

Original Article

Dietary supplements usage among elderly Taiwanese during 2005-2008

Shih-Ying Chen PhD¹, Jia-Rong Lin PhD², Tzu-Hsiu Chen PhD³, Shiou-Guei Guo MS³, Mei-Ding Kao MS⁴, Wen-Harn Pan PhD^{5,6,7}

¹*Chia Nan University of Pharmacy and Science, Department of Applied Life Science and Health, Tainan, Taiwan, ROC*

²*Chia Nan University of Pharmacy and Science, Department of Early Childhood Education and Nursery, Tainan, Taiwan, ROC*

³*Chia Nan University of Pharmacy and Science, Department of Health and Nutrition, Tainan, Taiwan, ROC*

⁴*Providence University, Department of Food and Nutrition, Taichung, Taiwan, ROC*

⁵*Nutrition Medicine Research Program, Division of Preventive Medicine and Health Services Research, Institute of Population Health Sciences, National Health Research Institutes, Miaoli, Taiwan, ROC*

⁶*Institute of Biomedical Science, Academia Sinica, Taipei, Taiwan, ROC*

⁷*Department of Biochemical Science and Technology, National Taiwan University, Taipei, Taiwan, ROC*

This study describes dietary supplement consumption practices among the Taiwanese population over the age of 65. Data for the analyses were derived from the 2005-2008 Nutrition and Health Survey in Taiwan. Data from a total of 914 participants (456 men and 458 women) was collected in the study to delineate patterns of supplement usage. The results indicated that the percentage of individuals taking supplements was 45.7% for men and 52.2% for women. There were no significant differences in supplement use by gender, age group, geographic stratum, current employment status, household monthly income, self-reported health status or marital status, except for higher education and adequate perceived financial resources. Half of both men and women chose to take only one supplement. In addition, as the number of supplements taken increased, the number of people decreased. The elderly with higher education levels were more likely to take two kinds of supplements. The top five supplements consumed from highest to lowest were: glucosamine, multivitamins and minerals, calcium, fish oil and vitamin B complex. The major reason for supplements use for men was to supplement an unbalanced diet, and that for women was to prevent joint degeneration. The main factor influencing choice of supplements in the elderly was receiving the supplement as a gift from another person. Note that mean intakes of vitamins A, C, E, B-1, B-2, B-6, B-12, biotin, niacin, and pantothenic acid from supplements over-exceeded DRIs in Taiwan.

Key Words: dietary supplements, the elderly, Nutrition and Health Survey in Taiwan (NAHSIT 2005-2008), consumption practices, dietary reference intakes (DRIs)

INTRODUCTION

Increased dissemination of medical information, greater health consciousness in the population and advances in medical technology has resulted in increased life expectancy in Taiwan. In addition, in recent years the birth rate has declined and the age structure of society has changed with an increase in older persons in the population. The World Health Organization has defined an aging society as one in which the proportion of the population aged 65 years and over is more than 7%. According to data from the Department of Household Registration, Ministry of the Interior, the proportion of older persons in Taiwan reached the 7% cut-off for an ageing society in 1993. In 2010 the proportion of the population aged 65 years and over reached 10.74%.¹ As a result, Taiwan, like Europe, the United States and Japan, has become an ageing society and therefore, chronic diseases (e.g. cancer, cardiovascular disease, the metabolic syndrome or diabetes) and health issues common to older persons (e.g. joint health, bone density, cardiovascular health, immune function and

delayed aging) are becoming increasingly important.² More recently, the concept of preventative medicine has begun to gradually replace more traditional disease treatment methods. People's attitudes towards medical therapy have also changed from passive to active. Their expectations of health and quality of life have increased, which is the main contributing factor behind the rise in use of supplements. In order to satisfy the demands of different consumer groups, the dietary supplement market has become increasingly individualized, with reported health

Corresponding Author: Dr Shih-Ying Chen, Department of Applied Life Science and Health, Chia-Nan University of Pharmacy and Science, 60 Erh-Jen Road, Section 1, 71710, Jen-Te, Tainan, Taiwan, ROC.

Tel: +886-6-2664911-3501; Fax: +886-6-2667097

Email: shihying@mail.chna.edu.tw; osyc@ms48.hinet.net

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protection effects also becoming more diversified.^{2,3} Dietary supplements have already become an important product in the food market.

