

Original Article

The usage of dietary supplements among elderly individuals in Taiwan

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This study describes dietary supplement consumption practices among the Taiwanese population over the age of 65. Data for the analyses were derived from the Elderly Nutrition and Health Survey in Taiwan (1999-2000) which was carried out from 1999-2000. Data from a total of 1937 participants (970 men and 967 women) were collected in the study to delineate patterns of supplement usage. The results indicated that the percentage of women taking supplements was 34.9%, which was higher than 30.1% for men. About 50% of male and female supplement takers took only one type of supplement. The numbers of people taking supplements decreased as the total number of supplement types chosen increased. The top five types of supplements consumed from highest to lowest were: multivitamins and minerals, calcium, vitamin E, vitamin C and fish oil. The elderly residing in the first stratum in the northern areas of Taiwan had the highest rate of taking supplements compared to other locations. In contrast, the elderly residing in mountain areas, eastern areas, and the third stratum in the central areas of Taiwan had a significantly lower rate of supplement ingestion. In addition, elderly people with the following characteristics had a significantly higher rate of taking supplements: higher education, higher monthly income, sufficient disposable income, higher scores in nutrition knowledge, daily ingestion of vitamin or mineral supplements, awareness of nutritional knowledge, regular ingestion of health-enhancing medicines, a lacto-ovovegetarian diet, good understanding of their own health status, and frequent exercisers.

Key Words: dietary supplements, the elderly, nutrition knowledge, practices, physiopsychological situation, Elderly Nutrition and Health Survey in Taiwan (1999-2000)

Introduction

In recent years, people in Taiwan have substantially increased their interest in the relationship between diet and health. There is much greater recognition today that people can help themselves and their families to reduce the risk of disease and maintain their health and well being through a healthy lifestyle, including a healthy diet. There is ongoing support for the important role of foods such as fruit and vegetables and wholegrain cereals in disease prevention. The latest research on dietary antioxidants and combinations of protective substances in plants has helped to provide the impetus for further developments in the dietary supplement market in Taiwan.¹ Consumers in Taiwan spent about NT\$25 billion on dietary supplements in 1995-1996.² In 2002, the consumption of dietary supplements reached NT\$20 billion in this one year period alone. It is obvious that the dietary supplement market in Taiwan has been gradually maturing. Most consumers bought their dietary supplements from multilevel marketing and imported goods are the leading sources.² In Lin's report, vitamins and minerals were the principal supplements taken by people in Taiwan. The product values of vitamins and minerals were NT\$3.5-4.0 billion and NT\$1.0-1.2 billion, respectively in 1998.³ However, contamination and over-

dosing of supplements has resulted in many incidences of intoxication. Manufacturers of dietary supplements need to demonstrate that they are a responsible industry to policy makers, the scientific community and consumers.⁴⁻⁶ The elderly population is increasing in Taiwan and therefore providing care to the elderly will be an important consideration in this century. There are many ways to improve life, but nutrition and health are the most important. We were unaware of what kinds of dietary supplements are ingested, and the purpose and motivation behind their use by the elderly. The purpose of this study was to investigate the usage patterns of dietary supplements, and to identify factors that might influence these patterns in the elderly. The following four topics will be discussed:

1. The relationship between demographic characteristics of the elderly and the use of dietary supplements.

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2. The distribution of use of a variety of dietary supplements.
3. The relationship between nutritional related knowledge and dietetic habits of the elderly and the use of dietary supplements.
4. The relationship between elderly physiopsychological status and the use of dietary supplements.

Subjects and methods

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 Elderly Nutrition and Health Survey in Taiwan (1999-2000) which was carried out during 1999-2000. Data from a total of 1937 participants (970 men and 967 women) were collected in the study to delineate patterns of supplement usage. The data were collected by household interviews in the above survey.⁷ The household interview was carried out by local part-time interviewers who systematically collected cases from 1999 to 2000. The local public health department nutritionist was responsible for supervising the household interview. The following interview data were collected: household information, basic demographics, food frequency and eating habits, knowledge, attitudes and behavior, a 36-item Short Form about general health status (SF-36), and physical activity. 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. Logistic regression analysis was carried out using SUDAAN 8.0.⁸ The descriptive analysis, *t* test and correlation analysis were done by Window's SAS software. Statistical significance was taken as $P < 0.05$.

