ever, such a database has not been established or distributed in Japan. In contrast, several studies have attempted to estimate quantitatively the amount of nutrient intake from these products in the United States and European countries.[2-11]

Therefore, we conducted a self-administered dietary supplement frequency questionnaire to collect information on dietary supplement use in the National Institute for Longevity Sciences-Longitudinal Study of Aging (NILS-LSA), and developed a database of dietary supplements to estimate the amount of nutrient intake from these products. The purpose of this study was to clarify the following four points: (1) the prevalence of dietary supplement use, (2) the characteristics of dietary supplement users, (3) nutrient intake from dietary supplements, and (4) the existence of dietary supplement users who took excessive nutrients from these products.

METHODS

Subjects

The subjects were 2,259 males and females aged 40 to 82 years who participated in the second wave examination of the NILS-LSA (from April 2000 through May, 2002). The NILS-LSA is a comprehensive population-based longitudinal study of aging, which started in 1997. The participants were stratified by both age and sex, and were randomly selected from resident registrations in the city of Obu and town of Higashiura in central Japan. The numbers of males and females recruited were similar and the baseline age was 40 to 79 years, with the similar numbers of participants in each decade of age (40s, 50s, 60s, 70s). At the first wave examination, we sent an invitation letter to 7,790 people and 3,434 people replied. A total of 2,267 people participated in the first wave examination. All participants gave their informed consent before they participated in the study. Details of the study purpose, design, and examination procedures have been described elsewhere.[12]

Definition and Categories of Dietary Supplements in the NILS-LSA

Dietary supplements were defined as supplements to meals containing any dietary ingredients from unnatural food forms such as capsules, tablets, powders, or liquid. Dietary supplements included vitamins, minerals, herbs, botanical products, and other sub-

Table 1. Categorization of dietary supplements by the National Institute for Longevity Sciences Longitudinal Study for Aging.

Category	Description or sub-category
1. Vitamin *	14 sub-categories Multivitamin, Vitamin A, Vitamin D, Vitamin E, Vitamin K, Vitamin B_1, Vitamin B_2, Vitamin B_6, Vitamin B_{12}, Niacin, Vitamin C, Folic acid, Biotin, and Pantothenic acid
2. Mineral *	4 sub-categories Calcium, Iron, Magnesium, and Other minerals
3. Fatty acid *	6 sub-categories Linoleic acid, Linolenic acid, Stearic acid, Docosahexaenoic acid, Eicosapentaenoic acid, and Other fatty acids
4. Amino acid	Formulations containing mainly of single amino acids and some proteins
5. Dietary fiber	Water soluble and water insoluble dietary fibers
6. Drink type	Liquid type dietary supplement for recovery from tiredness, or health promotion, etc. The amount consumed at one time is about 30 mL to 200 mL. Includes quasi-drugs and medicinal drugs but does not include beverages.
7. Medicine	Prescription and non-prescription medicines which contain some nutrients, except medicines which are classified into categories 1 to 6. Example : remedies for cold which contain vitamin C.
8. Others	These formulations included compounds that do not fit into any other category. Example: flavonoids, carotenoids other than beta-carotene, catechin, and herbal products (propolis, royal jelly, chlorella, garlic, etc.)

Dietary supplements were defined as supplements to meals including any dietary ingredients from unnatural food forms such as capsules, tablets, powders, or liquids. Dietary supplements included prescription medicine, and non-prescription medicine, but functional foods and modified foods were not included in the category of dietary supplement.

*: Further classified into sub-categories shown in the Table.

stances (e.g., enzymes, organ tissues, metabolites, concentrates, and constituent extracts of these substances). Dietary supplements also included prescription medicine and non-prescription medicine, but functional foods and modified foods were not included in the category of dietary supplements.

Dietary supplements were grouped into eight major categories on the basis of primary nutrient content or similarity in overall ingredients and rationale for use.[13] In addition, we defined "drink type" separately, because Hakura et al[14] reported that "drink type" dietary supplements were widely consumed in Japan. The major categories of dietary supplements used in the NILS-LSA were (1) vitamin, (2) mineral, (3) fatty acid, (4) amino acid, (5) dietary fiber, (6) drink type (liquid type dietary supplement for recovery from tiredness, health promotion, etc., with a serving size of about 30 mL to 200 mL. The drink type category included quasi-drugs, but did not include beverages), (7) medicine (prescription and non-prescription medicines which contained some nutrients, except medicines which were classified into categories 1 to 6, e.g. cold remedies with vitamin C), and (8) others (These formulations included compounds that did not fit into any other category and were not described in the Standard Tables of Food Composition in Japan, Fifth Revised Edition,[15] for example, flavonoids, carotenoids expect beta-carotene, propolis, and so on) (Table 1). In addition, vitamins, minerals, and fatty acids were further classified into sub-categories. We use the term "all" dietary supplements which consisted of eight categories, when we did not consider the categories of the dietary supplements.

Assessment of Dietary Supplement Intake

A self-administered questionnaire was used to assess dietary supplement intake. First, it was mailed to the participants and the participants were asked to record it by themselves at home before the study examination. Then, the participants came to our center to get the study examination. At the examination, the questionnaire was reviewed by trained dietitians through an interview that took approximately 10 minutes. In the questionnaire, participants were asked whether they had taken any dietary supplement in the previous year. In case they had taken any dietary supplement, the name of the product, manufacturer or distributor, serving size and frequency of intake in the previous year (6 categories, i.e., less than once per week, 1-2 times per week, 3-6 times per week, one per day, 2 times per day, and 3 or more times per day) were also recorded.

Definition of Dietary Supplement Users

Dietary supplement users in the present study were defined as persons who took any dietary supplement at least once in the previous year. Users of dietary supplements were categorized into three groups: "daily users": those who reported any dietary supplement use once a day or more for the past 12 months, "weekly users": those who reported any dietary supplement use once a week or more but less than once a day for the past 12 months, and "seldom users": those who reported any dietary supplement use once a year or more but less than once a week for the past 12 months. When a participant had taken multiple dietary supplements in a major category or in a sub-category, the user category was defined based on the dietary supplement with the highest frequency of use. We used the term "any users" when we did not consider the frequency of use. "Weekly users" and "daily users" were considered to be "regular users". "Seldom users" were excluded when we calculated the amount of nutrient intake from dietary supplements.

Development of Dietary Supplement Database

A new dietary supplement database was developed for the NILS-LSA based on information obtained from the study participants and additional intensive investigation. We asked dietary supplement users to bring the products to the study visit. Then, the labels of the products were transcribed or photocopied to get information on the nutrient contents. In case dietary supplement users did not bring the products or could not provide enough information about the products at the visit, we asked them to send the labels of the products by mail. In addition, when information on nutrient content was not available from users, we tried to get it directly from the manufacturer or distributor of the products. We created a database of dietary supplements that included the names of products, manufacturer and/or distributor and nutrient contents in standardized units such as a tablet or a capsule.

Some products in which nutrient content was not described were excluded when we developed the database, and we did not calculate the nutrient intake from these products (62 products). Finally, we succeeded in constructing a database of 902 dietary supplement products in May 2002.

Assessment of Nutrient Intake from Dietary Supplements

Energy and nutrient intake from "all" dietary supplements among "regular users" was estimated using the frequency, amount of intake and nutrient contents in the dietary supplement database. The frequency of dietary supplement intake per day was quantified during the calculation (0.2 for 1-2 per week, 0.6 for 3-6 per week). If a participant reported uncertainty about the information on dietary supplement intake, that dietary supplement was excluded from the calculation of nutrient intake (7 males and 22 females were excluded from the analysis because they reported uncertainty about the information on dietary supplement intake). When a participant had taken various kinds of dietary supplements, energy and nutrient intake were summed across all dietary supplements. Nutrient intakes from "all" dietary supplements were compared with those from food according to the results of the National Nutrition Survey in Japan 2002.[16]

Participants who daily consumed some nutrients at more than the tolerable upper intake level (UL) in the 6th Edition[17] or 2005 Edition[18] of Nutrient-Based Dietary Reference Intakes (DRIs) in Japan were defined as "excess users". The ULs for adults in the 6th Edition of DRIs were as follows: 5,000 IU for vitamin A, 2,000 IU for vitamin D, 600 mg α -TE for vitamin E, 30,000 μg

for vitamin K, 30 mgNE for niacin, 100 mg for vitamin B_6, 2,500 mg for calcium (under 70 years old), 40 mg for iron, and 650 mg (50 years old and over) or 700 mg (40 to 49 years old) for magnesium. The UL for adults in the 2005 Edition of DRIs were as follows: 3,000 μgRE (10,000 IU) for vitamin A, 50 μg (2,000 IU) for vitamin D, 600 mg (70 years old and over for females) to 800 mg (40 to 69 years old for males) for vitamin E, 300 mgNE for niacin (the amount of mg of nicotinic acid amide was used), 60 mg for vitamin B_6, 2,300 mg for calcium, and 40 mg (40-49 and 70 years old and over for females) to 55 mg (40 to 49 years old for males) for iron.