Consumer expenditure on supplements in Taiwan has continued to grow in recent years and the proportion of people taking supplements has increased. In 1995-96 it reached a value of NT\$25 billion and further increased to approximately NT\$46.1 billion in 2008.³⁻⁵ The scale of the supplement market continues to increase year by year, along with associated import and export market values.³ Supplement marketing channels have also diversified. The early stages of direct selling were followed by the introduction of television sales and the conversion of pharmacies to mixed businesses that sell both pharmaceuticals and cosmetic products. The 2008 survey of food products found an increasing trend of supplement purchasing through television, online and door-to-door sales.³ Many researches have found that women, Caucasians, older persons, those living in highly urbanized environments, those with high education or high income are all more likely to take supplements.⁶⁻¹³ However, as the population of older person increases, the proportion of older supplement users will also increase, and hence older person have become an important potential new consumer group. In the United States, supplement use has demonstrated an increasing trend.^{6,13,14} A growing proportion of older persons are using vitamin and mineral supplements, which can substantially increase nutrient intake and counter some of these shortfalls.^{15,16} Lin found that vitamins and minerals accounted for the greatest expenditure on supplements in Taiwan. Approximately NT\$3.5-4 billion was spent on vitamins and NT\$1-1.2 billion was spent on minerals.¹⁷ In the United States, the total supplement market increased to US\$50 billion, of which expenditure on vitamins and minerals made the largest contribution. Sales of vitamins throughout the entire United States reached US\$7.4 billion and sales of minerals reached US\$1.8 billion.^{2,14} However, little is known about the effectiveness of supplements in appropriately compensating for dietary deficits. Each product is alleged to have health benefits, many of which have not yet been established, and companies use exaggerated and unrealistic advertising to promote their products.¹⁸ In addition, there is great variability in the safety and quality of available supplements. As supplement use continues to increase in Taiwan, it is important to have an understanding of people's practices towards supplement use and the marketing techniques used for each product. This information needs to be conveyed to relevant professionals and the general public so that they are able to critically examine the marketing techniques and advertisements used for particular products, thereby ensuring public health and safety.

The aim of this study was to understand the following in regards to older persons in Taiwan: 1) the characteristics associated with use of supplements; 2) the characteristics associated with use of single or multiple supplements; 3) the types of supplements used, the motivations behind taking supplements and factors influencing choice of supplements; 4) the associations between supplement use behavior and medical history; and 5) nutrient intakes from supplements. An understanding of older people's

use of supplements and the motivations behind such use will enable the development of recommendations for improving appropriate supplement intake in elderly Taiwanese and will facilitate the appropriate management of supplements and other health products in this age group.

MATERIALS AND METHODS

Data source and sample

This study describes dietary supplement consumption practices among the Taiwanese population over the age of 65, including the purpose and motivation behind supplement usage as well as the personal characteristics of supplement takers. Data for the analyses were retrieved from the Nutrition and Health Survey in Taiwan (2005-2008) which was carried out during 2005-2008. Data from a total of 914 participants (456 men and 458 women) was collected in the study to delineate patterns of supplement usage. A complex multistage, area probability sample design was used to select persons within households. Individuals aged 65 years and older were oversampled. Details of the sample design and methods have been enumerated elsewhere.¹⁹ Data were collected by household interviews in the above survey. Household interviews were carried out by local part-time interviewers who systematically collected cases from 2005 to 2008. The local public health department nutritionist was responsible for supervising the household interview. Sociodemographic variables for this analysis included variables shown in previous studies to be related to supplement use, including gender, age group, education level, geographic location, current employment status, household and personal monthly income, perceived financial resources, self-reported health status or marital status.^{20,21}

Data processing from supplements

Supplement information was collected through a series of questions, including the frequency of consumption in the past month, the amount of each nutrient in the supplement (the formulation) and the brand name. Supplement users were defined as individuals who took any kind of vitamin or mineral supplement, or health promotion products in the past month. Based on the nutritional characteristics of the supplements, we classified dietary supplements in this study into eight categories for descriptive statistics: "vitamins", "vitamins and minerals", "minerals", "Chinese herbs", "lipids", "protein and formula food", "plant derived products" and "other health promotional foods". Data from the Nutrition and Health Survey in Taiwan (2005-2008) were used to calculate nutrient intake from supplement users. Some nutrients required conversion to standardized measurement units before comparison of dietary intakes to the dietary reference intakes (DRIs) could be made. Vitamin A had to be converted to micrograms retinol activity equivalents, and vitamin E to milligrams α -tocopherol.¹²

Statistical analyses

Most of the results were obtained from logistic regression analyses and describe the use of dietary supplements based on information collected by the questionnaire based interview. In order to produce representative estimates of certain attributes, a weighting process was needed. Logis-

tic regression analysis was carried out using SUDAAN 8.0. The descriptive analyses were done by Window's SAS software. Statistical significance was taken as $p < 0.05$.

RESULTS

Relationships between demographic characteristics of the elderly and use of supplements

Table 1 shows that a total of 45.7% of men and 52.2% of women reported taking supplements. Elderly subjects who had a senior high school (66.0%, odds ratio (OR)=2.36, 95% confidence interval (CI)=1.28-4.37) or college/ university and above educational status (64.2%, OR=2.17, 95% CI=1.40-3.37) were more likely to take supplements than those with a junior high school or lower level of education (45.2%, $p < 0.05$). Subjects with a household monthly income of more than NT\$20,000 (61.2%) or no income (56.3%) were significantly more likely to take supplements compared to those with less than NT\$20,000 (39.7%). Subjects with perceived adequate financial resources (53.0%, OR=1.59, 95% CI=1.12-2.24) were significantly more likely to use supplements than those who perceived their financial resources as inadequate (41.6%). There were no statistical differences in supplement use by gender, age group, geographical location, current employment status, self-reported health status or marital status.