Results

The relationship between demographic characteristics of the elderly and the use of dietary supplements

Basic demographic information such as gender, stratified district, education level, current employment status, profession before retirement, household and personal income, and disposable income were collected and included in the logistic regression analysis. The results of the analysis are shown in Figures 1 & 2 and Tables 1 & 2. Figure 1 shows that 30.1% of men aged 65 and above took dietary supplements. For women in the same age group, the rate was 34.9%. In either gender, almost 80% of those who took dietary supplements were taking supplements regularly. The proportion of elderly men taking dietary supplements was considerably lower than elderly women ($OR = 0.08$, $CI = 0.65-1.00$; $P < 0.05$). About 50% of men and women taking dietary supplements only took one type of dietary supplement. The numbers of people taking supplements decreased as the total number of supplement types chosen increased (Fig. 2).

As shown in Tables 1 & 2, the rates and odds ratios of taking dietary supplements among men in each stratum in the northern areas of Taiwan (level 1 through 3) were 51.6% ($OR = 4.06$, $CI = 1.99-8.27$; $P < 0.05$), 39.9%

($OR = 2.53$, $CI = 1.02-6.30$; $P < 0.05$), and 40.7% ($OR = 2.62$, $CI = 1.03-6.67$; $P < 0.05$) respectively. All of the rates mentioned above in the northern areas were higher than those of other locations. These rates were significantly different compared to that of the reference district (the third stratum in the southern areas of Taiwan). Women in the first stratum in the northern areas of Taiwan had a higher rate (65.3%) of taking dietary supplements compared to other places, but there was no significant difference compared to that of the reference district. In addition, the rate of taking dietary supplements was highest in both men and women in the first stratum in the northern areas of Taiwan, where above 90% of elderly people were taking supplements regularly. In locations such as the mountain areas, the eastern part of Taiwan, and the third stratum in the central areas of Taiwan, the rates of taking dietary supplements in the elderly were comparatively lower than other places, and were significantly different to that of the reference district. The rates in these three locations were: in men, 2.6% ($OR = 0.10$, $CI = 0.01-0.99$; $P < 0.05$), 6.6% ($OR = 0.27$, $CI = 0.13-0.56$; $P < 0.05$), and 7.8% ($OR = 0.32$, $CI = 0.15-0.71$; $P < 0.05$) respectively; and in women, 3.0% ($OR = 0.04$, $CI = 0.00-0.40$; $P < 0.05$), 3.6% ($OR = 0.06$, $CI = 0.02-0.26$; $P < 0.05$), and 15.1% ($OR = 0.29$, $CI = 0.12-0.73$; $P < 0.05$) respectively.

Both men and women who had never attended school or had a primary school level of education, had significantly lower rates and odds ratios of taking dietary supplements. At each education level, higher percentages of women were taking dietary supplements than men of the same educational level. By analyzing current employment status it was shown that the rates of taking dietary supplements in men were significantly higher among those who were still working or were retired than those who had never worked. The rates in employed and retired men were 25.9% ($OR = 12.07$, $CI = 1.25-116.97$; $P < 0.05$) and 31.4% ($OR = 15.79$, $CI = 1.68-148.60$; $P < 0.05$), respectively. There were no significant differences in the rates of taking dietary supplements among women who were currently working, retired, housewives, or had never taken a job before. However, the retired women had a higher rate of taking dietary supplements than the others (Tables 1,2). Regarding profession before retirement, men

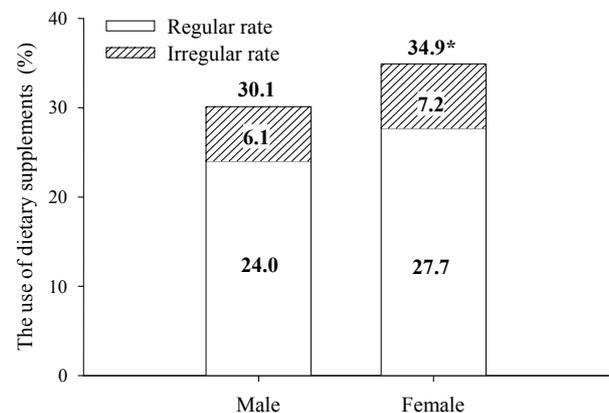
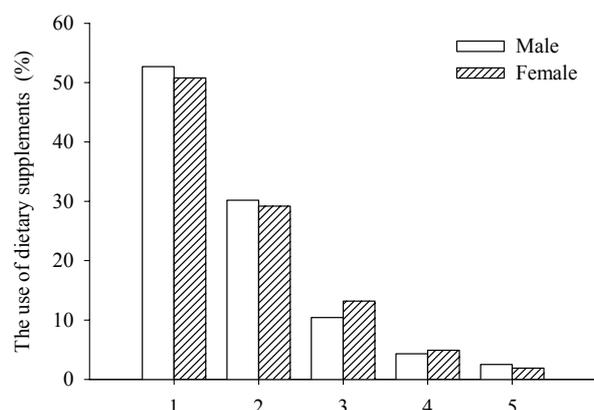


Figure 1. The relationship between gender and the use of dietary supplements. *indicates significant difference at $P < 0.05$ for comparison between male ($N = 970$) and female ($N = 967$).