Other Variables

Sociodemographic and lifestyle characteristic data, such as smoking habits, subjective health status, total family annual income, education, marriage status, and care of maintaining appropriate weight, were collected using a questionnaire. The body mass index (BMI) was calculated using the formula (weight (kg)/height $(m)^2$). Energy intake from food, energy intake from fat, and total alcohol intake were assessed through 3-day weighed dietary records (3DR). 3DR was carried out on three continuous days (two weekdays and one weekend day). The average intakes of nutrient per day were calculated according to the 5th Edition Standard Tables of Foods Consumption and other resources.[19]

Statistical Analysis

The prevalences of "all" dietary supplement users among males and females were compared by the chi-squared test by user category (any, seldom, weekly, and daily). Sociodemographic and lifestyle characteristics of "all" dietary supplement users and nonusers were compared by the Cocran-Mantel-Haenszel test adjusted for sex and age by user category. The prevalences of dietary supplement use of each major category of users and of the main sub-categories of users among males and females were compared by the chi-squared test by user category. Energy and nutrient intake from "all" dietary supplements among "regular users" (by sex), and major categories of dietary supplements, including (1) vitamin, (2) mineral, (6) drink type, and (8) others among "regular users" were expressed as percentiles, maximum values, and number of "excess users". All the statistical analyses were performed using the Statistical Analysis System, release 8.2.[20] Differences with p value less than 0.05 were considered significant.

RESULTS

The prevalence of "all" dietary supplement users in each user category and sociodemographic and lifestyle characteristics by user categories are shown in Table 2. In this study, 55 % of males and 61 % of females consumed some kind of dietary supplement ("all" dietary supplements) in the previous year. Among these subjects, females were more likely to take dietary supplements than males ($p<0.01$). "Seldom users" constituted about 20 % of the subjects (males: 23%, females: 19%). "Regular users" constituted about 30 % of males ("weekly users": 14 %, "daily users": 18 %) and 40% of females ("weekly users": 16 %, "daily users": 26 %). "Seldom users" were predominant among males ($p<0.05$) while "daily users" were predominant among females ($p<0.001$). The prevalence of "all" dietary supplement users in each user category varied depending on the age group ($p<0.05$, adjusted for sex). "Seldom users" ($p<0.001$) and "weekly users" ($p<0.05$) were prevalent among middle-aged people, while "daily users" were prevalent among older people ($p<0.001$). "All" dietary supplement users were subjectively less healthy than nonusers after adjustment for sex and age ("any users": $p<0.01$). However, the association was influenced by the frequency of use ("seldom users": not significant, "weekly users": $p<0.01$, and "daily users": $p<0.05$). When dietary supplement use was limited to use without all prescription and non-prescription medicine, subjective health status was significantly associated with the use of dietary supplements in "any users" and "weekly users" ("any users": $p<0.01$, "seldom users": $p=0.57$, "weekly users": $p<0.01$, "daily users": $p=0.07$). "All" dietary supplement users were more careful of maintaining appropriate weight than nonusers in the "any users"category ($p<0.05$); however, the associations of "all" dietary supplements with other characteristics were not significant (i.e., smoking, education, marriage status, BMI, energy intake from food, alcohol intake, etc.) in all user categories.

The prevalence of dietary supplement users by major category and sub-category by user categories are shown in Table 3. Among major categories of dietary supplements, the most widely consumed dietary supplement was drink type (27.0%), the second was vitamin (23.1%), the third was "others" (18.3%) and the fourth was medicine (12.0%) in males. On the other hand, the most widely consumed dietary supplement was vitamin (30.2%), the second was "others" (26.9%), the third was drink type (24.8%), and the fourth was medicine (9.7%) in females. The prevalence of vitamin, "others", and mineral dietary supplement use in females was significantly higher than that in males; however, drink type dietary supplement use in males was significantly higher than that in females in "any users". The prevalence of amino acid, fatty acid, and dietary fiber use was only about 1 % or less in "any users".

About a half of vitamin, "others", and mineral users consumed their respective supplements daily, whereas 60 % of drink type dietary supplement users and most medicine users consumed these supplements less frequently than once a week.

With regard to the prevalence in the sub-category of vitamin users, the prevalence of multivitamin was the highest, the second highest was vitamin C, and the third highest was vitamin E for both sexes. Calcium was the most popular nutrient in the mineral sub-category for both sexes.

Energy and nutrient intake from "all" dietary supplements among "regular users" are shown in Table 4. Median values of energy, macronutrients, minerals, and some fat-soluble vitamins (vitamin A, vitamin D, vitamin E, and vitamin K) intake from

Table 2. Prevalence of "all" dietary supplement users in each user category and sociodemographic and lifestyle characteristics by user categories.

			User category (%)†			
		n	Any‡	Seldom§	Weekly‖	Daily¶
Sex	Males	1,152	55	23	14	18
	Females	1,107	61**	19*	16	26***
Age (year)	40-49	534	65	33	17	14
	50-59	580	55	23	15	17
	60-69	562	55	17	15	24
	70-	583	57*	11***	13*	33***
Smoking	Never	1,268	61	20	15	25
	Past	524	55	21	13	21
	Current	462	54	22	16	17
Subjective health status	Excellent/Good	573	55	26	12	18
	Usual	1,433	58	19	16	23
	Bad/Very bad	244	66**	20	18**	28*
Total sum of family annual income, million yen	-4.49	668	57	15	14	28
	4.50-9.99	1,012	57	24	14	20
	10.00-	513	61	24	18	19
Education	Less than high school	671	58	15	14	28
	High school or equivalent	923	57	20	16	22
	More than high school	655	60	28	15	17
Marriage status	Unmarried	58	50	24	14	12
	Married	1,944	57	21	15	22
	Separated/Divorced	51	67	31	20	16
	Widowed	202	63	13	17	33
Body mass index (kg/m^2)	<18.5	123	56	16	11	29
	18.5-24.9	1,588	59	21	16	22
	25.0-	547	56	21	14	21
Care of maintaining appropriate weight	Yes	1,375	60	20	16	24
	No	876	55*	22	14	20
Energy intake (kcal/day) ††	-1500	201	58	19	13	26
	1500-1999	926	60	19	15	26
	2000-2499	759	56	22	15	20
	2500-	225	58	27	16	15
Energy intake from fat (%) ††	<20	203	59	15	16	28
	20-24	639	56	19	14	24
	25-29	792	58	22	15	21
	30-	477	61	25	15	21
Total alcohol intake (g etanol/day) ††	<10	1,500	60	20	16	24
	10-19	265	56	21	12	23
	20-29	139	52	24	13	15
	30-	207	51	23	12	16

Participants using any dietary supplements were defined as any dietary supplement users during the previous year.

†: Dietary supplement users were categorized into three user groups:
Seldom; seldom users those who reported any dietary supplement use once a year or more but less than once a week for the past 12 months.
Weekly; weekly uses those who reported any dietary supplement use once a week or more but less than once a day for the past 12 months.
Daily; daily users those who reported any dietary supplement use once a day or more for the past 12 months.

‡: n=1,306 (628 males and 678 females)

§: n=470 (260 males and 210 females)

‖: n=335 (158 males and 177 females)

¶: n=501 (210 males and 291 females)

*p<0.05, **p<0.01, ***p<0.001: Sex distribution was tested by chi-squared test. Age distribution was tested by Cocran-Mantel-Haenszel chi-squared test adjusted for sex. Other variables were tested by Cocran-Mantel-Haenszel chi-squared test adjusted for sex and age

††: Intake was settled using 3-day diet record.

"all" dietary supplements were very few in both sexes. On the other hand, 90th percentile value of vitamin E, vitamin B group, vitamin C, and niacin intake exceeded respective nutrient intake from diet shown in the National Nutrition Survey; i.e. about 10 % or more of dietary supplement users took large amount of such nutrient from dietary supplement. "Excess users" existed for iron, magnesium (only the 6th Ed.), vitamin A, vitamin K (only the 6th Ed.), vitamin B_6, and niacin (only the 6th Ed.).

Energy and nutrient intake from dietary supplement by major category among "regular users" is shown in Table 5. Individuals with intake of some nutrients at the 90th percentile value were larger amount than that from diet by the National Nutrition Survey (vitamin category: vitamin E, vitamin B group, niacin, and vitamin C; Mineral category: calcium; Drink type category: vitamin B_1, vitamin B_2, vitamin B_6, and niacin; "other" category: vitamin E and vitamin B group). "Excess users" existed in vitamin

Table 3. Prevalence of dietary supplement users by major category and sub-category by user category (%) (1,152 males and 1,107 females)

		User category†							
		Any		Seldom		Weekly		Daily	
Category	Sub-category	Males	Females	Males	Females	Males	Females	Males	Females
1. Vitamin		23.1	30.2*	6.2	6.8	6.9	7.2	10.0	16.2*
	Multivitamin	14.6	15.5	4.4	4.4	5.4	4.4	4.8	6.6
	Vitamin C	4.7	8.0*	1.1	1.4	1.5	2.1	2.1	4.6*
	Vitamin E	4.0	6.8*	0.7	1.3	0.5	1.0	2.8	4.5*
	Vitamin B_2	2.0	2.8	0.8	1.1	0.4	0.5	0.9	1.2
	Vitamin B_{12}	2.3	2.4	0.6	0.6	0	0.4*	1.7	1.4
	Vitamin D	0.3	2.8*	0	0.1	0	0.5*	0.3	2.2*
	Vitamin A	0.4	1.1*	0.1	0.2	0.1	0	0.2	0.9*
	Vitamin B_1	0.5	0.8	0.2	0.1	0.2	0.2	0.2	0.5
	Pantothenic acid	0.2	0.8*	0	0.1	0.1	0.1	0.1	0.6*
	Vitamin B_6	0.4	0.3	0.1	0	0	0	0.3	0.3
	Vitamin K	0.1	0.5	0	0	0	0	0.1	0.5
	Folate	0.1	0	0	0	0	0	0.1	0
2. Mineral		2.7	7.6*	0.8	1.4	0.4	2.1*	1.5	4.2*
	Calcium	1.7	5.2*	0.4	0.6	0.3	1.3*	1.0	3.3*
	Iron	0.2	2.4*	0.2	0.6	0	1.0*	0	0.7*
	Magnesium	0.4	0.5	0.1	0.2	0.1	0	0.2	0.3
	Other minerals	0.5	0.5	0.2	0.1	0.1	0	0.3	0.4
3. Fatty acid		1.0	1.2	0.1	0.3	0.1	0.2	0.7	0.8
4. Amino acid		1.1	1.5	0.1	0.4	0.4	0*	0.6	1.2
5. Dietary fiber		0.1	0.5	0	0.1	0	0	0.1	0.5
6. Drink type		27.0	24.8*	17.5	14.0*	7.4	8.0	2.2	2.9
7. Medicine		12.0	9.7	10.0	8.2	1.6	0.9	0.4	0.5
8. Others		18.3	26.9*	3.0	4.6*	4.1	6.0*	11.3	16.4*

† : Dietary supplement users were categorized into three user groups:
Seldom; seldom users those who reported any dietary supplement use once a year or more but less than once a week for the past 12 months.
Weekly; weekly uses those who reported any dietary supplement use once a week or more but less than once a day for the past 12 months.
Daily; daily users those who reported any dietary supplement use once a day or more for the past 12 months.
Any; combined three groups.

