Original Article

Nutrition knowledge, attitudes, and dietary restriction behavior of the Taiwanese elderly

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The purpose of this study is to understand knowledge about and general attitudes towards nutrition, dietary restriction attitudes, and dietary restriction behavior in the Taiwanese elderly, and the relationship of these various components to each other. Data from the Elderly Nutrition and Health Survey in Taiwan (1999-2000) were used for analysis and included 1937 elderly persons aged over 65. The results indicated that the elderly had poor nutrition knowledge, especially about the relationship between nutrition and disease. Elderly nutrition attitudes were fair; they tended to disagree with misconceptions about "healthy" or functional foods and also had quite positive general eating attitudes. However, the Taiwanese elderly hold quite strong attitudes influenced by Chinese traditional or food-texture-related dietary restrictions. Elderly people frequently avoid eating foods considered unhealthy by modern medical science (e.g. high fat/cholesterol foods) as well as foods forbidden by Chinese traditional medicine (e.g. "heating" foods, "cooling" foods). Most of the elderly regularly eat three meals a day, however, they seldom pay attention to dietary and nutrition information. The most important sources of nutrition information are offspring or family members, TV, and medical practitioners. In general, elderly men with a higher educational level and living in less remote areas had better nutrition knowledge, held more positive nutrition attitudes, and kept to dietary restrictions less frequently. Elderly people's nutrition knowledge was positively related to their health-care attitudes, general eating attitudes, high-fat or high-cholesterol food restriction behavior, fermented or pickled food restriction behavior, attention to nutrition information, and regularity of meals. However, nutrition knowledge was inversely related to Chinese traditional or food-texture-related dietary restriction behaviors. The results of this study suggest that education of elderly people about nutrition is important, and the design of such nutrition education programs should consider the low educational levels of the elderly. Children or other family members may also be included in the program. The use of TV as a medium for nutrition education of the elderly may also be important for nutrition educators.

Key Words: elder, nutrition knowledge, nutrition attitude, eating behavior, dietary restriction, Elderly Nutrition and Health Survey in Taiwan (1999-2000)

Introduction

According to the United Nations, "an advanced age society" is one where the percentage of the population over 65 is higher than 7%. By this definition, Taiwan became a society of advanced age in September 1993. Increased life expectancy is accompanied by the increased incidence and prevalence of chronic disease. A healthy and nutritious diet can prevent disease and improve health conditions leading to an improved quality of life for older people.[1-5] Food faddism is one among many influencing factors on elderly food choices.[6] For older persons, some dietary restrictions may be due to culture and some due to physiological states. For thousands of years, people in Chinese and Indian societies have believed that certain foods are either 'heating' (or 'fire increasing') or 'cooling' (or 'fire reducing') in the body when eaten. In accordance with the Chinese belief of yin and yang, health is thought to result from a proper balance of 'heating' and 'cooling' foods.[7,8] In addition, poor dental health may cause elders to avoid eating foods with tough texture, and high-fat or high-cholesterol foods are avoided due to suggestions from medical practitioners and dietitians based on modern medical science. Nutrition knowledge presumably influences attitudes and eating behavior.[9] But food restriction behavior and its relationship with nutrition knowledge and attitudes has not been well studied. The purpose of this study is to understand knowledge about and general attitudes towards nutrition, dietary restriction attitudes, and dietary restriction behavior in the Taiwanese elderly.

Subjects and methods

Data collection

This study is part of the Department of Health sponsored Elderly Nutrition and Health Survey in Taiwan conducted between 1999 and 2000. A multistaged, stratified random sampling method was used in this study.[10] A total of 1937 elderly persons aged over 65 completed the interview with

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a response rate of 55.2%. All of those who completed the interview also completed the nutrition knowledge, attitudes, and behavior scales were used for this analysis. The survey population was stratified into 13 strata in the original design,[10] which comprise 4 strata ("Hakka areas", "Mountain areas", "Eastern areas", "PengHu islands") of particular geographic locations and ethnic groups, and 9 strata of the remaining areas of Taiwan. For ease of comparison, the 9 strata within "Northern", "Central" and "Southern" parts of Taiwan were regrouped as "Urban" and "Rural" areas based on population density as this is an indicator of urbanization. The cut-off points used for urban areas were: (1) Northern: greater than 3,044 persons/km^2, (2) Central: greater than 2,600 persons/km^2, (3) Southern: greater than 3,184 persons/ km^2.