Table 1. The relationship between demographic characteristics of male subjects and the use of dietary supplements

Demographic characteristics of male subjects	Sample size	Dietary supplements				OR (95% CI)	P value
		No	Yes		Regular use		
		%	%	Irregular use			
Stratified district							
Hakka areas	74	81.4	18.6	1.4 (7.3)	17.3 (92.7)	0.87 (0.31-2.46)	< 0.0001
Mountain areas	70	97.4	2.6	1.6 (61.4)	1.0 (38.6)	0.10 (0.01-0.99)*	
Eastern areas	76	93.4	6.6	17.3 (92.7)	4.1 (61.8)	0.27 (0.13-0.56)*	
PengHu islands	76	80.4	19.6	1.0 (38.6)	17.3 (88.2)	0.93 (0.26-3.35)	
Northern areas: 1st stratum	73	48.4	51.6	4.1 (61.8)	47.4 (91.8)	4.06 (1.99-8.27)*	
Northern areas: 2nd stratum	76	60.1	39.9	17.3 (88.2)	26.7 (67.0)	2.53 (1.02-6.30)*	
Northern areas: 3rd stratum	75	59.3	40.7	47.4 (91.8)	34.8 (85.5)	2.62 (1.03-6.67)*	
Central areas: 1st stratum	71	64.2	35.8	26.7 (67.0)	27.6 (77.1)	2.13 (0.69-6.56)	
Central areas: 2nd stratum	73	74.0	26.0	34.8 (85.5)	15.6 (60.1)	1.34 (0.60-3.00)	
Central areas: 3rd stratum	76	92.2	7.8	27.6 (77.1)	6.5 (83.5)	0.32 (0.15-0.71)*	
Southern areas: 1st stratum	76	70.6	29.4	15.6 (60.1)	23.2 (78.8)	1.59 (0.73-3.45)	
Southern areas: 2nd stratum	76	73.9	26.1	6.5 (83.5)	21.1 (81.0)	1.35 (0.60-3.02)	
Southern areas: 3rd stratum	78	79.2	20.8	23.2 (78.8)	14.5 (69.6)	1	
Education level							
Never attended school	170	83.4	16.6	5.0 (30.4)	11.6 (69.6)	0.16 (0.08-0.33)*	< 0.0001
Primary school education	499	76.4	23.6	4.7 (19.9)	18.9 (80.1)	0.25 (0.15-0.43)*	
Junior high school	75	61.2	38.8	6.7 (17.3)	32.1 (82.7)	0.52 (0.23-1.18)	
Senior high school	110	57.3	42.7	8.4 (19.6)	34.3 (80.4)	0.61 (0.38-0.99)*	
University graduate and above	114	45.1	54.9	8.6 (15.6)	46.3 (84.4)	1	
Current employment							
Still working	124	74.1	25.9	6.3 (24.3)	19.6 (75.7)	12.07 (1.25-116.97)*	0.0247
Retired	814	68.7	31.4	6.2 (19.9)	25.2 (80.1)	15.79 (1.68-148.60)*	
Never worked	23	97.2	2.8	0.0 (0.0)	2.8 (100.0)	1	
Personal income (NT dollars)							
No income	191	71.7	28.3	6.3 (22.2)	22.0 (77.8)	1	< 0.0001
Less than 1,999	31	80.7	19.4	12.9 (66.7)	6.5 (33.3)	0.76 (0.22-2.55)	
2,000-4,999	253	85.8	14.2	4.0 (27.8)	10.3 (72.2)	0.63 (0.37-1.05)	
5,000-9,999	122	82.0	18.0	6.6 (36.4)	11.5 (63.6)	0.67 (0.41-1.10)	
10,000-19,999	173	72.3	27.8	2.3 (8.3)	25.4 (91.7)	0.97 (0.62-1.53)	
20,000-49,999	117	53.9	46.2	6.8 (14.8)	39.3 (85.2)	2.59 (1.49-4.51)*	
More than 50,000	14	21.4	78.6	7.1 (9.1)	71.4 (90.9)	26.47 (3.77-185.9)*	
Disposable income							
Enough, some money left over	155	60.4	39.6	3.2 (8.0)	36.4 (92.0)	2.36 (0.73-7.70)	0.0294
Just enough, without difficulties	529	68.4	31.6	7.6 (24.1)	24.0 (75.9)	1.67 (0.56-4.96)	
Difficulties	221	81.5	18.5	4.5 (24.3)	14.0 (75.7)	0.82 (0.23-2.87)	
Extreme difficulties	29	78.3	21.7	0.0 (0.0)	21.7 (100.0)	1	

*indicates significant difference at $P < 0.05$ in comparison with the reference group.