* : $p<0.05$ by Chi square test

No subject used niacin or biotin sub-category dietary supplement.

Table 4. Energy and nutrient intake per day from "all" dietary supplements among "regular users".

		Males (n=361)								Females (n=446)							
	National Nutrition		90th per-	95th per-		Tolerable upper intake level †		Excess Users ‡ 6th	2005		90th per-	95th per-		Tolerable upper intake level †		Excess Users ‡ 6th	2005
Nutrient	Survey *	Median	centile	centile	Max.	6th edition	2005 edition	edition	edition	Median	centile	centile	Max.	6th edition	2005 edition	edition	edition
Energy (kcal)	1930	0	16	30	363	-	-	-	-	0	30	60	237	-	-	-	-
Protein (g)	72.2	0	1	2	80	-	-	-	-	0	1	2	35	-	-	-	-
Fat (g)	54.4	0	trace §	1	20	-	-	-	-	0	1	1	17	-	-	-	-
Carbohydrate (g)	271.2	0	trace §	1	21	-	-	-	-	0	trace §	1	15	-	-	-	-
Calcium (mg)	546	0	126	256	1320	2500 (40-69 y.o.) - (70+ y.o.)	2300	0	0	0	226	400	2123	2500 (40-69 y.o.) - (70+ y.o.)	2300	0	0
Iron (mg)	8.1	0	trace §	2	129	40	55 (40-49 y.o.) 50 (50-69 y.o.) 45 (70+ y.o.)	1	1	0	1	5	93	40	40 (40-49 y.o.) 45 (50-69 y.o.) 40 (70+ y.o.)	1	1
Magnesium (mg)	259	0	9	30	808	700 (40-49 y.o.) 650 (50+ y.o.)	-	1	-	0	7	48	906	700 (40-49 y.o.) 650 (50+ y.o.)	-	1	-
Vitamin A (IU)	3130	0	1200	2900	10200	5000	10000	8	4	0	800	1500	11000	5000	10000	12	4
Vitamin D (IU)	328	0	26	120	726	2000	2000	0	0	0	40	140	678	2000	2000	0	0
Vitamin E (mg)	8.2	0	91	198	483	600	800 (40-69 y.o.) 700 (70+ y.o.)	0	0	0	112	210	483	600	700 (40-69 y.o.) 600 (70+ y.o.)	0	0
Vitamin K (μ g)	260	0	0	0	30000	30000	-	1	-	0	0	4	45000	30000	-	6	-
Vitamin B_1 (mg)	0.87	2	38	55	280	-	-	-	-	1	43	72	144	-	-	-	-
Vitamin B_2 (mg)	1.21	1	6	10	68	-	-	-	-	1	8	16	64	-	-	-	-
Vitamin B_6 (mg)	1.17	1	16	41	185	100	60	3	9	1	30	66	106	100	60	3	26
Vitamin B_{12} (μ g)	7.4	0	250	1000	2340	-	-	-	-	0	500	1044	1566	-	-	-	-
Niacin (mg)	14.8	2	34	43	128	30	300‖	41	0	0	26	44	140	30	300‖	43	0
Vitamin C (mg)	101	0	210	668	6482	-	-	-	-	0	500	1100	4400	-	-	-	-

'Weekly users" plus "daily users" were defined as "regular users".

Seven males and 22 females were excluded from the analysis because they reported uncertainty about the information on dietary supplement intake.

Some products in which nutrient content was not described were excluded when we developed the database and we did not calculate nutrient intake from these products.

*: Results from the National Nutrition Survey in Japan, 2002 (mean of the total).

†: Tolerable upper intake level of adults in 6th edition or 2005 edition of Nutrient-Based Dietary Reference Intakes in Japan.

- : Tolerable upper intake level of adults in 6th edition or 2005 edition of Nutrient-Based Dietary Reference Intakes in Japan was not shown.

‡: Number of participants who daily consumed some nutrients at more than the tolerable upper intake level in the 6th Edition or 2005 Edition of Nutrient-Based Dietary Reference Intakes (DRIs) in Japan.

§: Below display limit

‖: The amount of mg of nicotinic acid amide was used.

Table 5. Energy and nutrient intake per day from dietary supplements by major category among "regular users".

	1. Vitamin†						2. Mineral‡						6. Drink type§						8. Others‖					
		90th	95th		Excess Users *			90th	95th		Excess Users *			90th	95th		Excess Users *			90th	95th		Excess Users *	
		per-	per-		6th	2005		per-	per-		6th	2005		per-	per-		6th	2005		per-	per-		6th	2005
Nutrient	Median	centile	centile	Max	edition	edition	Median	centile	centile	Max	edition	edition	Median	centile	centile	Max	edition	edition	Median	centile	centile	Max	edition	edition
Energy (kcal)	0	4	12	80	-	-	0	8	10	57	-	-	0	16	30	237	-	-	5	27	54	145	-	-
Protein (g)	0	0	0	2	-	-	0	0	0	1	-	-	0	0	trace¶	28	-	-	0	2	3	36	-	-
Fat (g)	0	0	0	2	-	-	0	0	0	trace¶	-	-	0	0	0	0	-	-	0	1	3	20	-	-
Carbohydrate (g)	0	0	0	9	-	-	0	0	1	2	-	-	0	0	0	13	-	-	0	1	2	21	-	-
Calcium (mg)	0	7	130	1040	0	0	126	600	920	1833	0	0	0	0	9	54	0	0	0	106	320	1200	0	0
Iron (mg)	0	0	0	12	0	0	0	4	5	10	0	0	0	0	0	4	0	0	0	4	6	129	2	2
Magnesium (mg)	0	0	0	36	0	-	0	125	300	906	1	-	0	0	0	42	0	-	0	20	60	205	0	-
Vitamin A (IU)	0	1,000	2400	8000	3	0	0	0	0	200	0	0	0	0	0	0	0	0	0	1,000	3,600	11000	12	8
Vitamin D (IU)	0	30	40	600	0	0	0	80	159	396	0	0	0	0	0	0	0	0	0	40	200	726	0	0
Vitamin E (mg)	2	182	285	483	0	0	0	0	0	10	0	0	0	0	trace¶	27	0	0	0	30	100	280	0	0
Vitamin K (μ g)	0	0	0	45000	7	-	0	6	8	66	0	-	0	0	0	11	0	-	0	4	48	400	0	-
Vitamin B1 (mg)	2	58	78	280	-	-	0	0	0	6	-	-	1	5	6	20	-	-	0	10	20	68	-	-
Vitamin B2 (mg)	trace¶	8	12	64	-	-	0	0	trace¶	6	-	-	1	4	5	10	-	-	0	3	14	68	-	-
Vitamin B6 (mg)	1	48	66	185	5	34	0	0	0	4	0	0	1	5	6	25	0	0	0	2	10	61	0	1
Vitamin B12 (μ g)	0	1008	1500	2340	-	-	0	0	0	4	-	-	0	0	0	10	-	-	0	9	30	62	-	-
Niacin (mg)	0	39	60	140	62	0	0	0	0	15	0	0	4	20	20	100	6	0	0	7	18	128	10	0
Vitamin C (mg)	0	700	1336	4400	-	-	0	40	50	1000	-	-	0	44	50	2500	-	-	0	90	360	1620	-	-

'Weekly users" plus "daily users" were defined as "regular users".

Because there were few "regular users", 3.fatty acid, 4.amino acid, 5.dietary fiber, and 8.medicine were omitted.

Seven males and 22 females were excluded from the analysis because they reported uncertainty about the information on dietary supplement intake.

Some products for which nutrient content was not described were excluded when we developed the database and we did not calculate nutrient intake from these products.

* : Number of participants who daily consumed some nutrients at more than the tolerable upper intake level (UL) in the 6th Edition or 2005 Edition of Nutrient-Based Dietary Reference Intakes (DRIs) in Japan.

† : n=451 (191 males and 260 females)

‡ : n=85 (21 males and 64 females)

§ : n=232 (110 males and 122 females)

‖ : n=302 (129 males and 173 females)

- : Tolerable upper intake limit of adults in 6th edition or 2005 edition of Nutrient-Based Dietary Reference Intakes in Japan was not shown.

¶ : Below display limit

category (vitamin A, vitamin K, vitamin B6, and niacin), in the mineral category (magnesium), in drink type (niacin), and in the "others" category (iron, vitamin A, vitamin B_6, and niacin). In the other major categories, there were no "excess users" for any nutrients.

According to the 6th Ed. UL, 20 people were "excess users" of vitamin A among "all" dietary supplement users (Table 4), 12 among the "others" category and 3 among vitamin category (Table 5). This indicates that 5 people consumed excess doses of vitamin A from more than one dietary supplement category. Some people consumed excess doses of magnesium (one participant), vitamin B_6 (one participant), and niacin (six participants) from more than one dietary supplement category.