Relationships between demographic characteristics of the elderly and use of single or multiple supplements

Figure 1 shows the distribution of the number of supple-

ments used by the elderly. In both men and women, 50% of persons chose to use only one type of supplement. As the number of supplements taken increased, the number of people using these supplements decreased. Table 2 demonstrates that the elderly with gender, age, geographical location, current employment status, household monthly income, self-reported health status, perceived financial resources and marital status were not significantly associated with the use of more than one type of supplement. However, those with college / university and above were significantly more likely to use several types of supplements (63.1%, OR=2.11, 95% CI=1.10-4.03) than those with a junior high school or lower level of education (44.7%, $p < 0.05$).

The distribution of use of a variety of supplements

Based on the characteristics of the supplements, dietary supplements were divided into eight categories: "vitamins", "vitamins and minerals", "minerals", "Chinese herbs", "lipids", "protein and formula food", "plant derived products" and "other health promotional foods". Among all of these dietary supplements, the highest percentage use was of other health promotional foods (42.5%), followed by vitamins and minerals at 37.8%, vitamins at 21.1%, lipids at 13.8%, minerals at 12.8%, Chinese herbal at 13.3%, and plant derived products at 9.6%. The lowest percentage use was of protein and formula food at 8.3%. In the vitamins category, the highest consumption was of vitamin B (9.2%), followed by vitamin E (4.4%). In regards to vitamins and mineral products,

Table 1. Demographic characteristics of elderly subjects and supplement use

	Characteristic	n	Take supplements		χ^2	p	OR (95% CI)
			Yes (%)	No (%)			
Gender	Male	456	45.7	54.3	2.74	0.110	1
	Female	458	52.2	47.8			
Age (years)	65-69	319	51.2	48.8	0.16	0.925	1.11 (0.65-1.90)
	70-74	250	47.7	52.3			
	75-79	210	47.8	52.2			
	80 and above	135	48.5	51.5			
Educational level	Junior high school and below	750	45.2	54.8	6.99*	0.004	1
	Senior high school	91	66.0	34.0			
	college /university and above	69	64.2	35.8			
Geographical stratum	First northern stratum	176	54.6	45.4	1.33	0.284	1.53 (0.86-2.71)
	Second northern stratum	193	41.6	58.4			
	Central stratum	177	47.0	53.0			
	Southern stratum	183	49.5	50.5			
	Eastern stratum	185	44.0	56.0			
Current employment status	Working full-time	92	38.5	61.5	1.19	0.333	1
	Working part-time	16	57.2	42.8			
	Not currently working	548	51.2	48.8			
Household monthly income	Home duties	254	46.9	53.1	5.56*	0.010	1.41 (0.76-2.62)
	No income	25	61.2	38.8			
	≤NT\$20,000	282	39.7	60.3			
Self-rated health	>NT\$20,000	233	56.3	43.7	0.25	0.781	0.82 (0.28-2.39)
	Much better than other people	256	47.5	52.5			
	About the same as other people	417	50.0	50.0			
Perceived financial circumstances	Much worse than other people	199	49.5	50.5	7.48*	0.011	1.59 (1.12-2.24)*
	Adequate	588	53.0	47.0			
	Inadequate	286	41.6	58.4			
Marital status	Single	309	52.3	47.7	1.17	0.290	1
	Not single	604	47.2	52.8			

*Indicates a significant difference at $p < 0.05$, compared to the reference group.

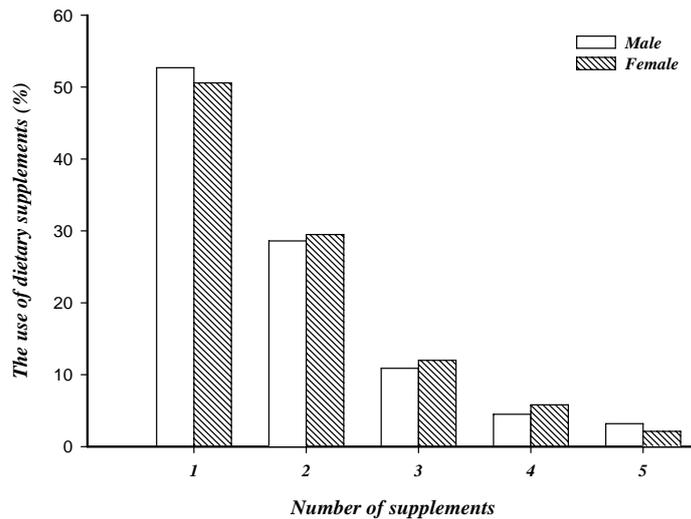


Figure 1. Number of supplements used by the elderly.

