 0.47[d]	1.32 ± 0.33[bc]	
Vitamin B_6 (mg)	0.94 ± 0.26[b]	1.07 ± 0.38[a]	1.03 ± 0.33	0.98 ± 0.34	
Vitamin B_{12} (mg)	4.9 ± 4.3[c]	6.0 ± 5.1	6.8 ± 7.0[ad]	4.9 ± 5.0[c]	
Niacin (mg)	15.8 ± 4.6	17.1 ± 4.9[d]	15.3 ± 4.7	14.7 ± 8.2[b]	<0.05
Vitamin C (mg)	115 ± 54[bc]	139 ± 68[a]	159 ± 80[ad]	132 ± 49[c]	<0.01

Mean ± S.D.
Figures in parentheses indicate the number of subjects.
TFA; Total fatty acid
TDF; Total dietary fiber
a; Significantly different from the 40-49 yr group, $p<0.05$. Tukey's test for multiple comparisons.
b; Significantly different from the 50-59 yr group, $p<0.05$. Tukey's test for multiple comparisons.
c; Significantly different from the 60-69 yr group, $p<0.05$. Tukey's test for multiple comparisons.
d; Significantly different from the 70-79 yr group, $p<0.05$. Tukey's test for multiple comparisons.

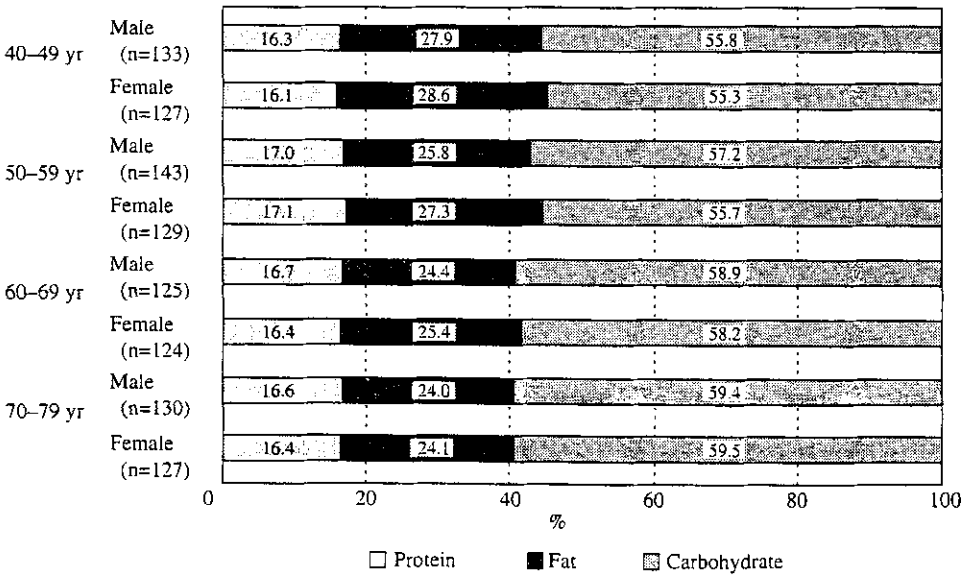

Figure 1. Proportion of energy from protein, fat and carbohydrate of total energy in the NILS-LSA.