DISCUSSION

We conducted this study to evaluate the information on dietary supplement use and nutrient intake from these products in a random sample of a community-living population. Dietary supplements were used by more than half of the respondents in the previous year. The intake of some minerals and vitamins from these products were equal or more than the daily intake from food in the National Nutrition Survey.[16] Some users were found to take excess doses of minerals or vitamins from these products.

The prevalence of "all" dietary supplement use among "any users" in the previous year in our study was more than 50 % among both sexes. This is relatively high in comparison to those reported from Japan,[21,23] but it is almost the same as the prevalence found in studies that were conducted in the US.[2,20,22] However, differences in the definition of dietary supplements, dietary supplement users, duration of the study period (e.g., not specified or previous one year), and survey method (e.g., questionnaire only or including interview) among these studies make direct comparisons difficult.

In the National Nutrition Survey in Japan (J-NNS) in 2001,[23] dietary supplements were defined only as products which contained vitamins and minerals, and a concrete study period was not specified. Under this condition, 17.0 % of males and 23.6 % of females reported usual use of dietary supplements. In the subgroup of the Japan Public Health Center-based Prospective Study on Cancer and Cardiovascular Disease Cohort II,[21] dietary supplement was investigated in a questionnaire survey. In this study, dietary supplement was classified into multivitamins, beta-carotene, vitamin C, vitamin E, and others, and dietary supplement users were defined as subjects who used a dietary supplement one or more times a week for a year or longer. In this situation, the prevalence of dietary supplement use was 10.9 %.

Survey method (e.g., questionnaire only or including interview) may be another methodological factor to affect the prevalence of the dietary supplement intake. Third National Health and Nutrition Examination Survey in 1999-2000 (NHANES III)[22] in the US was conducted by household interviews. In NHANES III, dietary supplements included non-vitamin and non-mineral products, the duration of the study period was the previous month. Under this condition, the prevalence of dietary supplement use was 52 %, and it was similar to our results. It is possible that relatively high prevalence of dietary supplement use found in NHANES III and our study may result from the use of survey methods including interview.

At present, there have been a few studies on dietary supplement assessment methodology.[5-7,11,21,24-27] It is important to develop generally accepted assessment method in the dietary supplement study to make direct comparison.

We clarified the characteristics of dietary supplement users for the first time in Japan. Many studies conducted in the US and European countries reported that dietary supplement use was related to many aspects of appropriate lifestyles and a high health status.[6,9,13,28-33] In contrast, dietary supplement users in this study were likely to feel less healthy than nonusers. Dietary supplement users might have been more careful of maintaining an appropriate weight than nonusers, whereas other characteristics (i.e., smoking, education, marriage status, BMI, energy intake from food, and alcohol intake) were not significantly associated with dietary supplement use or nonuse in this study. The characteristics of dietary supplement users in our study might have been different from the characteristics of dietary supplement users in other countries. Such characteristics may depend on sex, age, and ethnicity.[7-9,28] Furthermore, some characteristics were different between frequencies of use of dietary supplements. For example, "seldom users" were prevalent among middle-aged subjects and were more likely to be males, whereas "daily users" were prevalent among older people and more likely to be females in our study. The association between dietary supplement use and other characteristics may be affected by the frequency of use of dietary supplements.

Multivitamin, vitamin C, and vitamin E were the popular dietary supplements in the vitamin category, and calcium was the most popular dietary supplement in the mineral category in our study. In the US, approximately 40% of subjects was reported to be users of some vitamin or mineral supplements in the NHANES III.[8] About 40 to 80% of adults was reported to be users of some vitamin or mineral supplements. Multivitamins were the most popular dietary supplements, and vitamin C, vitamin E, vitamin A, and calcium were commonly used in vitamins and mineral supplements.[8,9,13,28,29,31,34-36] Many studies reported the prevalence of combined dietary supplement use (vitamins and mineral). The prevalence of use of each dietary supplement was not determined; however, our results (vitamin plus mineral: males 25.8%, females; 37.8%) would be broadly comparable to the results of those studies.

Schaffer et al[33] reported that the prevalence of non-vitamin and non-mineral dietary supplement use was 32.7% (participants were the members of a large group in a model health plan, the duration of the study period was the past 12 months, and dietary supplement use was assessed by a questionnaire). The prevalence of non-vitamin and non-mineral dietary supplement users in our study ("all" - vitamin - mineral: males; 28.7%, females; 23.5%)

was close to the results of Schaffer et al. Radimer et al[32] reported that non-vitamin and non-mineral dietary supplements included many herbal supplements in NHANES III, and the term "herbal" is often used loosely, including non-plant dietary supplement (i.e., enzymes, glandular extracts, choline, and fish oils). Herbal supplements were most commonly used because they were considered "healthy or good for you",[14,34,37,38] and consumers may perceive plant products as more natural than manufactured medicines.[38] Furthermore, some studies reported that herbal supplement use is accelerating, and some products might have adverse health effects.[8,32,33,38] We could not determine the reason why some individuals chose "others" types of dietary supplements. As the prevalence of "others" types of dietary supplement use was high in our study, it will be important to estimate the prevalence of this kind of product (non-vitamin and non-mineral dietary supplements) and to clarify the health effects of these products.

In our study, the prevalence of drink type dietary supplement was high, especially in males, and more than 60 % of drink type dietary supplement users were "seldom users". Hakura et al[14] also reported that high prevalence of drink type dietary supplement was observed in Japan, and many of the occasional dietary supplement users took this kind of dietary supplements to maintain or recover health. However, drink type dietary supplement was not usually described in the studies reported from the Western countries.[32-34,38] The high prevalence of drink type dietary supplement use might be one of the characteristics observed in Japan, and might be caused by broad accessibility that people can get drink type dietary supplements easily at supermarkets and convenience stores when they feel weary.

The purpose of dietary supplement use may be to compensate the shortage of nutrients from foods, but some users had excessive intake of some nutrients. The median values of Vitamin B_1 and 90 percentile values of vitamin E, Vitamin B_2, B_6, B_{12}, niacin, and vitamin C from dietary supplements in this study were more than that from food, according to the results of J-NNS 2002.[16] Some dietary supplement users consumed huge amounts of nutrients from dietary supplements.

Regarding overdoses, this study had two important findings. The first was that overdoses sometimes occurred for non-target nutrients from dietary supplements, when the primary nutrient in the dietary supplement was defined as the target nutrient. For example, according to the 6th Ed. UL, only three persons took an excess dose of vitamin A among vitamin supplement users, whereas 12 people consumed an excess dose of vitamin A among the "others" type of supplement users (Table 5). The second was that overdose sometimes occurred in users of "multiple" dietary supplements. In this study, according to the 6th Ed. UL, five people consumed an excess dose of vitamin A from "multiple" dietary supplements which belonged to different categories.

Stewart et al[31] reported that there was a wide range of intake of vitamins from dietary supplements. Subjects who took more than 10 times the Recommended Dietary Allowances (RDAs) in the US were observed for vitamin B group, vitamin C, vitamin E, niacin, and pantothenic acid intakes. Other studies reported that some dietary supplement users consumed excess doses of some nutrients as compared to the RDAs.[6-9,39,40] Rock et al[2] noted that a few women consumed potentially toxic levels of vitamin A, vitamin B_6, iron, and zinc from dietary supplements. People need to be aware that excessive use of some dietary supplements may produce undesirable health effects.[41,42] Because we did not include fortified foods and modified foods among dietary supplements in this study, nutrient intake from those foods was not included the estimation of total nutrient intake. We are apprehensive that excessive levels of nutrient intake could be more common people with in a combination of fortified foods, modified foods and dietary supplement use.

The main strength of this study is the development of the nutrient content database of more than 900 dietary supplements, and the use of this database to calculate nutrient intake from these products for more than 2,000 middle-aged and older people. Although our database of dietary supplements is extensive, a lack of information on some dietary supplements still exists. Information on the nutrient content of some products available in the marketplace had not been obtained even by the producer and/or was difficult to get,[6,7,43-45] because dietary supplements except for medicines are not required to show their nutrient contents.

APPENDIX

We succeeded in constructing the database of more then 1500 dietary supplement products in April 2006. The database has been regularly updated according to the study. We will make latest dietary supplement database generally available, but for non-profit use only, in the internet website (http://www.nils.go.jp/department/ep/index-j.html) of our institute, without a need for permission. The authors, however, request that this article be cited when a study in which the data, or even a part of it, were used is published or open to the public. We expect that this database will be useful for the prevention of excess intake of dietary supplements and contribute to the development of research on nutritional epidemiology.