Measures

The nutrition knowledge, attitudes and behavior scales were developed by the researchers. The 48-item knowledge scale included three subscales: (1) 8 items related to the relationship between nutrition (e.g. calories, fat, cholesterol, salt/sodium, sugar, dietary fiber, calcium, iron, smoked food) and disease, (2) 15 items related to the requirements of different food groups, and (3) 15 items related to the comparison of foods in terms of specific nutrients (e.g. calorie, fat, cholesterol, protein, sodium, sugar, dietary fiber, calcium, iron) and cooking method. The format of the scale included true-false, multiple-choice and open-ended questions. "I don't know" was provided as a possible answer choice for all questions. Inter-item reliabilities (Cronbach alpha coefficient) of the total scale and the three sub-scales were 0.93, 0.89, 0.73, and 0.87, respectively. The test-retest reliabilities (N=44) were 0.95, 0.93, 0.74 and 0.91, respectively.

The nutrition attitudes studied included general nutrition attitudes (attitudes related to eating, health-care, and 'healthy foods') and dietary restriction attitudes. To facilitate ease of answering, we chose a 3-point Likert-type format with the response items ranging from 'agree', 'neutral' to 'disagree', and one extra item of 'I don't know'. Principal axis factor analysis with varimax rotation, screen-test and criteria of a Kaiser eigen value larger than 1 were used to determine the number of factors. Items that loaded over 0.30 were considered part of a particular factor. The final scale contained 21-items which was divided into three factors (subscales). They accounted for 26.0% of the total variance and the Cronbach alpha reliability coefficient of the total scale was 0.69. The three subscales and their Cronbach alpha coefficients were: (a) health-care related attitudes (8 items), 0.73 (b) general eating attitudes (8 items), 0.66 (c) Chinese traditional or food-texture-related dietary restriction attitudes (5 items), 0.58. The test-retest reliabilities (N=44) were 0.75, 0.74, 0.75 and 0.63, respectively. Three types of foods were under the third factor: Chinese traditional dietary restriction items (cooling and heating), food-texture or mouth-feel-related dietary restriction items (irritating, rough, cold and hot), and natural foods. These particular food items were chosen based on the results of interviewing 21 elderly persons (12 men and 9 women) in the questionnaire development stage.

The nutrition behaviors studied here focused mainly on dietary restriction behavior, meal patterns, and behaviors which may influence the dietary intake of elders, such as attention to nutrition information and sources of nutrition information. The food items listed were based on the results of interviews mentioned above. The 3-point Likert-type format was used with response items ranging from 'usually' and 'sometimes' to 'seldom' and 'I don't know'. The dietary restriction behavior scale could be broken down into four factors by factor analysis using the method mentioned above. The four factors accounted for 36% of total variance. The Cronbach alpha coefficients of the total scale was 0.86 and for the four subscales were (a) Chinese traditional or food-texture-related dietary restriction behavior (7 items): 0.81. As in the attitude scale, there were three types of foods under this factor: Chinese traditional dietary restriction items (cooling and heating), food-texture or mouth-feel-related dietary restriction items (irritating, rough, tough, cold and hot) and natural foods; (b) high-fat and/or cholesterol food restriction behavior (8 items): 0.80; (c) pickled or fermented food restriction behavior (2 items): 0.76; and (d) high starch and/or high sugar food restriction behavior (2 items): 0.56. The test-retest reliabilities (N=44) were 0.85 for the total scale and 0.75, 0.85, 0.88 and 0.52 for the four subscales, respectively. Other nutrition related behaviors studied were: meal patterns, attention to nutrition information, and sources of nutrition information. Examples of questions about nutrition knowledge, attitudes and dietary restriction behavior are shown in Appendix 1.