Table 2. The relationship between demographic characteristics of elderly subjects and number of supplements taken

Characteristic	n	Number of supplements taken		χ^2	p	OR (95% C.I.)
		1 (%)	≥2 (%)			
Gender				0.13	0.724	1
	Male	200	52.7	47.3		
	Female	231	50.6	49.4		1.11 (0.67-1.84)
Age (years)				0.45	0.719	1
	65-69	154	47.9	52.1		1.17 (0.67-2.03)
	70-74	112	58.3	41.7		0.76 (0.45-1.30)
	75-79	103	49.4	50.6		1.14 (0.62-2.09)
	80 and above	62	52.1	47.9		1
Educational level				3.75*	0.037	1
	Junior high school and below	323	55.3	44.7		1
	Senior high school	59	43.8	56.2		1.58 (0.86-2.93)
	college /university and above	46	36.9	63.1		2.11 (1.10-4.03)*
Geographical stratum				0.94	0.455	1
	First northern stratum	96	43.2	56.8		1.66 (0.77-3.61)
	Second northern stratum	81	50.7	49.3		1.27 (0.68-2.39)
	Central stratum	83	56.6	43.4		1.06 (0.58-1.93)
	Southern stratum	91	55.3	44.7		1.06 (0.55-2.06)
	Eastern stratum	80	57.4	42.6		1
Current employment status				0.56	0.646	1
	Working full-time	32	51.5	48.5		1
	Working part-time	8	54.4	45.6		1.37 (0.16-11.8)
	Not currently working	269	50.6	49.4		1.58 (0.71-3.50)
	Home duties	121	50.6	49.4		1.63 (0.64-4.17)
Household monthly income				2.53	0.099	1
	No income	13	33.1	66.9		1
	≤NT\$20,000	113	57.7	42.3		0.55 (0.14-2.16)
	>NT\$20,000	125	47.4	52.6		0.81 (0.20-3.18)
Self-rated health				0.46	0.637	1
	Much better than other people	118	47.5	52.5		1.23 (0.60-2.54)
	About the same as other people	205	54.0	46.0		0.90 (0.52-1.65)
	Much worse than other people	95	52.0	48.0		1
Perceived financial circumstances				1.15	0.294	1
	Adequate	304	49.9	50.1		1.37 (0.77-2.46)
	Inadequate	111	57.5	42.5		1
Marital status				0.07	0.788	1
	Single	151	50.6	49.4		1
	Not single	279	52.3	47.7		0.91 (0.55-1.50)

*Indicates a significant difference at $p < 0.05$, compared to the reference group.

Multivitamins and minerals were the most commonly taken supplements (34.2%). Calcium was the most commonly taken mineral (11.3%). In Chinese herbal products, the most commonly taken item was Chinese medicinal products (5.3%), followed by *gingko biloba* (2.5%) and *Ganoderma lucidum* (2.2%). In protein and formula foods, high protein products were the most commonly taken item (2.5%). Fish oil was the most commonly consumed lipid product (11.2%) and glucosamine was the most frequently consumed other health promotional product

(36.0%). The most commonly taken plant derived product was na-dou (3.2%), followed by grape seed (2.8%). Of the supplements taken by the elderly, only 0.02% of items conform to "Health Food Control Act" of Taiwan. Moreover, accounting for 50% of items used under the Act of "Health Food" was chicken essence (data not shown).

Table 3 shows that the ten most commonly used supplements by the elderly were: glucosamine (36.0%), multivitamins and minerals (34.2%), calcium (11.3%), fish oil (11.2%), vitamin B group (9.2%), Chinese medicine

(5.3%), vitamin E (4.6%), vitamin D plus calcium (4.0%), vitamin C (3.4%), and natural extracts (3.2%). The greatest differences between men and women in supplements most commonly used were that men had higher usage rates of multivitamins and minerals, vitamin B group, natural extracts, nadou and multivitamins. In contrast, women were more likely to take glucosamine, calcium, fish oil, vitamin D plus calcium, Chinese medicine, cod-liver oil and vitamin C.

Motivations behind supplement use and factors contributing to choice of supplements

Figure 2 indicates the reasons elderly subjects take supplements. The five most common reasons for taking supplements were: to supplement an unbalanced diet (40.3%), to prevent joint degeneration (32.5%), to prevent osteoporosis (23.7%), other (13.5%) and to improve cholesterol (9.9%). The greatest difference between men and women in terms of the reasons for taking supplements was that the number one motivation for men was to supplement an unbalanced diet followed by to prevent joint degeneration and osteoporosis. In women, the number one motivation behind taking supplements was to prevent joint degeneration followed by to supplement an unbalanced diet and to prevent osteoporosis. Figure 3 list the factors influencing