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REFERENCES

1. Japan Health Food & Nutrition Food Association. The newest dietary supplement guidebook 2003. Tokyo: Health Food &

Nutrition Food Association, 2003. (in Japanese)
2. Rock CL, Newman V, Flatt SW, Faerber S, Wright FA, Pierce JP. Nutrient intakes from foods and dietary supplements in women at risk for breast cancer recurrence. The Women's Healthy Eating and Living Study Group. Nutr Cancer 1997; 29: 133-9.
3. White E, Kristal AR, Shikany JM, Wilson AC, Chen C, Mares-Perlman JA, et al. Correlates of serum alpha- and gamma-tocopherol in the Women's Health Initiative. Ann Epidemiol 2001; 11: 136-44.
4. Patterson RE, Kristal AR, Tinker LF, Carterb RA, Bolton MP, Agurs-Collins T. Measurement characteristics of the women's health initiative food frequency questionnaire. Ann Epidemiol 1999; 9: 178-87.
5. Bates CJ, Prentice A, van der Pols JC, Walmsley C, Pentieva KD, Finch S, et al. Estimation of the use of dietary supplements in the National Diet and Nutrition Survey: people aged 65 years and over. An observed paradox and a recommendation. Eur J Clin Nutr 1998; 52: 917-23.
6. Greger JL. Dietary supplement use: Consumer characteristics and interests. J Nutr 2001; 131: 1339S-43S.
7. American Dietetic Association. Position of the American Dietetic Association: food fortification and dietary supplements. J Am Diet Assoc 2001; 101: 115-25.
8. Balluz LS, Kieszak SM, Philen RM, Mulinare J. Vitamin and mineral supplement use in the United States. Results from the third National Health and Nutrition Examination Survey. Arch Fam Med 2000; 9: 258-62.
9. Subar AF, Block G. Use of vitamin and mineral supplements: demographics and amounts of nutrients consumed. The 1987 Health Interview Survey. Am J Epidemiol 1990; 132: 1091-101.
10. Erkkola M, Karppinen M, Javanainen J, Räsänen L, Knip M, Virtanen SM. Validity and reproducibility of a food Fequency questionnaire for pregnant finnish women. Am J Epidemiol 2001; 154: 466-76.
11. Block G, Sinha R, Gridley G. Collection of dietary-supplement data and implications for analysis. Am J Clin Nutr 1994; 59: 232S-39S.
12. Shimokata H, Ando F, Niino N. A new comprehensive study on aging-the National Institute for Longevity Sciiences, Longitudinal Study of Aging (NILS-LSA). J Epidemiol 2000; 10: S1-S9.
13. Newman V, Rock CL, Faerber S, Flatt SW, Wright FA, Pierce JP. Dietary supplement use by women at risk for breast cancer recurrence. The Women's Healthy Eating and Living Study Group. J Am Diet Assoc 1998; 98: 285-92.
14. Hakura T, Murakami T, Maruyama C. Study on habitual use of dietary supplements and/or special health foods in male subjects in a major general trading corporation. Jpn J Nutr 1995; 53: 209-15. (in Japanese)
15. Science and Technology Agency. Standard Tables of food composition in Japan 5th revised ed. Tokyo: Printing Bureau, Ministry of Finance; 2000. (in Japanease)
16. Ministry of Health, Labor and Welfare. The National Nutrition Survey in Japan, 2002. Tokyo:Daiichi Public, 2004. (in Japanese)
17. Ministry of Health and Welfare. Recommended dietary allowance 6th ed. Daiichi Public, Tokyo, 1999. (in Japanese)
18. Ministry of Health, Labour, and Welfare, Japan. Dietary reference intakes for Japanese, 2005. Daiichi Public, Tokyo, 2005. (in Japanese)
19. Imai T, Sakai S, Mori K, Ando F, Niino N, Shimokata H. Nutritional assessments of 3-day dietary records in National Institute for Longevity Sciences - Longitudinal Study of Aging (NILS-LSA). J Epidemiol 2000; 10: S70-S76.
20. SAS/STAT User's guide, Version 8. Cary, NC: SAS Institute Inc., 1999.
21. Ishihara J, Sobue T, Yamamoto S, Sasaki S, Akabane M, Tsugane S. Validity and reproducibility of a self-administered questionnaire to determine dietary supplement users among Japanese. Eur J Clin Nutr 2001; 55: 360-5.
22. Radimer K, Bindewald B, Hughes J, Ervin B, Swanson C, Picciano MF. Dietary supplement use by US adults: Data from the National Health and Nutrition Examination Survey, 1999-2000. Am J Epidemiol 2004; 160: 339-49.
23. Ministry of Health, Labor and Welfare. The National Nutrition Survey in Japan, 2001. Tokyo: Daiichi Public, 2003. (in Japanese)
24. Patterson RE, Kristal AR, Levy L, McLerran D, White E. Validity of methods used to assess vitamin and mineral supplement use. Am J Epidemiol 1998; 148: 643-9.
25. Kim I, Williamson DF, Byers T, Koplan JP. Vitamin and mineral supplement use and mortality in a US cohort. Am J Public Health 1993; 83: 546-50.
26. Satia-Abouta J, Patterson RE, King IB, Stratton KL, Shattuck AL, Kristal AR, Potter JD, Thornguist MD, White E. Reliability and validity of self-report of vitamin and mineral supplement use in the vitamins and llfestyle study. Am J Epidemiol 2003; 157: 944-54.
27. Dwyer J, Picciano MF, Raiten DJ. Collection of food and dietary supplement intake data: what we eat in America-NHANES. J Nutr 2003; 133: 590S-600S.
28. Slesinski MJ, Subar AF, Kahle LL. Dietary intake of fat, fiber and other nutrients is related to the use of vitamin and mineral supplements in the United States: the 1992 National Health Interview Survey. J Nutr 1996; 126: 3001-8.
29. Bender MM, Levy AS, Schucker RE, Yetley EA. Trends in prevalence and magnitude of vitamin and mineral supplement usage and correlation with health status. J Am Diet Assoc 1992; 92: 1096-101.
30. Lyle BJ, Mares-Perlman JA, Klein BE, Klein R, Greger JL. Supplement users differ from nonusers in demographic, lifestyle, dietary and health characteristics. J Nutr 1998; 128: 2355-62.
31. Stewart ML, McDonald JT, Levy AS, Schucker RE,

Henderson DP. Vitamin/mineral supplement use: a telephone survey of adults in the United States. J Am Diet Assoc 1985; 85: 1585-90.
32. Radimer KL, Subar AF, Thompson FE. Nonvitamin, nonmineral dietary supplements: issues and findings from NHANES III. J Am Diet Assoc 2000; 100: 447-54.
33. Schaffer DM, Gordon NP, Jensen CD, Avins AL. Nonvitamin, nonmineral supplement use over a 12-month period by adult members of a large health maintenance organization. J Am Diet Assoc 2003; 103: 1500-5.
34. Schutz HG, Read M, Bendel R, Bhalla VS, Harrill I, Monagle JE, et al. Food supplement usage in seven western states. Am J Clin Nutr 1982; 36: 897-901.
35. Foote JA, Murphy SP, Wilkens LR, Hankin JH, Henderson BE, Kolonel LN. Factors associated with dietary supplement use among healthy adults of five ethnicities: The multiethnic cohort study. Am J Epidemiol 2003; 157: 888-97.
36. Slesinski MJ, Subar AF, Kahle LL. Trends in use of vitamin and mineral supplements in the United State: the 1987 and 1992 National Health Interview Surveys. J Am Diet Assoc 1995; 95: 921-3.
37. Kaufman DW, Kelly JP, Rosenberg L, Anderson TE, Mitchell AA. Recent patterns of medication use in the ambulatory adult population of the United States. The Slone Survey. JAMA 2002; 287: 337-44.
38. Winslow LC, Kroll DJ. Herbs as medicines. Arch Intern Med 1998; 158: 2192-9.
39. Block G, Cox C, Madans J, Schreiber GB, Licitra L, Melia N, Vitamin supplement use, by demographic characteristics. Am J Epidemiol 1988; 127: 297-309.
40. Park YK, Kim I, Yetley EA. Characteristics of vitamin and mineral supplement products in the United States. Am J Clin Nutr 1991; 54: 750-9.
41. Koplan JP, Annest JL, Layde PM, Rubin GL. Nutrient intake and supplementation in the United States (NHANES II). Am J Public Health 1986; 76: 287-9.
42. Palmer ME, Haller C, Mckinney PE, Klein-Schwarts W, Tachirgi A, Smolinske SC, et al. Adverse events associated with dietary supplements: an observational study. Lancet 2003; 361: 101-6.
43. Fugh-Berman A. Herb-drug interactions. Lancet 2000; 355: 134-8.
44. Dwyer J, Picciano MF, Raiten DJ. Food and dietary supplement databases for what we eat in America?NHANES J Nutr 2003; 133: 624S-634S.
45. Neuhouser ML. Neuhouser. Dietary supplement use by American women: Challenges in assessing patterns of use, motives and costs. J Nutr 2003; 133: 1992S-1996S.

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研究論文●14

地域在住中高年者の抑うつの関連要因
—日常活動能力に着目して—

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1 背景と目的

近年，高齢者の精神保健上の問題として「抑うつ状態」が大きく取り上げられており，多くの疫学調査でも，高齢者において抑うつ状態有症率の高いことが報告されている[1)]。

高齢者の抑うつに関連する要因としては，日常生活における活動性の低下，性別や居住形態といった基本属性などが報告されている[2)]。しかしながら，それらの要因の影響力や要因間の因果関係などは十分に明らかにされていない。抑うつ状態の高齢者に対する地域的な援助を考える際には，地域在住高齢者の抑うつの実態を把握し，抑うつを引き起こす可能性のある危険因子を明らかにする必要があると考えられる。

そこで本研究では，①地域在住高齢者の抑うつの分布を明らかにし，②日常活動能力や基本属性がどのように抑うつに影響するのかについて検討する。

2 方法

1．対象

対象は，「国立長寿医療センター老化に関する長期縦断疫学調査(National Institute for Longevity Sciences-Longitudinal Study of Aging(NILS-LSA))」の第1次調査(1997～2000年)に参加した60～79歳の地域在住高齢者939名(平均年齢68.5±5.4歳：男性498名，女性441名)である。なお，NILS-LSAは，年齢および性で層化無作為抽出された地域住民を対象とした老化と老年病に関する縦断的コホート調査であり，国立長寿医療センター倫理委員会の了承の下に「調査への参加の文書による同意(informed consent)」の得られた者を対象として行われている[3)]。

2．変数

調査票により，以下の変数を収集した。

1）抑うつ(GDS：Geriatric Depression Scale短縮版[4)])