Statistics

Data were analyzed using the Statistical Analysis System (version 8.2) for Windows. Data were weighted by residential area to represent the Taiwanese population using the models developed by the SUDAAN Software Company, but not including data for performing Pearson product-moment correlation. One-way analysis of variance was used to compare the differences in nutrition knowledge, attitudes and behavior among elderly people of different genders, age groups, educational levels and residential areas. The Pearson product-moment correlation coefficient was used to study the relationships between nutrition knowledge, attitudes, and behavior. The significant level used was P<0.05.

Results

Demographics characteristics of the sample

The characteristics of the subjects are listed in Table 1. The sample was composed of equal numbers of men and women and 70% were between 65 and 74 years of age. Almost 80% of the sample had only primary school education or lower. Chi-Square analysis revealed that the distribution of gender and educational level of the sample was not significantly different from the overall population (data not shown). No data on age distribution of the overall population was available for comparison. In order to have a sufficient sample size of relevant ethnic groups, the sampling design had a distribution of residential areas and the data was weighted by residential area for analysis.

Table 1. Characteristics of Subjects *(N*=1937)

	N	%
Gender		
Male	970	50.1
Female	967	49.9
Age-group		
65-69	754	38.9
70-74	636	32.8
75-79	347	17.9
≥ 80	200	10.3
Educational background		
No formal education	680	35.1
Primary school	857	44.2
Junior & Senior high school	266	13.7
College & above	126	6.5
Missing	8	0.4
Residential area		
Urban areas	739	38.1
Rural areas	605	31.2
Hakka areas	148	7.6
Mountain areas	143	7.4
Eastern areas	152	7.8
PengHu islands	150	7.7

Dietary and nutrition knowledge, attitudes and behavior in the elderly

The mean, standard deviation, and percentage of correct or positive responses out of the total scale and subscales are presented in Table 2.

Nutrition knowledge

The results showed that the nutrition knowledge of the Taiwanese elderly was poor in all three aspects studied, and that they were least knowledgeable about the relationship between nutrition and disease. On average they answered only 49.4% of the nutrition knowledge questions correctly.

Nutrition attitudes

From the mean percentage of positive responses on the three attitude subscales (Table 2), we found that elderly people expressed favorable attitudes toward healthy foods. They tended to disagree with misconceptions about 'healthy' or functional foods, and they also had quite positive general eating attitudes. However, the Taiwanese elderly held quite strong Chinese traditional or food-texture-related dietary restriction attitudes. A total of 78.8% of elderly people agreed that older persons should avoid eating irritating foods, 74.4% believed in avoiding cold foods and 65.1% believed in avoiding 'cooling' foods (these are foods considered "cold" for the human body by Chinese traditional medicine, but are not cold in actual temperature measured). More than 80% of elderly people agreed that older persons should eat natural foods when possible.

Dietary restriction behavior

From the percentages of positive responses to dietary restriction behaviors, we found that a moderate to high number of elderly people abided by Chinese traditional or texture-related dietary restrictions. Sixty-seven percent of participants stated that they usually avoided eating foods that are irritating (acidic, spicy, etc.), 59.3% usually avoided foods with a tough texture, 53.5% usually avoided cold foods, 50.9% usually avoided 'heating' foods, 45.8% usually avoided 'cooling' foods, 41.5% usually avoided hot foods and 40.8% usually avoided rough foods. On the other hand, many elderly people also reported that they usually avoided eating certain foods considered unhealthy by modern medical science, mainly those foods in the high-fat/high-cholesterol category, such as offal (66.9%), lard (63.7%), fried foods (63.3%), ham and sausages (54.9%), shrimp and crab (52.9%), fatty meats and skin (45.7%). Pork and ordinary red meats were also in this category, but they were avoided by only 27.7% and 19.8% of elderly people. Compared to the high-fat/cholesterol foods, fewer elderly people avoided fermented foods, pickled foods, high sugar or high starch foods. Only 35.1% of participants stated that they usually avoided eating fermented foods, 25.7% usually avoided eating pickled foods, 35.6% usually avoided eating sweet foods and 20.0% usually avoided eating high starch foods.

Other nutrition related behaviors

Meal pattern

More than 96% of participants stated that they usually ate breakfast, 98.2% usually ate lunch, 98.7% usually ate dinner (Table 3), and 94.6% usually ate all three meals.

Attention to nutrition information

Sixty percent (60.2%) of participants stated that they seldom paid attention to nutrition information, 24.0% paid attention sometimes, while only 15.8% of elderly people usually paid attention to nutrition information.