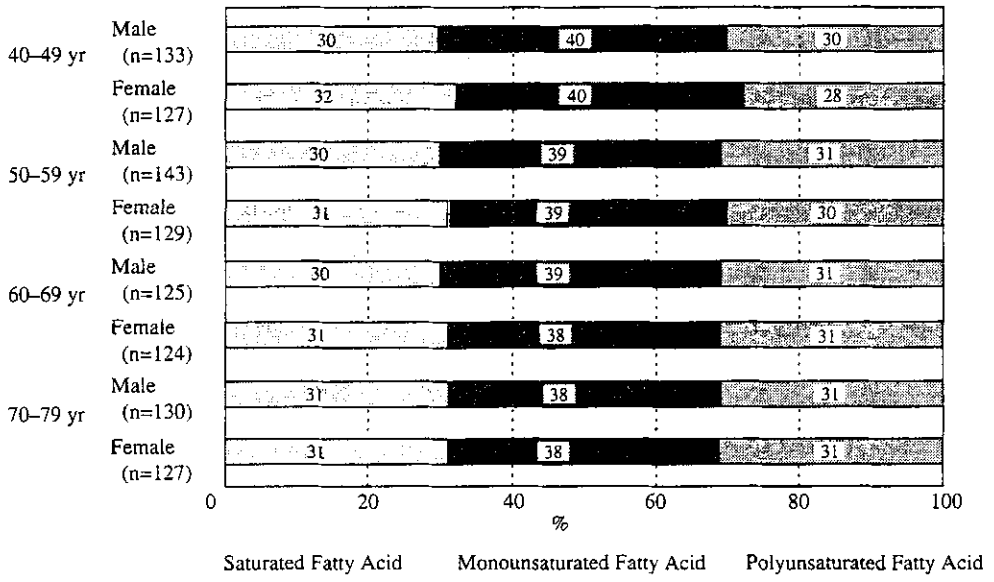

Figure 2. Proportion of fatty acid in the NILS-LSA.

30 to 39, and 40 to 49 yr groups exceeded the 25% level. In addition, a high intake of saturated fatty acid and cholesterol and a low intake of polyunsaturated fatty acid increased the level of serum cholesterol [19], which can lead to coronary heart disease and stoke [3]. People who intake high levels of polyunsaturated fatty acid are at less risk of a cerebral infarction than those who take high levels of saturated fatty acid. The polyunsaturated fatty acid / saturated fatty acid (P/S) ratio is an index of accurate fat intake [2, 3, 20, 28]. The proportion of saturated, monounsaturated, and polyunsaturated fatty acids of every group in the NILS-LSA was not much different from the amount of fatty acids of the RDA [28] (30: 40: 30).

It appears that the nutritional intake levels and patterns in the NILS-LSA were not extremely different from average Japanese people.

We assessed food and nutrient intake in the NILS-LSA through 3DR. The dietary intake of individuals varied from day to day when superimposed on an underlying consistent pattern [29-31]. We also used a FFQ in the NILS-LSA because current and past intake or food habits could be measured by FFQ. We intend to report the result of the FFQ in the near future.

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Effects of Social Support and Self-Esteem on Depressive Symptoms in Japanese Middle-Aged and Elderly People

Yasuyuki Fukukawa [1], Satomi Tsuboi [1], Naoakira Niino [1], Fujiko Ando [1], Shotaro Kosugi [2], and Hiroshi Shimokata [1]

We examined the relationship among social support, self-esteem, and depression. The subjects were 1,116 Japanese community-dwelling adults aged between 40-79, who were the first wave participants of the National Institute for Longevity Sciences-Longitudinal Study of Aging (NILS-LSA). Exploratory and confirmatory factor analyses were performed on the Rosenberg's self-esteem scale that supported the superiority of the bi-dimensional structure of the scale marked by self-confidence and self-deprecation subscales. The subsequent causal analyses, using structural equation modeling, demonstrated that social support reduced depressed affect through an increase in self-confidence and a decrease in self-deprecation. By contrast, social support did not show a direct effect on depressed affect. The findings suggest the importance of esteem-improving elements of social support in reducing depressive symptoms. *J Epidemiol*, 2000 ; 10 : S63-S69.

social support, self-esteem, depression, structural equation modeling

INTRODUCTION

Research over the past several decades has shown that social relationships affects psychological well-being. In related studies, social support, psychological and material resources provided from relationships [1], has been demonstrated to have a favorable impact on various subjects such as infertile couples [2], arthritis patients [3], and unemployed persons [4]. The question of how social relations influence the psychological distress of elderly people has also attracted considerable attention, much of it in relation to research on caregiving [5]. In fact, gerontological researchers are interested in social support because of its potential usefulness for care, continued health, and sustained independent living [6], which are the issues pertinent to elderly people.

Unfortunately, previous findings on the effects of social support for elders are inconsistent. Studies have found both positive [7] and negative [8] effects of social support on elderly psychological well-being. One study addressing the inconsistency demonstrated that moderate emotional support increased internal control of elderly people to cope with stressful situations, whereas excessive support decreased their internal control and could result in a negative outcome [9]. This suggests the importance of the internal process to mediate the relationship between social support and psychological well-being. In addition, the association between psychological well-being and social support is rather weak [10,11], which also requires a mediational model to be tested to understand how interpersonal relationships affect well-being.

Several studies suggested that self-esteem may be an important mediator [3,7]. Self-esteem, a positive or negative attitude toward the self [12], has been conceptualized both as a causal variable that determines other psychological phenomena and/or as an outcome variable influenced by life events and interpersonal feedback [13]. One study insisted that low self-esteem increases a person's vulnerability to depression [14], while others suggested that interpersonal relationships predict subsequent changes in self-esteem [10,15].