**Figure 2.** Distribution of numbers of dietary supplements used by the elderly.

who were in “transportation, storage, telecommunication” (OR = 4.74, CI = 1.48-15.15; $P < 0.05$), “financial, insurance, real-estate, commercial services” (OR = 4.94, CI = 1.73-14.12; $P < 0.05$) and “public administration, social services, and personal services” (OR = 2.08, CI = 1.28-3.36; $P < 0.05$) had significantly higher odds ratios of taking dietary supplements than those who were unemployed (data not shown). Women in “public administration, social services, and personal services” were among the group with the highest rate of taking dietary supplements at 78.8% (OR = 8.42, CI = 3.96-17.89; $P < 0.05$), which was significantly different to those who were not employed (30.6%) (data not shown). There was a significantly higher rate of taking dietary supplements among men and women whose monthly income was more than twenty thousand NT dollars compared to those on lower monthly incomes ($P < 0.05$). This indicated that with a higher income, people tended to take dietary supplements more frequently. In addition, women at each

Table 2. The relationship between demographic characteristics of female subjects and the use of dietary supplements

Demographic characteristics of female subjects	Sample size	Dietary supplements				OR (95% CI)	P value
		No	Yes		Regular use		
		%	%	Irregular use			
Stratified district							
Hakka areas	74	69.0	31.0	4.4 (14.1)	26.6 (85.9)	0.74 (0.28-1.93)	0.0080
Mountain areas	73	97.0	3.0	0.0 (0.0)	2.6 (100.0)	0.04 (0.00-0.40)*	
Eastern areas	76	96.4	3.6	0.0 (0.0)	3.6 (100.0)	0.06 (0.02-0.26)*	
PengHu islands	74	75.6	24.4	11.9 (48.5)	12.6 (51.5)	0.53 (0.11-2.66)	
Northern areas: 1st stratum	73	34.7	65.3	6.4 (9.6)	58.9 (90.3)	3.10 (0.71-13.64)	
Northern areas: 2nd stratum	72	71.3	28.7	9.2 (31.9)	19.6 (68.1)	0.66 (0.29-1.52)	
Northern areas: 3rd stratum	78	66.8	33.2	8.5 (25.7)	24.7 (74.3)	0.82 (0.44-1.52)	
Central areas: 1st stratum	70	62.1	37.9	4.8 (12.7)	33.1 (87.3)	1.01 (0.51-1.97)	
Central areas: 2nd stratum	72	75.1	24.9	8.2 (32.9)	16.7 (67.1)	0.55 (0.27-1.11)	
Central areas: 3rd stratum	78	84.9	15.1	2.2 (14.3)	13.0 (85.7)	0.29 (0.12-0.73)*	
Southern areas: 1st stratum	76	67.8	32.2	7.3 (22.7)	24.9 (77.3)	0.78 (0.26-2.41)	
Southern areas: 2nd stratum	76	66.7	33.3	6.5 (19.5)	26.8 (80.6)	0.82 (0.36-1.90)	
Southern areas: 3rd stratum	75	62.3	37.7	11.7 (30.9)	26.1 (69.1)	1	
Education level							
Never attended school	510	74.8	25.2	6.3 (24.8)	18.9 (75.2)	0.10 (0.02-0.47)*	< 0.0001
Primary school education	358	61.6	38.4	7.3 (19.0)	31.1 (81.0)	0.19 (0.04-0.77)*	
Junior high school	50	28.9	71.1	10.3 (14.5)	60.8 (85.5)	0.74 (0.16-3.37)	
Senior high school	31	32.1	67.9	12.0 (17.7)	55.9 (82.3)	0.63 (0.12-3.37)	
University graduate and above	13	23.1	76.9	12.8 (16.7)	64.1 (83.3)	1	
Current employment							
Still working	62	66.8	33.2	17.5 (52.6)	15.7 (47.4)	0.97 (0.48-1.98)	0.0157
Retired	257	56.1	43.9	9.3 (21.1)	34.6 (78.9)	1.54 (0.65-3.65)	
Housewife	571	69.3	30.7	5.1 (16.6)	25.6 (83.4)	0.87 (0.41-1.85)	
Never worked	71	66.2	33.8	5.3 (15.7)	28.5 (84.3)	1	
Personal income (NT dollars)							
No income	317	65.6	34.4	6.0 (17.4)	28.4 (82.6)	1	0.0026
Less than 1,999	34	73.5	26.5	8.8 (33.3)	17.7 (66.7)	0.77 (0.27-2.19)	
2,000-4,999	331	81.3	18.7	4.8 (25.8)	13.9 (74.2)	0.49 (0.32-0.77)*	
5,000-9,999	121	74.4	25.6	6.6 (25.8)	19.0 (74.2)	0.77 (0.42-1.41)	
10,000-19,999	71	60.4	36.6	7.0 (19.2)	29.6 (80.8)	1.02 (0.60-1.74)	
20,000-49,999	18	33.3	66.7	16.7 (25.0)	50.0 (75.0)	4.08 (1.51-11.02)*	
More than 50,000	5	20.0	80.0	0.0 (0.0)	80.0 (100.0)	8.75 (0.85-90.2)	
Disposable income							
Enough, some money left over	117	40.5	59.5	7.9 (13.3)	51.6 (86.7)	4.20 (0.89-19.80)	0.0012
Just enough, without difficulties	508	65.7	34.3	6.1 (17.7)	28.3 (82.3)	1.49 (0.37-5.97)	
Difficulties	241	80.9	18.1	6.0 (31.4)	13.1 (68.6)	0.68 (0.15-2.99)	
Extreme difficulties	49	74.1	25.9	10.3 (39.7)	15.6 (60.3)	1	