得点範囲は0～15点で，得点の高い者ほど抑うつ状態が強い。①身体症状や認知障害について考慮されていること，②「はい・いいえ」の2段階評定で回答が容易であることから，高齢者の抑うつ尺度として有用であるとされている。

2）日常活動能力(老研式活動能力指標[5)])

3下位尺度「手段的自立(得点範囲0～5点)」「知的能動性(0～4点)」「社会的役割(0～4点)」から構成されている。地域高齢者の生活機能の自立性を測定するために開発され，十分な信頼性が確認されている。

3）基本属性

性(男性＝0/女性＝1)・年齢・教育歴(小学校・新制中学校＝0/旧制中学校・新制高校＝1/専修学校(高卒後)＝2/高専・短大＝3/大学・大学院＝4)・所得(0～149万円＝0から2,000万円以上＝9の10段階)・居住形態(単身世帯＝0/単身世帯以外＝1)・主観的健康感(非常に悪い＝0/悪い＝1/普通＝2/良い＝3/非常に良い＝4)。

3．統計解析

対象者個人の基本属性が日常の活動性へ影響をもたら

1）国立長寿医療センター研究所疫学研究部 2）桜美林大学大学院

Table 1 基本属性・日常活動能力の基礎統計量

性別*		居住形態*	
男性	498(53.0)	単身世帯	74(7.9)
女性	441(47.0)	単身世帯以外	865(92.1)
年齢**	68.5±5.4	所得*	
教育歴*		0～149万円	54(5.8)
小学校・新制中学校	435(46.3)	150～249万円	81(8.6)
旧制中学校・新制高校	338(36.0)	250～349万円	154(16.4)
専修学校(高卒後)	49(5.2)	350～449万円	167(17.8)
高専・短大	58(6.2)	450～649万円	153(16.3)
大学・大学院	59(6.3)	650～749万円	68(7.2)
主観的健康感*		750～849万円	56(6.0)
非常に悪い	10(1.1)	850～999万円	69(7.3)
悪い	120(12.8)	1,000～1,999万円	120(12.8)
普通	638(67.9)	2,000万円以上	17(1.8)
良い	146(15.5)	日常活動能力**	
非常に良い	25(2.7)	手段的自立	4.8±0.4
		知的能動性	3.8±0.6
		社会的役割	3.7±0.7

*：N(%)，**：Mean±S.D.

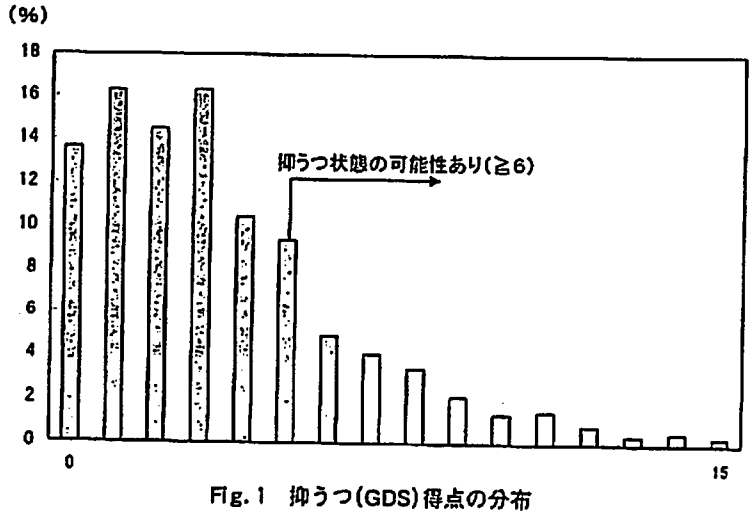

Fig. 1 抑うつ(GDS)得点の分布

し，さらに，日常活動能力の程度が抑うつ状態を規定すると仮定して，[基本属性]→[日常活動能力]→[抑うつ]という因果モデルのパス解析を行った。統計解析にはSAS release 8.2を用いた。

3 結果

1．基本属性・日常活動能力の基礎統計量

分析対象者の基本属性の分布および日常活動能力の平均点をTable 1に示す。

2．抑うつ(GDS)得点の分布

GDS得点の分布をFig. 1に示す。GDSの平均点(標準偏差)は3.5(2.9)点であった。また，「抑うつ状態の可能性あり」と診断されるGDS 6点以上を示した者は，183名(19.5%)であった。

3．抑うつと基本属性・日常活動能力との関連

[基本属性]→[日常活動能力]→[抑うつ]のパス・ダイ

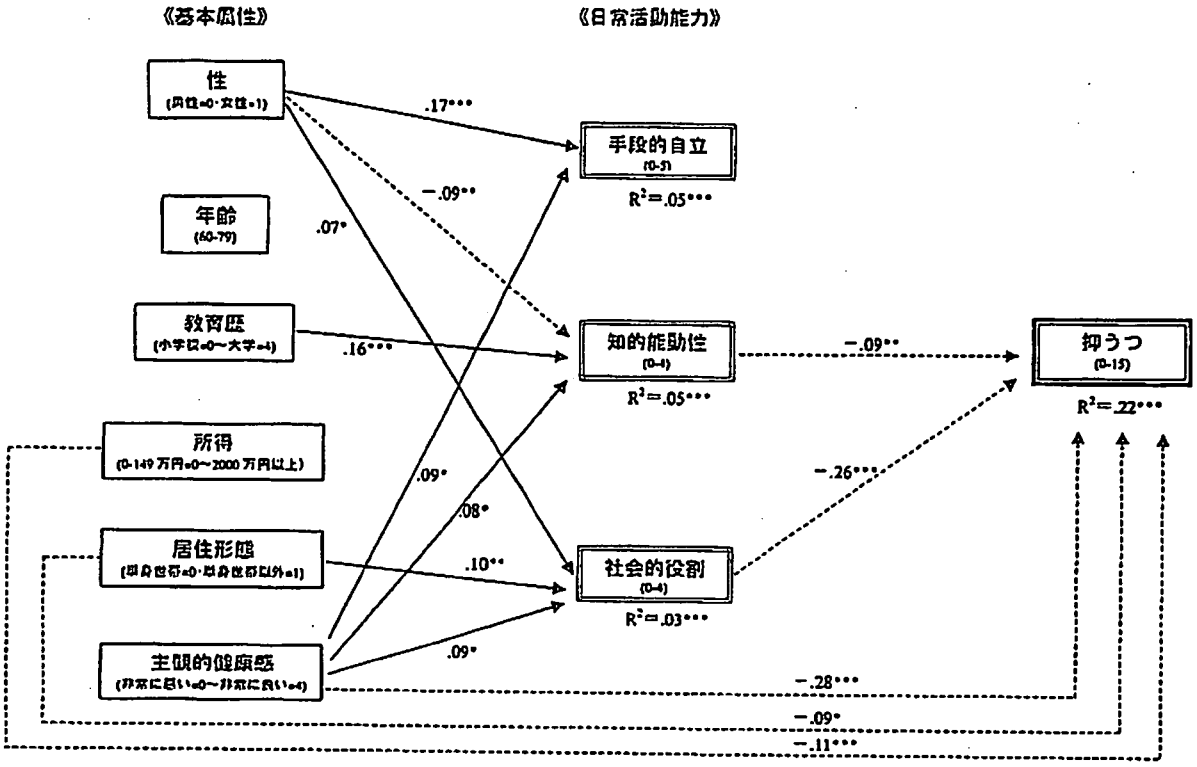

Fig. 2　抑うつと基本属性・日常活動能力のパス・ダイアグラム

*：p<0.05, **：p<0.01, ***：p<0.001.

値は標準偏回帰係数，実線は正のパス，破線は負のパスを示す。

第1段階として日常活動能力各変数を従属変数，基本属性を独立変数とする重回帰分析を，第2段階として抑うつを従属変数，その他の全変数を独立変数とする重回帰分析を行った。

アグラムをFig. 2に示す。

第1段階として，日常活動能力各変数を従属変数，基本属性全変数を独立変数とする重回帰分析を行った。その結果，手段的自立に対して性，主観的健康感からのパスが有意な正の係数を示した。知的能動性には，教育歴，主観的健康感が有意な正の係数，性が有意な負の係数を示した。一方，社会的役割には，性，主観的健康感，居住形態が有意な正の係数を示した。さらに第2段階として，抑うつを従属変数，すべての要因を独立変数とする重回帰分析を行った結果，日常活動能力のうち，知的能動性と社会的役割，基本属性の所得と主観的健康感，居住形態から抑うつへのパスが有意に負の係数を示した。

4．考察

高齢者の抑うつ得点の度数分布は小さい値に偏っており，低得点を示す高齢者が多かった。しかしながら，約20%の高齢者が「抑うつ状態の可能性あり」と診断される得点を示したことは注目に値する。また，[基本属性]→[日常活動能力]→[抑うつ]という因果モデルを検討した結果から，日常活動能力の中で，知的能動性や社会的役割の低下が抑うつを高めること，性・教育歴・居住形態・主観的健康感といった属性は，日常活動能力を介して抑うつに影響することが示唆された。一方，低所得・独居や主観的な健康不良は，直接的にも抑うつ増大に影響することが示された。抑うつ状態にある高齢者をスクリーニングしたり，効果的な介入方法を検討する際には，これらの背景要因を考慮する必要があると考えられる。

高齢者の抑うつには様々な要因が複雑に関与している。今後，抑うつ状態の経時的変化を検討し，より広範な危険因子を明らかにする必要があろう。

文　献

1) Yesavage. J. A. et al.: Development and validation of a geriatric depression screening scale: a preliminary report. J. Psychiatr. Res. 17: 37-49, 1982-1983.
2) 黒田研二, 岡田好美: 高齢者における日常生活自立度低下の予防に関する研究. 厚生の指標 49(8): 14-20, 2002.
3) Shimokata. H. Ando. F. and Niino. N.: A new comprehensive study on aging—the National Institute for Longevity Sciences. Longitudinal Study of Aging (NILS-LSA). J. Epidemiol. 10: S1-S9, 2000.
4) Niino. N. Imaizumi. T. and Kawakami. N.: Japanese translation of the Geriatric Depression Scale. Clin. Gerontol. 10: 85-87, 1991.
5) 古谷野亘, 柴田 博, 中里克治ほか: 地域老人における活動能力の測定—老研式活動能力指標の開発. 日公衛誌 34: 109-114, 1987.