Sources of nutrition information

The major sources (Table 4) of nutrition information for elderly people were offspring or relatives (58.1%), TV (49.7%), and medical practitioners (48.3%). Among health professionals, dieticians were not as an important source of information as medical practitioners or nurses. Only 8.2% of elderly people received information from dietitians, which was a much lower number than that for medical practitioners (48.3%) and nurses (29.2%). Although TV was an important source, other forms of mass media were not; only about twenty percent of participants received information from newspapers, magazines or radio. Very few elderly people obtained information from continuing education courses or lectures.

Table 2. Mean and percentage of correct or positive responses on nutrition knowledge, attitudes and dietary restriction behavior scales (*N*=1937)

	Total score	Mean	S D	% of correct or positive response
Dietary and nutrition knowledge-total	48	23.7	0.6	49.4
Relationship between nutrition and disease	18	7.5	0.3	41.7
Requirements of different food groups	15	8.1	0.2	54.0
Comparison of foods in terms of specific nutrients	15	8.0	0.3	53.3
Health-care related attitudes	24	17.9	0.3	74.6
General eating attitudes	24	16.8	0.4	70.0
Chinese traditional or food texture related dietary restriction attitudes	15	12.8	0.2	85.3
Dietary restriction behaviors-total	19	8.7	0.2	45.8
Chinese traditional or food texture related restriction behaviors	7	3.6	0.2	51.4
High fat/ cholesterol foods	8	4.0	0.1	50.0
Fermented / pickled foods	2	0.6	0.1	30.0
High starch/sugar foods	2	0.6	0.5	30.0

Table 3. Frequency of eating three meals (*N*=1937)

	Usually	Sometimes	Seldom
Breakfast	1850 (96.1%)	56 (2.5%)	31 (1.5%)
Lunch	1897 (98.2%)	34 (1.5%)	6 (0.3%)
Dinner	1908 (98.7%)	19 (0.8%)	10 (0.5%)

Comparison of nutrition knowledge, attitudes and behavior based on demographic characteristics of elderly people

Table 5 shows the mean, standard deviation and summary results of the ANOVA of nutrition knowledge, attitudes, and dietary restriction behaviors by elderly demographic characteristics.

Knowledge

The results showed that elderly people who were male, younger, and had higher educational levels had better nutrition knowledge than those who were female, older, and with lower educational levels. In addition, compared with those living in eastern Taiwan or the PengHu islands, elderly people living in urban areas, rural areas, or Hakka areas were more knowledgeable about nutrition.

Attitudes

Elderly persons who were male, younger, and had higher educational levels, expressed more positive attitudes about general nutrition; they agreed less with folk health care methods and foods, and agreed more with general eating and food selecting attitudes. On the other hand, elderly persons who were female, had lower educational levels, and lived in rural areas or the PengHu islands expressed significantly stronger Chinese traditional or texture-related restriction attitudes.

Behavior

When we looked at all of the dietary restriction behaviors together, those respondents who were female, junior college graduates or higher, and those living in the Peng-Hu islands, abided by dietary restriction behaviors more frequently. Elderly persons who were male, and those living in urban or mountain areas restricted their diets less frequently. As far as specific dietary restriction behavior was concerned, participants who were female, older, and living in the PengHu islands restricted almost all types of foods studied more often than elderly persons from other areas with the exception of high starch/sugar foods. No statistically significant differences were found among elderly people of varying demographic characteristics for restricting high starch/sugar foods. Older respondents exhibited Chinese traditional or texture-related dietary restriction behaviors more frequently. Elderly people who had a higher educational level avoided eating fermented or pickled foods more frequently. As mentioned above, elderly people from the PengHu islands exhibited all types of dietary restriction behaviors more frequently than others, while elderly people from eastern Taiwan restricted their diet less frequently than others.