*indicates significant difference at $P < 0.05$ in comparison with the reference group.

income level had a higher rate of dietary supplement ingestion than men. Both men and women who felt they "had sufficient disposable income", took dietary supplements at rates of about 40% and 60% respectively. These rates were higher than the rates of those who felt they had "difficult" and "very difficult" financial circumstances (less than 30% in either group). However, the odds ratios of taking dietary supplements, for men and women who "had sufficient disposable income" were not significantly different to those whose financial status was "very difficult" (Tables 1,2).

The distribution of use of a variety of dietary supplements

Based on the characteristics of the supplements, dietary supplements were divided into eight categories: "vitamins and minerals", "vitamins", "minerals", "lipids", "Chinese herbal", "protein and formula food", "other health promotional foods" and "unknown". Among all of these dietary

supplements, the highest percentage use was of vitamins and minerals (35.0%), followed by vitamins at 30.8%, minerals at 21.8%, lipids at 15.9%, Chinese herbal at 15.7%, other health promotion foods at 13.5%, and unknown at 11.5%. The lowest percentage use was of protein and formula food at 3.5%. In the vitamins category, the highest consumption was of vitamin E (19.4%), followed by vitamin C (9.7%). In those who took minerals, the most popular item was calcium (20.9%). In those who took vitamins and minerals, the most popular item was multivitamins and minerals (32.2%), followed by vitamin D with calcium (2.1%). In the lipids category, the most popular item was fish oil (9.1%). In the protein and formula food category, the most frequently consumed item was formula food (2.8%). In the Chinese herbal category, the most popular item was ginseng (5.3%). In the other health promotional foods category, the most popular item was chicken extracts (2.9%).

Table 3. Top ten dietary supplements used by the elderly

Rank	Total (%)	Men (%)	Women (%)
1	Multivitamins and minerals (32.2%)	Multivitamins and minerals (32.7%)	Multivitamins and minerals (31.6%)
2	Calcium (20.9%)	Vitamin E (20.1%)	Calcium (28.7%)
3	Vitamin E (19.4%)	Calcium (13.0%)	Vitamin E (18.8%)
4	Vitamin C (9.7%)	Fish oil (10.7%)	Vitamin C (9.3%)
5	Fish oil (9.1%)	Vitamin C (10.1%)	Fish oil (7.4%)
6	Vitamin B-complex (5.5%)	Vitamin B-complex (6.2%)	Ginseng (5.1%)
7	Ginseng (5.3%)	Ginseng (5.6%)	Vitamin B-complex (4.7%)
8	Alinamin A25 (3.0%) [†]	Vitamin B ₁₂ (3.4%)	Vitamin D with calcium (4.1%)
9	Omega-3 FA, Chicken extracts (2.9%)	Omega-3 FA (3.3%)	Chicken extracts (3.3%)
10	Formula food (2.8%)	Formula food, Lecithin (3.1%)	<i>Ganoderma lucidum</i> (3.2%)

[†]Alinamin A25 contains fursultiamine, vitamin B₁, vitamin B₆ and vitamin B₁₂.