choice of supplements in the elderly which in decreasing order of importance, namely: receiving a particular supplement as a gift (55.0%), being introduced to a supplement by family or friends (20.5%), being introduced to a supplement by a medical professional (13.3%) and brand or reputation of the product (8.3%). Furthermore, according to medical history, the elderly took significantly more dietary supplements if they were diagnosed as pulmonary tuberculosis (OR=12.9, 95% CI=3.67-45.2), allergies (OR=2.49, 95% CI=1.60-3.87), peptic ulcer (OR=2.11, 95% CI=1.17-3.82), chronic liver disease (OR=2.49, 95% CI=1.14-5.46), arthritis (OR=2.03, 95% CI=1.09-3.80), hyperlipidemia (OR=2.14, 95% CI=1.16-3.93), heart disease (OR=1.53, 95% CI=1.00-2.33), depression (OR=6.20, 95% CI=1.19-32.27), prostatic enlargement (OR=2.19, 95% CI=1.35-3.53) and Oother diseases (OR=1.99, 95% CI=1.03-3.86) (data not shown). In addition, glucosamine and "vitamins and minerals" were the items more frequently taken by the elderly with any kind diseases. Except that the main choice item for the elderly with tuberculosis was "protein and formula food", and calcium (data not shown). This data indicated that the elderly with different diseases did not choose to take special property supplements.

Table 3. Top ten dietary supplements used by the elderly

Rank	Overall (%)	Male (%)	Female (%)
1	Glucosamine (36.0)	Multivitamin/mineral (45.3)	Glucosamine (42.8)
2	Multivitamin/mineral (34.2)	Glucosamine (28.0)	Multivitamin/mineral (24.7)
3	Calcium (11.3)	Vitamin B complex (11.8)	Calcium (12.4)
4	fish oil (11.2)	fish oil (10.8)	fish oil (11.5)
5	Vitamin B complex (9.2)	Calcium (9.9)	Vitamin B complex (7.1)
6	Chinese medicine (5.3)	Chinese medicine (4.9)	Vitamin D + Calcium (6.3)
7	Vitamin E (4.6)	Vitamin E (4.6)	Chinese medicine (5.7)
8	Vitamin D + Calcium (4.0)	Natural extracts (4.6)	Vitamin E (4.5)
9	Vitamin C (3.4)	Na-dou (4.0)	Cod liver oil (3.6)
10	Natural extracts [†] (3.2)	Multivitamin (3.9)	Vitamin C (3.4)

[†]Natural extracts include bilberry, blueberry, mushroom, other types of plant extracts, and products containing several kinds of plant concentrate and extracts.

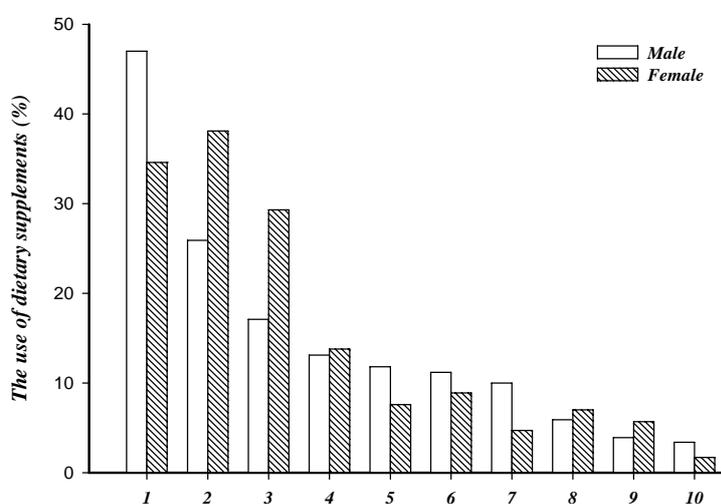


Figure 2. The reasons for taking supplements in 431 elders using supplements. 1. Supplement an unbalanced diet (n=172); 2. Prevent joint degeneration (n=142); 3. Prevent osteoporosis (n=105); 4. Other (n=57); 5. Improve body composition (n=41); 6. Improve cholesterol (n=39); 7. Increase physical strength (n=33); 8. Strengthen immunity (n=25); 9. Regulate digestion (n=18); and 10. Fight fatigue (n=13).

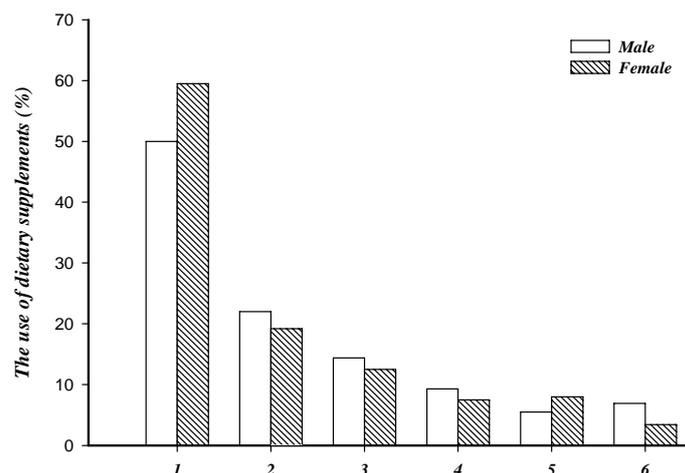


Figure 3. Factors influencing choice of supplements in 431 elders using supplements. 1. Given as a present (n=241); 2. Recommended by family or friends (n=85); 3. Recommended by health professional (n=65); 4. Trade-name or reputation (n=35); 5. Other (n=26); 6. Recommended by shop manager or other staff-member (n=21).