Relationship between dietary and nutrition knowledge, attitudes, and behavior

The correlation coefficients (r) for dietary and nutrition knowledge, attitudes, and behavior are reported in Table 6. Participants' nutrition knowledge was positively related to health-care attitudes, general eating attitudes, high-fat or high-cholesterol food restriction behavior, fermented or pickled food restriction behavior, attention to nutrition information and regularity of meals. Nutrition knowledge

Table 4. Sources of dietary and nutrition information (*N*=1937)

Sources	Medical practitioner	Nurse	Dietitian	Spouse	Offspring or relatives	Friend or neighbor	Salesman	Newspapers and magazines	TV	Radio	Continuing education courses	Lectures
Yes (%)	48.3	29.2	8.2	22.8	58.1	35.4	4.7	22.1	49.7	19.1	4.1	5.3
No (%)	46.9	65.1	84.2	72.0	37.4	60.0	89.7	72.2	45.7	75.5	90.6	89.6

was inversely related to Chinese traditional or texture-related dietary restriction behaviors.

Significant positive correlations were found between health-care attitudes and general eating attitudes, fermented or pickled food restriction behavior and attention to nutrition information. Significant negative correlations were found between health-care attitudes and Chinese traditional or food-texture-related dietary restriction attitudes and behavior. General eating attitudes were inversely correlated with Chinese traditional or food-texture-related dietary restriction attitudes and behavior, however, they were positively related to fermented or pickled food restriction behavior, attention to nutrition information, and regularity of eating meals. Significant positive correlations were found between Chinese traditional or food-texture-related restriction attitudes and the four dietary restriction behaviors studied, as well as regularity of eating meals. A positive relationship existed between attention to nutrition information and three dietary restriction behaviors, excluding Chinese traditional or food-texture-related restriction behavior.

Table 5. Summary of ANOVA of nutrition knowledge, attitudes, and dietary restriction behavior by demographic characteristics of the elderly (N=1937, P <0.05)

Variable	*N*	Mean ± SD								
		Nutrition knowledge-total	Health related attitudes	General eating attitudes	Chinese traditional or food texture related dietary restriction attitudes	Chinese traditional or food texture related dietary restriction behavior	High fat/ cholesterol food restriction behavior	Fermented/ pickled food restriction behavior	High starch/ sugar food restriction behavior	Dietary restriction behavior-total
Gender										
(1) male	970	25.1±0.6	18.4±0.3	17.2±0.4	12.6±0.2	3.3±0.2	3.6±0.2	0.7±0.1	0.5±0.1	8.1±0.5
(2) female	967	22.1±0.8	17.3±0.4	16.4±0.5	13.0±0.1	3.9±0.3	4.3±0.2	0.5±0.1	0.6±0.1	9.4±0.5
		(1)>(2)	(1)>(2)	(1)>(2)	(2)>(1)	(2)>(1)	(2)>(1)	(1)>(2)		(2)>(1)
Age-group										
(1) age 65-69	754	26.5±0.5	18.2±0.3	17.2±0.4	12.9±0.2	3.4±0.3	3.8±0.2	0.6±0.1	0.6±0.1	8.4±0.5
(2) age 70-74	636	24.7±0.8	18.3±0.3	17.1±0.4	12.8±0.2	3.5±0.3	3.9±0.2	0.6±0.1	0.5±0.1	8.5±0.5
(3) age 75-79	347	22.1±1.0	17.5±0.3	16.3±0.5	12.9±0.2	3.9±0.3	4.2±0.2	0.6±0.1	0.5±0.1	9.2±0.6
(4) age 80 above	200	16.9±1.4	17.0±0.4	15.8±0.5	12.5±0.2	3.9±0.2	4.1±0.3	0.6±0.1	0.6±0.1	9.1±0.6
		(1)>(2)> (3)>(4)	(1)(2)> (3)(4)	(1)(2)> (3)(4)		(3)(4)> (1) (3)>(2)				
Educational level (N =1929)										
(1) none	680	23.7±0.6	16.8±0.5	15.5±0.7	13.1±0.1	4.0±0.5	4.0±0.4	0.4±0.1	0.6±0.1	9.0±0.9
(2) primary school	857	18.9±0.8	18.0±0.2	16.6±0.4	12.8±0.2	3.5±0.2	3.8±0.2	0.6±0.1	0.5±0.0	8.4±0.4
(3) high school	266	24.2±0.7	19.1±0.3	18.5±0.3	12.2±0.2	3.2±0.2	4.0±0.2	0.8±0.1	0.6±0.1	8.6±0.4
(4) college & above	126	32.2±0.8	20.0±0.3	20.3±0.3	12.3±0.3	3.4±0.2	4.6±0.2	1.1±0.1	0.5±0.1	9.6±0.5
		(4)>(3)> (2)>(1)	(4)>(3)> (2)>(1)	(4)>(3)> (2)>(1)	(1)>(3) (4) (2)>(3)		(4)>(2) (3)	(4)> (3) (2)> (1)		(4)> (2)(3)
Residential area										
(1) urban areas	739	25.0±0.6	18.4±0.4	17.2±0.5	12.4±0.2	3.3±0.1	4.2±0.1	0.7±0.1	0.6±0.1	8.8±0.3
(2) rural areas	605	22.5±1.1	17.5±0.5	16.5±0.8	13.2±0.1	3.9±0.5	4.0±0.4	0.6±0.1	0.6±0.1	9.5±0.3
(3) Hakka areas	148	25.0±3.1	17.5±0.6	16.8±1.3	13.3±0.8	3.7±0.7	3.0±0.8	0.4±0.1	0.5±0.2	7.6±1.4
(4) mountain areas	143	18.3±5.2	17.2±1.0	16.1±1.0	12.4±0.3	4.0±0.4	2.8±0.7	0.7±0.3	0.4±0.1	8.0±1.2
(5) eastern areas	152	17.0±2.3	17.1±1.4	16.1±0.3	11.7±0.7	3.0±0.1	3.4±0.1	0.5±0.0	0.6±0.0	7.4±0.2
(6) PengHu islands	150	15.3±2.3	18.3±0.8	14.9±0.5	13.3±0.2	5.6±0.2	5.8±0.1	1.0±0.1	0.7±0.1	13.1±0.4
		(1)(2)(3)> (5)(6)		(1)>(6)	(2)(6)> (1) (4)(5)	*(6)> (1)(2)(3) (4)(5)* (1)(4)> (5)	(6)> (1)(2)(3) (4)(5) (1)> (4)(5)	(6)> (1)(2)(3) (5) (1)>(3)		(6)>(1) (2)(3)(4) (5) (1)>(5)