Table 3 shows the top ten dietary supplements consumed by the elderly. The most popular supplements taken by men were: multivitamins and minerals (32.7%), vitamin E (20.1%), calcium (13.0%), fish oil (10.7%), vitamin C (10.1%), vitamin B-complex (6.2%), ginseng (5.6%), vitamin B₁₂ (3.4%), omega-3 fatty acid (3.3%), and formula food/lecithin (3.1%). The top ten dietary supplements taken by women were: multivitamins and minerals (31.6%), calcium (28.7%), vitamin E (18.8%), vitamin C (9.3%), fish oil (7.4%), ginseng (5.1%), vitamin B-complex (4.7%), vitamin D with calcium (4.1%), chicken extracts (3.3%) and *Ganoderma lucidum* (3.2%). The major difference between men and women for the ten most popular items was that men tended to choose more fish oil and omega-3 fatty acids than women. Women tended to take more calcium, and vitamin D with calcium than men.

The relationship between nutritional related knowledge and dietetic habits of the elderly and the use of dietary supplements

Elderly men obtained an average of 44% for scores of nutritional knowledge and elderly women scored 35%. Although neither of these scores were satisfactory, men's nutritional knowledge scores were better than women's ($t = 7.27, P < 0.01$). Furthermore, there was a significant positive correlation between the nutritional knowledge score and the consumption of dietary supplements in both men ($r = 0.20$) and women ($r = 0.22$) ($P < 0.01$). This indicates that people who obtained higher scores in nutrition or diet related-illness knowledge were more likely to take dietary supplements.

According to the dietary attitudes survey, elderly people took significantly more dietary supplements if they thought that it was good to "take vitamin supplements daily" (OR = 7.10, CI = 5.15-9.79, $P < 0.05$), or to "take mineral supplements daily" (OR = 5.66, CI = 4.49-7.14, $P < 0.05$). However, there was no significant relationship between taking dietary supplements and agreeing with the statements "it is good to take body enhancing supplements (such as Chinese medicine, chicken extracts, or herbal wine)", "healthy food is high in nutritional value", "body enhancing medicines or supplements can make the

body stronger", "as long as I take vitamins or dietary supplements everyday, I don't have to worry about nutrition", "eating healthy food may prolong life", and "more expensive food is more nutritious" (data not shown). These results indicate that even when the elderly people interviewed agreed with the ideas mentioned above, it did not increase their intake of dietary supplements.

According to the dietary behaviors survey, elderly people who were "always" or "often" aware of nutritional knowledge were significantly more likely to take dietary supplements than elderly people who were "seldom" aware (odds ratios: OR = 3.57, CI = 2.65-4.82 and OR = 1.76, CI = 1.30-2.38; $P < 0.05$, respectively). Elderly people on a lacto-ovo-vegetarian diet were significantly more likely to take dietary supplements (OR = 0.37, CI = 0.17-0.83; $P < 0.05$). Elderly people who were regularly taking health-enhancing medicines in the past month were also more likely to take dietary supplements (OR = 2.26, CI = 1.02-4.99; $P < 0.05$). Elderly people who had been smoking for 6 months were less likely to take dietary supplements than non-smokers (OR = 0.75, CI = 0.59-0.94; $P < 0.05$), indicating that elderly people who had been smoking for 6 months did not care for dietary supplements. In addition, elderly people on a vegetarian diet, strict vegetarian diet, ovo-vegetarian diet, or lacto-vegetarian diet, and elderly people who were regularly taking Chinese medicine in the past month, drank alcohol and chewed betel nut did not have a significant difference in the rate of dietary supplement consumption (data not shown).

The relationship between elderly physiopsychological status and the use of dietary supplements

The results are shown in Table 4. In regards to the question "I am more likely to get sick than others", there was no obvious difference in odds ratios between people who took dietary supplements and people who did not. However, when questioned about "my health condition is getting worse", the elderly whose answers were "mostly correct" (OR = 0.53, CI = 0.35-0.80; $P < 0.05$) had a significantly lower chance of taking dietary supplements than elderly people who answered "completely incorrect".

Furthermore, when asked about their "current health status", elderly people whose health was "average" were significantly less likely to take dietary supplements than elderly people whose current health status was "not as good" (OR=0.65, CI=0.45-0.94; $P < 0.05$). Elderly people whose answer to the question "have the same health as others" was "mostly correct" (OR = 0.41, CI = 0.20-0.83; $P < 0.05$), or "do not know" (OR = 0.43, CI = 0.23-0.79; $P < 0.05$) had a significantly lower chance of taking dietary supplements than elderly people whose answer was "completely incorrect". The results of asking the elderly the question "my health is very good" was similar to the question "have the same health as others". From the results shown in Table 4, we find that whatever the question asked, there were no significant differences in dietary supplement intake between the elderly whose answer to the question was "completely correct" and those whose answer was "completely incorrect". In addition, those who felt that their current health was "excellent", had no significantly different chance of taking dietary supplements from those who felt that their current health was "not as good". The results of Table 4 also indicate that elderly people who were unclear about their health status (giving an answer of "do not know"), or who answered with a more conservative attitude (giving an answer of "mostly correct", "mostly incorrect" or "average") had a significantly lower chance of taking dietary supplements than elderly people who knew their own health status (giving an answer of "absolutely correct", "completely incorrect", "excellent" or "not as good").