Table 4. Vitamin and Mineral intake from supplements in supplement users

Nutrient	n	DRIs	UL	Mean \pm SE	Range	Q25	Median	Q75
Vitamin A (μ g)	187	500-600	3000	813 \pm 51.3	17.5-4000	375	750	940
Vitamin D (μ g)	226	10	50	9.76 \pm 0.56	0.09-510	5	10	12.5
Vitamin E (mg)	198	12	1000	71.5 \pm 9.88	0.01-450	18	50	58
Vitamin C (mg)	197	100	2000	116 \pm 12.1	0.05-1026	60	90	100
Vitamin B-1 (mg)	203	0.8-1.3	-	13.0 \pm 1.96	0.003-202	1.5	1.5	11.4
Vitamin B-2 (mg)	203	0.8-1.4	-	7.51 \pm 1.24	0.01-100	1.7	1.7	7.16
Vitamin B-6 (mg)	203	1.6	80	8.94 \pm 1.29	0.003-200	2	3	6
Vitamin B-12 (μ g)	202	2.4	-	44.7 \pm 9.82	0.17-1006	6	25	25
Folate (μ g)	192	400	1000	390 \pm 16.6	3.33-1300	250	425	500
Biotin (μ g)	158	30	-	38.3 \pm 4.75	0.5-450	30	30	30
Niacin (mg)	170	10-17	35	19.3 \pm 1.11	0.04-107	11.2	20	20
Pantothenic acid (mg)	74	5	-	14.5 \pm 3.48	0.02-175	3.33	9.5	10
Choline (mg)	24	360-450	3500	74.1 \pm 17.4	1.5-220	20.2	50	75
Calcium(mg)	235	1000	2500	257 \pm 13.4	1.03-1604	118	220	324
Magnesium (mg)	182	315-360	700	63.1 \pm 5.55	0.53-735	42.7	50	70
Iron (mg)	72	10	40	9.09 \pm 0.88	0.09-39	2.43	8.2	13.8
Selenium(μ g)	149	50	400	44.0 \pm 3.01	0.93-300	25	55	55
Phosphorus (mg)	151	800	3000	103 \pm 6.64	1.14-636	61.9	110	110
Iodine (μ g)	147	140	1000	121 \pm 5.72	1.75-300	75	150	150
Potassium(mg)	161	-	-	76.6 \pm 7.58	0.04-780	40	80	80
Fiber (g)	8	20-30	-	0.72 \pm 0.27	0.02-3.6	0.18	0.41	0.87

Mean nutrient intake in elderly subjects taking supplements

Table 4 shows the nutrient intake from supplements in persons aged 65 years and over. Intake of vitamins A, C, E, B-1, B-2, B-6, B-12, biotin, niacin, and pantothenic acid all over-exceeded mean DRIs. Intake of vitamin D, folate, iron, selenium and iodine were similar to mean DRIs. However, intake of calcium, magnesium, dietary fiber, choline and phosphorus were all far below mean DRIs.

DISCUSSION

In the NAHSIT 1993-1996, 22.3% of elderly men and 22.6% of elderly women reported taking supplements.²² In the 1999-2000 Elderly Nutrition and Health Survey in Taiwan (ENAHST 1999-2000), 30.1% of elderly men and 34.9% of elderly women reported taking supplements.^{20,21} The present study found that 45.7% of elderly men and 52.2% of elderly women reported taking sup-

plements. The results from these three surveys demonstrate that women have a higher rate of supplement use than men, possibly related to a greater focus on health and nutrition by women.²⁰ In addition, it is clear that the rate of supplement use by the elderly is increasing over time. Although the rate of supplement use of the elderly in Taiwan remains higher than that of 23.8% found in South Korea,¹⁰ and that of 8.5% reported in mainland China,²⁴ it is lower than the rate of 63.3% found in the United States⁶ and is similar to that of 45.8% reported in central and southern areas of Japan.²⁵

Many results have shown that the consumption of dietary supplements is higher in urban areas.^{6,10,12,13} This trend is similar to that observed in mainland China and South Korea where persons living in metropolitan areas have higher rates of supplement use than those living in non-metropolitan areas.^{10,23,24} Furthermore, this was compatible with the results of NAHSIT 1993-1996 and ENAHST 1999-2000, where the highest rate of people

taking dietary supplements was found in those living in the capital city.²⁰⁻²² However, the elderly in the first northern stratum of Taiwan did not have a significantly higher rate of dietary supplements use than those in other areas in this study. If a more detailed examination of the ENAHSIT 1999-2000 and current survey data is made, we find that the rate of supplement use in the Eastern stratum has increased from 5.4% to 44.0%, which is a rate of increase that is higher than that observed in the other four strata. It demonstrates that in recent years, people in areas that are less urbanized are focusing more and more on taking supplements.