The esteem-enhancing facet of social support refers to a generalized appraisal which makes individuals believe that they are cared for and valued and that others are available to them in times of need [16]. This effect of social support is termed the

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main effect, distinguished from the *buffering effect* which works only for persons under stress [1,16]. The literature suggests that the main effect of support is important for health maintenance as well as the more practical or stress-related component of support [16,17]. However, prior social support studies in the gerontological field have tended to focus on older adults facing major stressors and have used small samples [7,18].

The present research attempted to address the limitations identified above by using larger samples collected from a community-dwelling population. The final objective of the study was to test a causal model of social support and depression, on the assumption that self-esteem mediates the relationship between them. This exploratory model also included the direct association of social support with depression via no mediator, which would also permit the comparison between the contribution of direct effect and that of indirect effect of social support in reducing depressive symptoms.

MATERIALS AND METHODS

The data for this study were taken from the first wave of the National Institute for Longevity Sciences-Longitudinal Study of Aging (NILS-LSA), an ongoing multidisciplinary project launched in 1997. The NILS-LSA participants comprise a random sample (stratified by age and gender) of Japanese adults dwelling around the institute, aged between 40 and 79. Of the 1,130 participants up until now, 1,116 (573 men and 543 women) with no missing data on any of the study variables were analyzed in the present study. The mean age of the sample was 58.7±10.9 (58.6±11.0 in men and 58.9±10.8 in women). The component ratio of gender showed no significant difference between the middle-aged (40-59 years) and the elderly (60-79 years).

Measures

The following three self-rating measures were used in this study. They were included in a questionnaire for psychological assessments which participants were asked to complete at home. To minimize missing data, however, trained staff checked the returned questionnaire and re-asked the questions which had improper responses (e.g., blank or double-checked) using spare time during other interview-based inspections.

Depressive Symptoms:

Depressive symptoms were measured by the Japanese version of the Center for Epidemiologic Studies Depression (CES-D) Scale [19,20]. This 20-item scale has been used widely in epidemiological studies. Subjects were asked to indicate how often they had experienced each of 20 symptoms during the past week. The response range was from 0 (rarely or none of the time) to 3 (most or all of the time), so that higher scores on the scale represented higher levels of depressive symptoms (positively worded items were reverse-scored).

Self-esteem:

The Rosenberg's self-esteem scale (RSE) [12], one of the most frequently used measures of self-esteem, was employed. The Japanese-translated version of the RSE scale [21] comprised 10 items, the same as the original. This scale, though designed for adolescents, is considered to be an appropriate measure for all age groups including the elderly [22]. The subjects responded to the items using 4-point options (response range: 1=strongly disagree, 4=strongly agree). Higher scores in positively worded items (items 1, 3, 4, 7 and 10) indicated higher self-esteem, whereas higher scores in negatively worded items (items 2, 5, 6, 8 and 9) indicated lower self-esteem.

Social Support:

Social support was measured using a 10-item scale developed in Japan [23]. This scale asked subjects whether there was someone whom they regarded as a support resource. An instruction given to the subjects restricted the support resources to friends and other acquaintances (Family support was measured using a different scale in the NILS-LSA, though not examined here). All ratings were made on 5-point options so that higher scores indicated high support perception (response range: 1=none, 5=many). Each item probed one of the following basic functional properties of social support: tangible support, informational support, emotional support, and companionship [24,25].

Procedure and Statistical Analyses

All statistical analyses were conducted using the Statistical Analysis System (SAS) release 6.12 [26]. The FACTOR procedure of the software was used to test the factor structure of the study scales, except the CES-D scale, on which a confirmatory factor analysis was performed via the CALIS procedure. Preliminary data analyses examined correlations between social support, self-esteem, and depression constructs and their age or gender specific difference with the CORR and the TTEST procedures, respectively. Causal analyses of the constructs were performed using structural equation modeling which was also available in the CALIS procedure.

RESULTS

Factor Analyses of the Study Scales

For the CES-D scale, a confirmatory factor analysis was conducted as a four-factor structure of the scale (consisting of depressive affect, positive affect, somatic and retarded activity, and interpersonal) has been reported previously [19,27]. As a result, indices indicated a good fit to the data, which suggested the factorial validity of the scale (Goodness of Fit Index: GFI=.94, Adjusted Goodness of Fit Index: AGFI=.92). However, only depressed affect was adopted in the subsequent causal analyses. The other factors were excluded from the analyses because of the following: 1) the measures of positive