Other questions from the psychophysiological questionnaire such as "encountering difficulty at work", "sleep situation", "the effect of physical or emotional conditions

on activities of daily living" and "the effect of bodily aches and pains on activities of daily living", had no significant difference on the use of dietary supplements. In addition, there was no significant difference on the use of dietary supplements based on different levels of exercise intensity. However, when asked about the frequency of doing exercise, elderly people who frequently exercised were more likely to take dietary supplements than elderly people who did not do exercise frequently (OR = 2.09, CI = 1.45-3.02; $P < 0.05$) (data not shown).

Discussion

We discovered in this survey that in Taiwan, 30.1% of men and 34.9% of women aged 65 years or older took dietary supplements. These results were higher than that of the previous Nutrition and Health Survey in Taiwan 1993-1996 (NAHSIT 1993-1996) carried out between 1993 and 1996 (which provided rates of 20.9% in men and 30.8% in women aged 19 years or older),⁹ but were lower than the prevalence of 50% in the USA.^{10,11} Both in this survey, NAHSIT 1993-1996^{9,12} and Lyle's study¹³, the results revealed that women were significantly more likely to take dietary supplements than men. These results indicate that women may be more concerned with personal health than men or feel more of a need to take supplements (due to such concerns as cosmetic enhancement, prevention of osteoporosis, and post-menopausal changes in body function).¹² The elderly in the first stratum in the northern areas of Taiwan had a significantly higher rate of taking dietary supplements than those in other areas in this study. This was compatible with the results of NAHSIT 1993-1996⁹, where the highest rate of people taking dietary supplements was found in those aged 19 years

Table 4. The relationship between elderly psychophysiological status and the use of dietary supplements

	Psychophysiological situation	Sample size	Dietary supplements		OR (95% CI)	P value
			No (%)	Yes (%)		
1. Current health status	excellent	57	73.5	26.5	0.57 (0.31-1.06)	0.0136
	very good	315	62.2	37.8	0.96 (0.60-1.56)	
	good	370	69.2	30.8	0.70 (0.40-1.25)	
	average	861	70.9	29.1	0.65 (0.45-0.94)*	
	not as good	299	61.3	38.7	1	
2. More likely to get sick than others	absolutely correct	109	66.5	33.5	0.70 (0.40-1.23)	0.0796
	mostly correct	281	67.0	33.0	0.69 (0.40-1.19)	
	do not know	461	76.5	23.5	0.43 (0.24-0.77) *	
	mostly incorrect	667	68.6	31.4	0.64 (0.43-0.96) *	
	completely incorrect	383	58.2	41.8	1	
3. As healthy as others	absolutely correct	327	61.5	38.5	0.64 (0.36-1.11)	0.0329
	mostly correct	712	71.4	28.6	0.41 (0.20-0.83)*	
	do not know	510	70.3	29.7	0.43 (0.23-0.79)*	
	mostly incorrect	279	67.1	32.9	0.50 (0.24-1.04)	
	completely incorrect	73	50.4	49.6	1	
4. Health is getting worse	absolutely correct	205	68.1	31.9	0.64 (0.40-1.03)	0.0490
	mostly correct	618	72.4	27.6	0.53 (0.35-0.80)*	
	do not know	545	67.5	32.5	0.66 (0.39-1.12)	
	mostly incorrect	347	66.7	33.3	0.69 (0.43-1.11)	
	completely incorrect	186	57.9	42.1	1	
5. Health is very good	absolutely correct	279	59.0	41.0	0.87 (0.54-1.42)	0.0037
	mostly correct	714	69.6	30.4	0.55 (0.30-1.01)	
	do not know	317	82.4	17.6	0.27 (0.13-0.55)*	
	mostly incorrect	477	64.3	35.7	0.70 (0.36-1.36)	
	completely incorrect	114	55.7	44.3	1	

*indicates significant difference at $P < 0.05$ in comparison with the reference group.

of age or older, living in the capital city. In Lee's study¹⁴ it was found that subjects who were living in urban areas, had the highest rates of people taking dietary supplements. In addition, elderly people in this study with a higher level of education and higher personal monthly income had higher rates of taking dietary supplements than other groups. These results are similar to investigations done in other countries that have shown that the consumption of dietary supplements is higher among women who are white, elderly, well urbanized and who have a higher education level and higher income.¹⁵⁻¹⁷ However, these results are not compatible with the results of Ji's investigation,¹⁸ which showed that there was no correlation between the consumption of dietary supplements and characteristics such as gender, age, education level and economic situation of the elderly. The different results found in Ji's and this study could be attributed to different sampling design and survey methodology. In addition, household monthly income did not directly affect the rate of dietary supplement consumption by elderly people in this investigation (data not shown). This differed from the results showing that elderly people with higher personal monthly income were more likely to take dietary supplements (Tables 1 & 2). The results indicate that whether a person took dietary supplements or not was related to their personal economical status but not the financial status of the family.