3. 高齢者の生活習慣はどこまで是正すべきか（Pro）

下方　浩史

日本老年医学会雑誌　第43巻　第4号　別刷

43 : 462

第47回日本老年医学会学術集会記録
〈老年医療における Controversy〉

3. 高齢者の生活習慣はどこまで是正すべきか（Pro）

下方　浩史

要　約　健康長寿を目指すためには生活習慣の改善が最も重要である．喫煙や飲酒のコントロール，肥満防止，栄養改善，運動習慣などの生活習慣の改善は，寝たきりを防止して健康寿命を延ばしていくためには不可欠である．生活習慣の是正は小児期から必要であり，青年期，中年期から老年期まで，生涯にわたって必要であるが，ライフステージごとに方法や目標は異なる．75歳以上の後期高齢者では肥満よりも痩せの危険が高いことを認識し栄養指導を行うことが必要である．喫煙による循環器疾患や呼吸器疾患への影響としては急性の不整脈の誘発や，末梢血管の収縮，気道への刺激などもあり，禁煙は高齢者でも有用と考えられる．また代謝予備力が落ちているために飲酒量も減らすことが望ましい．運動習慣は高齢者の身体活動能力を維持するだけでなく，代謝機能を高め，鬱を予防するなど心身の健康維持に重要であり，運動教室などを利用して積極的な介入を行っていくべきであろう．

Key words：生活習慣，老年病，予防，栄養，喫煙

（日老医誌　2006；43：462-464）

高齢者の生活習慣への介入

生活習慣病は，食事，肥満，身体活動，喫煙，飲酒などの生活習慣に起因する疾患であり日本人の死因の大部分を占めるがん，心臓病，脳卒中がその代表的疾患である[1]．また高齢者に多い痴呆や骨粗鬆症も生活習慣が重要な因子である場合が多い．生活習慣病は，性別や年齢，遺伝的素因，さらには職業や教育など社会的要因が相互に作用しあって発症する．したがって，これらの背景要因を考慮し，生活習慣への介入を行って疾病の発症予防，進行の予防，そして再発の予防を行うことが重要である．

生活習慣病の予防には小児期，青年期，中年期，老年期のそれぞれのライフステージに応じたストラテジーが必要である（図1）．小児期，青年期には将来の疾患発症を予防するための一次予防に重点を置いた指導が行われる．小児期には基本的な生活習慣が形作られるため，それに対応しての家庭や学校での健康教育が重要である．塩味や油の多い食事への嗜好なども小児期に形成される．青年期には栄養や運動など一生にかかわる生活習慣が確立する．また喫煙や飲酒の習慣もこの頃から始まることが多い．中年期には疾患の早期発見・早期治療を目指す二次予防も重要となる．効率的な健診の体制作りが必要だろう．さらに老年期には再発の予防を中心とした三次予防も重要である．

75歳未満の前期高齢者は元気である．多くの人が職

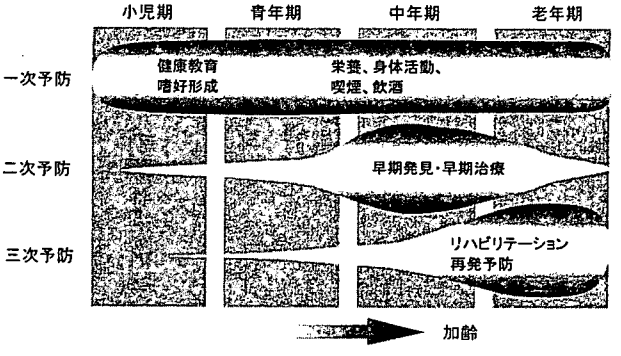

図1　ライフステージ別にみた生活習慣病の予防
生活習慣病の予防には小児期，青年期，中年期，老年期のそれぞれのライフステージに応じたストラテジーが必要である．

についており，また積極的に社会参加をしている．喫煙や飲酒のコントロール，肥満防止，栄養改善，運動習慣などの生活習慣の改善は，寝たきりを防止して健康寿命を延ばしていくためには不可欠である．一方，75歳以上の後期高齢者では加齢による身体機能の変化に対応し，10年先，20年先のことよりも現在の生活の質（Quality of life；QOL）を考慮した生活習慣への介入が必要だろう．

肥満と老化

食餌制限と寿命との関係については，1930年代のMcCayによるラットを使った有名な実験があり[2]，自由

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無制限の食餌を与えたラットより食餌を制限したラットの方が長生きするという結果は基礎老化の研究者の間ではよく知られている[3,4]．

人間ではやせていればいるほど健康にいいのか．もしそうでないなら，どの程度の体重であるのが医学的には理想なのか．Andresは米国の生命保険会社のデータから，体重（kg）を身長（m）の二乗で割って求めたBody Mass Index（BMI）を身長とは無相関の肥満の指標として用い，各年代ごとに最も死亡率の低いBMIをもとめた[5]．この結果死亡率を縦軸，BMIを横軸にとった時，きれいなU字を描くことを示した．BMIの小さいやせた人では，肺炎や結核などの感染症の発病率が高く，BMIの大きな太った人では糖尿病や心臓病などの発病率が高くなる．男女別に，各年齢毎にこのようなグラフを作成し，死亡率の最も低い肥満度を求めてみると，この理想的な肥満度の値は加齢とともに大きくなっている[6]．男女で大きな差はなく年齢とともにほぼ直線的に理想的なBMIの値が大きくなっていく．

BMIによる高齢者の肥満評価には，加齢に伴う椎間の狭小化，椎骨の圧迫骨折による脊椎前弯の増強などにより身長が年齢とともに低下し，BMIは本来あるべき値よりも，大きくなっていることにも留意せねばならない．

予備力が低下している後期高齢者では無理な減量はかえって健康を害することが多い．しかし複数の代謝性合併症を有するメタボリック・シンドローム，下肢の骨関節障害を有する高度肥満，睡眠時無呼吸症候群を有する高度肥満などでは高齢者においても減量は必要であると考えられる[7]．

一方で，高齢者では骨格筋萎縮に伴う基礎代謝の低下，味覚などの感覚器機能低下，ジギタリス製剤等の食欲を低下させる副作用のある薬物の使用，味気ない減塩食や老人食，ACE阻害剤などの薬剤による亜鉛欠乏症等により，食欲が低下していることが多い．慢性的に栄養不良の高齢者も多く，肥満よりもむしろやせのリスクに注意する必要がある[8]．

喫煙と老年病

喫煙により消化器の運動が低下する．口腔の衛生状態が悪くなり，歯周病のため歯牙が脱落する．喫煙で口がまずい，味覚障害などから食欲も低下する．1本のタバコを吸うと約10キロカロリーが使われる[9]．1パック20本の喫煙では200キロカロリーが消費される，これは1時間の歩行とほぼ同等のエネルギー消費である．このため喫煙は体重減少の要因となる．

喫煙はさまざまな老年病の危険因子でもある．アルツハイマー病についてはハワイ在住日系人ではリスクは2.4倍と報告されている[10]．喫煙による痩せ，エストロゲン抑制，骨カルシウム代謝障害などが骨粗鬆症の要因になる[11]．また喫煙は老人性難聴[12]，老人性白内障[13]，加齢に伴う記銘力障害[14]の要因でもある．慢性気管支炎，肺気腫の閉塞性肺疾患は高齢者に多くみられ，また喫煙との関連が強い．多くの化学物質が直接に気道に作用し，刺激により炎症反応を引き起こす．慢性閉塞性肺疾患による肺機能低下は禁煙によって回復しないが，禁煙をすることで，それ以上の悪化を防ぐことはできる．むしろ禁煙が進行を予防する唯一の手段である．

一般にがんは発がん物質に曝露されてから，実際にがんが見つかるまでの期間が長い．このため若い頃から喫煙を継続している高齢者が禁煙をしても，若い成人と同じようにがんのリスクを下げるような効果があるかどうかは不明である．

喫煙による循環器疾患や呼吸器疾患への影響は急性の不整脈の誘発や，末梢血管の収縮，気道への刺激など急性の影響もあり，禁煙は，高齢者でも有用と考えられる．しかしFramingham Studyでの18年間の観察で65歳以上の群では禁煙による虚血性心疾患のリスク低下は認められなかったとする報告もある[15]．

喫煙者の近くで，副流煙・排出煙を吸わされる受動喫煙は，主流煙を吸う喫煙者本人よりも有害である．家族，主として夫の喫煙による妻への影響，あるいは子どもや孫への影響も重要である．特に小さな子どもや妊婦への影響は大きい．大家族で暮らすことの多い日本では，高齢者の喫煙に関して，こうした家庭での環境についても考慮が必要であろう．

高齢者の飲酒

適量の飲酒は，血清脂質，耐糖能，インスリン抵抗性を改善させる．しかし少量の飲酒でも高血圧の要因となりうるので要注意である．飲酒は高齢者の脳出血のリスクを上げる．加齢に伴いアルコール代謝機能が低下し，顔面紅潮などの頻度が高くなる．飲酒量を一般成人よりも減らすことも重要であろう．もちろん慢性肝炎・肝硬変では高齢者でも禁酒は必要であろう．