Our findings that high education level or perceived financial adequacy are associated with a higher rate of supplement use are similar to those reported by other international research that found higher rates of supplement use in those with high compared to low levels of education.^{6,10-13,26} On the other hand, we found that household income had no direct association with the rate of supplement use. This is in contrast to the finding that individuals with higher monthly incomes had higher rates of supplement use and demonstrates that use of supplements is associated with individual economic capability rather than household circumstances.

Results of in this study indicated that gender, age, geographical location, current employment status, household monthly income, self-reported health status, perceived financial resources and marital status were not significantly associated with the choice of one as compared to several supplements. These findings are similar to those found in the ENAHSIT 1999-2000. However, they differ somewhat from those of a German study that found that women were more likely to use two or more kinds of supplements compared to men.²⁷ Chen *et al.* also found that women were more likely to use several kinds of supplements.²⁰ In addition, all of the abovementioned studies and the present study agree that the elderly and those with a higher level of education are more likely to take more than one kind of supplement. Compared to the elderly aged 60 years and over in the United States (63.2% use two or more kinds of supplements),⁶ the elderly in Taiwan are less likely to use two or more kinds of supplements.

In regards to use of vitamins or minerals by the elderly, the most commonly chosen supplement was multivitamins and minerals (34.2%), followed by calcium (11.3%), vitamin B complex (9.2%), and vitamin E (4.6%) in this study. These findings are similar to those of the ENAHSIT 1999-2000 where the most commonly used supplement was multivitamins and minerals (32.2%), followed by calcium (20.9%), vitamin E (19.4%), vitamin C (9.7%) and vitamin B complex (5.5%).^{20,21} Multivitamins and minerals is still the most commonly taken supplement. Use of vitamin B complex has clearly increased, but that of calcium, vitamin C or vitamin E supplements has decreased by about 50%, 60% or 75% compared to the ENAHSIT 1999-2000, respectively. The most commonly taken non-vitamin and non-mineral supplement (functional food) was glucosamine (36.0%) followed by fish oil (11.2%) and Chinese medicine (5.3%) in this study. These findings are quite different to those of the ENAHSIT 1999-2000 where fish oil (5.3%) and Ginseng

(4.9%) were the most commonly taken functional foods. Use of glucosamine in the elderly in Taiwan has dramatically increased and it has become the first choice of supplement. The findings are similar to those from the United States where glucosamine was the most commonly used supplement taken by the elderly.²⁸ The findings are also similar to those reported in Mexico in 1995-1999 where glucosamine was the most commonly used non-vitamin and non-mineral supplement with an increase in the rate of use from 0.4% to 17.5%.²⁹ Moreover, use of glucosamine is higher in elderly women compared to elderly men, which demonstrates that elderly women are more concerned with bone and joint problems. It is possible that the increase in use of glucosamine has been influenced by advertising related to the effect of glucosamine on the prevention of bone pathological changes, and it would be worthwhile investigating this phenomenon further. On the other hand, the use of fish oil has also increased, possibly related to associate health information that fish oil is able to prevent cardiovascular disease. International research shows that *gingko biloba*, garlic and ginseng are the most commonly used Chinese herbal supplements,²⁶ which differs somewhat from the findings of the present study that found that the most commonly used supplements from this group were Chinese medicine (5.3%), *gingko biloba* (2.5%) and *Ganoderma lucidum* (2.1%). This could be related to cultural differences between individual countries.

Results of Chou *et al.* found that consumer's knowledge about supplements came predominantly from recommendations from family and friends as well as professionals.³⁰ However, the most important sources of supplements for the elderly in this study were receiving them as a gift from other people, followed by being introduced to them by family or friends. In addition, research by Lee *et al.* has found that people with very poor self-reported health and those with chronic diseases are more likely to take supplements than their healthier counterparts.³¹ International research has also found that people with diabetes or high blood pressure are more likely to take supplements.^{32,33} These findings are similar to those of our study and the ENAHSIT 1999-2000 that the use of supplements are associated with some medical history. However, we did not find that elderly with different diseases choose to take special property supplements in the present study. Hence, an important topic of future research would be whether it is more appropriate for people with a particular health status to take specific supplements.