Table 6. Pearson correlation coefficients (r) between nutrition knowledge, attitudes, and behavior of elderly persons

Variable	r values									
	1 N=1873	2 N=1873	3 N=1873	4 N=1873	5 N=1873	6 N=1873	7 N=1873	8 N=1873	9 N=1697	10 N=1873
1.Nutrition knowledge-total	1.000	0.290*	0.435*	0.012	-0.123*	0.064*	0.116*	0.042	0.444*	0.053*
2. Health-care related attitudes		1.000	0.357*	-0.154*	-0.145*	0.024	0.146*	0.028	0.150*	0.037
3.General eating attitudes			1.000	-0.119*	-0.187*	-0.014	0.093*	-0.039	0.385*	0.083*
4.Chinese traditional or food texture related dietary restriction attitudes				1.000	0.351*	0.069*	-0.044	0.070*	-0.007	0.051*
5 Chinese traditional or food texture related dietary restriction					1.000	0.454*	0.193*	0.295*	-0.003	0.004
6. High fat/cholesterol food restriction						1.000	0.307*	0.339*	0.087*	0.054*
7. Fermented/pickled food restriction							1.0000	0.210*	0.151*	0.02*7
8. High starch/sugar food restriction								1.000	0.072*	0.002
9. Attention to nutrition information									1.000	0.083*
10. Regularity of eating meals										1.000