高齢者の身体活動

身体活動は加齢に伴う耐糖能を改善させ，骨粗鬆症を予防し，高齢者の循環器機能を維持するためきわめて重要である．我々は高齢者の身体活動が，うつを予防する効果のあることを報告している[16]．

高齢者の身体機能の維持・改善，QOLの向上を目指し，介護予防を行っていくためにも生涯にわたっての介入が望ましい．積極的なソーシャル・サポートや家族からの支えによって，閉じこもりや，寝たきりを防止していくことも重要であろう．

しかし運動指導には，高齢者に多い循環器疾患，骨関

節疾患，呼吸器疾患などに留意し，個人ごとの対応が必要である．

おわりに

健康長寿を目指すためには，人の一生を通じて生活習慣の是正が欠かせない．しかし，その目標や方法は加齢の進行によって異なる．特に75歳以上の後期高齢者では現在のQOLを重視した生活指導が行われるべきである．高齢者では肥満よりも痩せが問題になる．健康の維持のためには食欲の低下による栄養不良，体重減少を予防していくことが必要であり，食事の制限や減塩などはどうしても必要な場合に限るべきであろう．喫煙は高齢者でも避けるべきであり，過度の飲酒も好ましくない．また，高齢者では心身の健康の維持のために運動習慣への積極的な介入が必要である．

文　献

1) 厚生統計協会：国民衛生の動向．厚生の指標　2004 ; 51 : 45–56.
2) McCay CM, Crowell MF, Maynard LA : The effect of retarded growth upon the length of life span and upon the ultimate body size. J Nutr 1935 ; 10 : 63–79.
3) Lindsay DG : Diet and ageing: the possible relation to reactive oxygen species. J Nutr Health Aging 1999 ; 3 : 84–91.
4) Masoro EJ : Possible mechanisms underlying the antiaging actions of caloric restriction. Toxicol Pathol 1996 ; 24 : 738–741.
5) Andres R : Effect of obesity on total mortality. Int J Obesity 1980 ; 4 : 381–386.
6) Andres R : Mortality and obesity: the rationale for age-specific height-weight tables. In: Principales of Geriatric Medicine, Andres R, Bierman EL, Hazzard WR (eds), McGraw-Hill, New York, 1985, p311–318.
7) 横手幸太郎，村野俊一，斎藤　康：肥満．高齢者の生活習慣病の実際（井藤英喜編），メディカルビュー社，東京，2004, p82–91.
8) 下方浩史：長寿のための老年者の痩せの基準．治療 1998 ; 80 : 2247–2250.
9) Hofstetter A, Schutz Y, Jequier E, Wahren J : Increased 24-hour energy expenditure in cigarette smokers. N Engl J Med 1986 ; 314 : 79–82.
10) Tyas SL, White LR, Petrovitch H, Webster Ross G, Foley DJ, Heimovitz HK, et al. : Mid-life smoking and late-life dementia: the Honolulu-Asia Aging Study. Neurobiol Aging 2003 ; 24 : 589–596.
11) Mazess RB, Barden HS : Bone density in premenopausal women: effects of age, dietary intake, physical activity, smoking, and birth-control pills. Am J Clin Nutr 1991 ; 53 : 132–142.
12) 下方浩史，安藤富士子，岩尾　智：聴力の加齢変化に関する研究—63,000人の大規模集団での追跡．日老医誌 1997 ; 34 : 839.
13) Foster PJ, Wong TY, Machin D, Johnson GJ, Seah SK : Risk factors for nuclear, cortical and posterior subcapsular cataracts in the Chinese population of Singapore: the Tanjong Pagar Survey. Br J Ophthalmol 2003 ; 87 : 1112–1120.
14) 下方浩史，藤澤道子，安藤富士子：疫学調査におけるMCI．Geriatric Medicine　2002 ; 20 : 303–308.
15) Gordon T, Kannel WB, Dawber TR, McGee D : Changes associated with quitting cigarette smoking: the Framingham Study. Am Heart J 1975 ; 90 : 322–328.
16) Fukukawa Y, Nakashima C, Tsuboi S, Niino N, Ando F, Shimokata H, et al. : Age Differences in the Effect of Physical Activity on Depressive Symptoms. Psychol Aging 2004 ; 19 : 346–351.

How far should life-style be corrected in the elderly?

Hiroshi Shimokata

Abstract

To ensure a healthy elderly population, correction of life-style is one of the most important approaches. Smoking cessation, regulation of alcohol intake, prevention of obesity, improvement of nutrition, promotion of physical activity are key factors for prevention of bed-ridden and extension of healthy life span. Although corrections of life-style are essential in childhood, adolescence, and the middle-aged and elderly periods, the methods and purpose are different in each life stage. The risks of emaciation and malnutrition are more important rather than that of obesity in the elderly aged 75 years or over. As for the influence of smoking in cardiovascular and respiratory diseases, smoking can be a trigger for arrhythmia, peripheral vascular constriction, and irritation of the respiratory tract in the elderly. Smoking cessation is necessary even among elderly people. It is also necessary to decrease the amount of alcohol intake, because the ability of metabolize alcohol is limited in the elderly. Physical activity in the elderly people is fundamental not only to maintain the ability of daily living, but also to improve metabolic function and to prevent depression. Vigorous intervention to increase physical activity such as exercise class is recommended, especially in the elderly.

Key words: *Life-style, Geriatric disease, Prevention, Nutrition, Smoking*
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基礎老化研究　30(1):9－14,2006

【総　説】

老化に関する縦断疫学調査の概要と栄養疫学的側面からみた中高年者の心理的健康

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要約

老化や老年病の原因を疫学的に検討するためには多数の関連候補要因と老化・老年病の指標を一つのコホートで前向きに追跡していく縦断研究という手法が有用である。本編では、我々が1997年から行っている「国立長寿医療センター・老化に関する長期縦断疫学研究(NILS-LSA：National Institute for Logevity Sciences - Longitudinal Study of Aging)」の概論とそこから得られた魚由来脂肪酸と抑うつとの関連についての知見を紹介する。

魚油にはDHA(dochosahexaenoic acid)などのn-3系脂肪酸が多く含まれることが知られている。DHAは周産期前後の神経系、網膜の発達や幼児期の認知機能に関連すると報告されているがNILS-LSAにおける縦断的解析の結果、初回調査時に抑うつの認められなかった中高年男性が2年後に抑うつを示す危険率は、魚介類由来脂肪摂取量が1s.d.（標準偏差）増えるごとに約1/3に減少するという結果が得られた。近年、成人においてもDHA、EPA(eicosapentaenoic acid)摂取と心理・精神機能との関連が報告されるようになっており、また、うつ病患者では血漿リン脂肪中におけるn-3系多価脂肪酸の欠乏が見られるとも報告されている。我々の研究結果は、地域在住者が通常摂取している範囲内でのn-3系脂肪酸摂取で中高年男性の抑うつが抑制される可能性を示しており、今後機能的な解析や介入調査でのさらなる検討が望まれる。

Key words: epidemiology, depression, DHA(dochosahexaenoic acid), longitudinal study, aging

1. 科学としての疫学研究

「疫学」は、人の集団における健康に関連する状態やイベント（出来事）の分布とその規定要因を研究する科学であり、その目的とするところは因果律の把握による疾病発生の予防である[1,2]。近年の臨床疫学ではさらに治療効果の判定など幅広い分野が疫学の研究領域に含まれるようになってきた。また健康や長寿への人類の興味が大きくなるに従って、「健康」「長寿」の規定因子を検討することも疫学の研究範囲に含まれるようになってきている。

疫学研究は、集団のありのままにとらえる「観察研究(obsevational study)」と何らかの介入を加えることによる効果判定を含む「介入研究(intervention study)」とに大別される[3]。「観察研究」はさらにデータの分布、頻度を記述する「記述疫学」と因子間の関連を検討する「分析疫学」に分類される。「分析疫学」は説明変数（原因となっていると仮定される要因）と目的変数（説明変数によって影響を受けると仮定される要因）との時間的関係から、両者が同一時点で測定される「横断的研究(cross-sectional study)」、患者対照研究のように結果（疾病の有無）から原因を遡って検討する「後ろ向き研究（retrospective study)」、コホート研究のように観察している集団において目的とする事象の発生を経時的にとらえていく「前向き研究(prospective study)」とに分類できる。横断的研究では説明変数と目的変数の間での関連を示すことはできても時相的な前後関係を示すことはできない。後ろ向き研究では、目的とする結果（疾病の有無）が明らかになった後で改めて過去の関連要因を検討するために得られた結論のバイアスは大きい。バイアスの少ない、ありのままの状態を観察するためには、時間・労力はかかるが前向き研究が望ましい。

前向き研究では集団を経時的に追跡観察していく。この際に予め何らかの事象発生（例:死亡、急性心筋梗塞）を対象者観察の終了(end point)として設定し、初回調査時にその候補関連要因を調査するのが通常のコホート研究である。この場合は初回調査時の調査項目が限られており、追跡する項目はend point要因のみであるので調査項目は比較的限られるが、end pointの発生確率によっては統計的に意義のある結果をえるために1万人以上の対象を必要とすることもある。

一方、同じ前向き研究であっても、我々が行っているような「老化の縦断疫学研究（後述）」ではend pointとなりうる事象は無数にあり得る。死亡はもちろん、ADL(activity of daily living)、QOL(quality of life)、認知機能やいわゆる老年症候群といわれる痴呆、骨粗鬆症、尿失禁など、老化や老年病に関わるあらゆる健康事象が

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