Much international research indicates that multivitamins and minerals are the most commonly taken supplements.^{8,15} Chou *et al.* found that the most important requirement of consumers towards supplements was the product's effectiveness (results from using the product) followed by the dose of ingredients.³⁰ In addition, 50% of consumers thought that health foods or supplements could replace medicines for the treatment of disease and almost 60% believed that health foods or supplements can prevent certain diseases.³¹ Wang *et al.* showed that 85% of consumers did not have an understanding of safe doses of vitamins and minerals and had inadequate knowledge about the principles of safely using supplements or their nutritional content.³⁴ Moreover, many products on the

market exceed the upper limits of recommended intake levels, and it is possible that long-term use could harm health, which is in stark contrast to the goal of improving health that is behind the taking of such supplements. Research in Poland, the United States and Germany have all shown that intakes from supplements of vitamins A, D, E, B-1, B-2 and B-6 (50th percentile) exceed national recommended intake levels.^{7,11,27} In contrast, the quantity of calcium (50th percentile) ingested is only half that of the recommended intake in the countries concerned. These findings are similar to those of our study. We found that the intake from supplements of vitamins A, C, E, B-1, B-2, B-6, B-12, biotin, niacin, and pantothenic acid were all above mean recommended levels, although intake did not exceed the upper limits of recommended intake. However, long-term use of fat-soluble vitamins such as vitamins A has the potential to lead to excessive intakes, resulting in liver toxicity. Special care needs to be taken when using supplements containing fat-soluble vitamins or repetitive use should be avoided. Similarly we found that mean intake of calcium calculated from supplements was only 279 mg. Elderly peoples' mean intakes of calcium, magnesium and dietary fiber from supplements were all less than half of DRIs. In addition, calcium, magnesium and dietary fiber are the nutrients or food components more commonly lacking in elderly people's diets. Pan *et al.* has shown that dietary intake of calcium in Taiwan is only 60% of recommended levels.³⁵ If we add the mean nutrient intake from supplements, there is potential for intake to still fall short of the DRI of 1000 mg. This indicates that elderly subjects' supplementation of calcium fails to meet expectations. In addition, the quantity of dietary fiber in supplements is extremely low and it is therefore not expedient to obtain adequate quantities of fiber through supplements. The correct use of supplements can promote health. However, inappropriate use of supplements can not only lead to a failure to improve health and a waste of resources, it can also lead to toxicity if intakes are excessive or fail to improve health if intakes are inadequate. An important direction of future nutrition education research is how to educate the public to improve understanding about supplements.

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AUTHOR DISCLOSURES

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Original Article

Dietary supplements usage among elderly Taiwanese during 2005-2008

Shih-Ying Chen PhD¹, Jia-Rong Lin PhD², Tzu-Hsiu Chen PhD³, Shiou-Guei Guo MS³, Mei-Ding Kao MS⁴, Wen-Harn Pan PhD^{5,6,7}

¹*Chia Nan University of Pharmacy and Science, Department of Applied Life Science and Health, Tainan, Taiwan, ROC*

²*Chia Nan University of Pharmacy and Science, Department of Early Childhood Education and Nursery, Tainan, Taiwan, ROC*

³*Chia Nan University of Pharmacy and Science, Department of Health and Nutrition, Tainan, Taiwan, ROC*

⁴*Providence University, Department of Food and Nutrition, Taichung, Taiwan, ROC*

⁵*Nutrition Medicine Research Program, Division of Preventive Medicine and Health Services Research, Institute of Population Health Sciences, National Health Research Institutes, Miaoli, Taiwan, ROC*

⁶*Institute of Biomedical Science, Academia Sinica, Taipei, Taiwan, ROC*

⁷*Department of Biochemical Science and Technology, National Taiwan University, Taipei, Taiwan, ROC*

2005-2008 年臺灣 65 歲以上國人膳食補充品的使用狀況

本研究主要資料來源為「2005-2008 年臺灣營養健康家戶調查(NAHSIT)」，藉由資料庫進行 65 歲以上老人膳食補充品使用狀況分析。問卷樣本數為 914 人，含男性 456 人與女性 458 人。結果顯示，男性老人服用補充品的比率為 45.7%，女性為 52.2%；除了高教育程度與感覺財務狀況足夠的老人，服用補充品比率顯著較高外，老人服用補充品比率不因性別、各年齡層、居住的地區層別、目前工作情況、全家每月收入、自覺健康狀況與婚姻狀況，而有顯著不同。男、女性皆有五成的人只選擇一種補充品，並且隨著選擇補充品的商品數增加而人數遞減；此外，教育程度越高的老人選擇兩種補充品比率越高。使用補充品前五大選擇分別為葡萄糖胺、綜合維生素與礦物質、鈣、魚油、維生素 B 群。男性主要服用目的為補充營養不均衡，女性為預防關節退化；補充品來源主要為他人贈送為主。值得注意的是，從補充品中攝取的維生素 A、C、E、B₁、B₂、B₆、B₁₂、生物素、菸鹼酸、泛酸之平均攝取量，均遠超過國人膳食營養素參考攝取量(DRIs)。

關鍵字：膳食補充品、老年人、臺灣營養健康家戶調查(NAHSIT 2005-2008)、消費行為、國人膳食營養素參考攝取量(DRIs)。