The data shown in Table 3 in this study are similar to the results from NAHSIT 1993-1996 which showed that the major choices of dietary supplements by Taiwanese people 19-64 years of age were vitamin E (22.6%), multivitamins and minerals (20.1%), vitamin C (18.9%), and calcium (11.4%).¹² However, in Wang's study¹⁹ people aged 10-79 years living in the central part of Taiwan were interviewed and the data showed higher rates of use of multivitamins and minerals (40.0%) and vitamin C (27.3%). The investigation by Chang of the use of vitamins or minerals by medical students at Taipei Medical University also showed that multivitamins and minerals (55.7%) and vitamin C (35.9%) were the most popular choices. Many studies have shown that the most commonly used dietary supplements are vitamins and minerals. However, in Wang's study¹⁹ it was shown that 85.5% of subjects did not know about the safe dosage of vitamins and minerals. Most people also lacked sufficient knowledge about safety and nutrition information. Therefore, there is a hidden risk to the long-term health of people in Taiwan.

Apart from the use of vitamins or minerals, the elderly in this study chose fish oil (9.1%) and ginseng (5.3%) as their major dietary supplements, whereas, the major choices were ginseng (6.8%) and Four-Herbs (5.8%) in NAHSIT 1993-1996.¹² This result is obviously affected by the age difference of the subjects in these two studies. The higher rate of people taking fish oil in those aged 65 years or older in Taiwan might be related to health information indicating that fish oil could prevent cardiovascular disease. About 90% of the people aged 19-64 taking Four-Herbs were women. This might be related to the traditional Chinese medicine belief that Four-Herbs is helpful for women and can improve their post-menstrual cycle symptoms. On the other hand, results of investigations in other countries have demonstrated that the most

popular herbal supplements are ginseng, garlic, and ginkgo.¹⁵ It has been indicated that Ginseng is the most popular herbal supplement both in Taiwan and abroad. Other kinds of dietary supplements are used differently in different countries based on varying customs.

This study looked at the influence of several factors (such as nutritional knowledge, dietetic habits and psychophysiological status) on the use of dietary supplements by the elderly and found that elderly people were more likely to take dietary supplements if they thought that it was necessary to take vitamins or minerals as a dietary supplement, practiced a lacto-ovo-vegetarian diet, took health improving medicine regularly, were always aware of their health status, felt quite healthy or quite unhealthy, and exercised regularly. In addition, the higher the score obtained for disease/nutritional knowledge, the more likely a person was to take dietary supplements. These results infer that elderly persons who clearly know about their health status might be more likely to take dietary supplements because of their strong health expectations.

Conclusion

In summary, the results of this investigation indicate that elderly women, living in a well urbanized area with higher education, higher personal monthly income, sufficient disposable income, higher scores in nutrition knowledge, or high health expectations were significantly more likely to take supplements. The most popular dietary supplements belonged to the categories of "Vitamins" and/or "Minerals". Elderly people are not necessarily provided with correct knowledge regarding supplement usage, and food and nutrition as the nutritional knowledge scores of the elderly people surveyed were far from satisfactory. This phenomenon was also observed by Lee's study.¹⁴ In Lee's study, it was shown that about 50% of subjects thought that some dietary supplements could replace medicine in treating diseases. Moreover, about 60% believed that dietary supplements could prevent some specific diseases. Correct use of dietary supplements is beneficial to health, but incorrect use harms the body. The data in Lee's study indicate that most people's expectations about the effectiveness of dietary supplements were too high (such as drugs and foods belong to the same category and the power of food is as strong as that of medicine). These misconceptions might lead to the abuse of dietary supplements by people in Taiwan. Taking too much of a certain kind of nutrient might induce side effects of overloading, and the person might ignore the intake of other nutrients. Moreover, taking many different kinds of dietary supplements will result in interactions between ingredients.^{19,20} Hence, an important issue regarding dietary supplements to study in the future would be how to teach people to be aware of the characteristics of dietary supplements and to use them effectively to improve health.

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