* $P < 0.05$

Discussion

Nutrition knowledge may influence dietary behavior directly or through nutrition attitudes. Dietary behavior may further become dietary patterns and influence one's nutrient intake.[11-13] Therefore, understanding people's nutrition knowledge, attitudes, and behavior is the basis for nutrition education. Dietary restriction attitudes and behavior were especially focused upon in this study because there are many dietary taboos in Chinese culture in addition to the dietary restrictions relating to degenerative diseases that many elderly persons encounter. Results showed that the nutrition knowledge of the Taiwanese elderly was poor, especially about the relationship between nutrition and disease. Elderly persons who were female, older, with lower educational levels, and living in remote areas (e.g. eastern Taiwan, mountain areas, and the PengHu islands) scored lower on the knowledge scale than males with higher educational levels and living in more urban areas. All of these outcomes were similar to those found in other studies.[11,14-17] In regards to nutrition attitudes, the Taiwanese elderly have quite positive general nutrition attitudes, but at the same time also exhibit strong Chinese traditional or food-texture-related dietary restriction attitudes, especially elderly women with lower educational levels. Unlike the case for nutrition knowledge, the elderly from different residential areas did not differ much in their nutrition attitudes. Only those residing in rural areas and the PengHu islands held stronger Chinese traditional or food-texture-related dietary restriction attitudes. Elderly people from mountain areas and eastern Taiwan did not differ from urban and rural elderly in nutrition attitudes. We also found that the Taiwanese elderly frequently followed Chinese traditional or food-texture-related dietary restriction behavior as well as many modern medical dietary suggestions, but rarely sought nutrition information. More than half of the elderly persons studied avoided eating irritating, (acidic, acrid, etc.) tough or cold foods. On the other hand, only 30% of elderly people avoided eating fermented/pickled foods or high-fat/high-cholesterol foods which were classified as "forbidden foods" for older persons by medical practitioners and dietitians based on modern medical evidence. Elderly people from the PengHu islands undertook almost all of the dietary restrictions except those against high starch/sugar foods more often than the elderly from other areas. Elderly people from mountain areas less frequently avoided eating Chinese traditional or food-texture-related restricted foods and high-fat/cholesterol foods, while elderly people from Hakka areas avoided fermented foods less frequently. Overall, elderly people from the PengHu islands exhibited all types of dietary restriction behaviors more frequently than the elderly from other areas, and the elderly from eastern Taiwan restricted their diet less frequently than those in other areas.

Further analyses or studies would be necessary to fully explain the differences. However, some of the differences in dietary restriction behaviors of elderly people from different areas can be explained by differences in ethnic or other characteristics. Elderly people in the PengHu islands, especially the women, are of predominantly Fukienese origin. Due to geographic location, the PengHu

islands have been isolated from modern society for a long time. Therefore the elderly of the PengHu islands have lower educational levels and retain more Chinese traditions. Elderly people living in mountain areas and eastern Taiwan are mainly Taiwanese aborigines.[10] In their traditional culture, meat and offal are considered precious foods and can be eaten only by men or used for special occasions, such as religious ceremonies and weddings.[18] The results indicated that elderly people in both the mountain areas and eastern Taiwan restricted high-fat/cholesterol foods less frequently than the urban elderly, but only elderly people in the mountain areas abided by Chinese traditional food restrictions less frequently. This may be the result of the influences of culture transmission and information accessibility which occurred when aborigines moved to the plains. Therefore, eastern Taiwanese elderly aborigines have accepted Chinese culture more readily than those living in the mountain areas. Hakka people have many unique traditions; one of the most famous Hakka foods is pickled or fermented vegetables. This may explain why the Hakka elderly avoided such foods less frequently. The influences on eating behavior are very complex, and may be due to differences of ethnicity, culture, and educational background. The results showed that participants' nutrition knowledge positively correlated with general eating attitudes, health-related attitudes and dietary restriction behaviors encouraged by modern medical science, but negatively correlated with Chinese traditional or food-texture-related dietary restriction attitudes and behaviours. In addition, those with poorer nutrition knowledge such as women with lower educational levels, living in remote areas, also held stronger Chinese traditional or food-texture-related dietary restriction attitudes and performed those dietary restriction behaviors more frequently. We especially focused on dietary restriction or food taboos because there are many dietary restrictions for the Taiwanese elderly; some from Chinese culture and some from modern medical science. The results of factor analysis showed that the Chinese traditional dietary restriction items were in the same factor as food-texture-related dietary restriction items for both attitude and behavior scales. The authors suspect that this is because both of them are related to the "physical" characteristics of food.

Many studies have pointed out similar results regarding eating patterns of the elderly. Davidson, Lirermore, Anderson and Kanfman[19] mentioned that elderly people avoided fried food and food with strong flavor. The Nutrition and Health Survey in Taiwan 1993-1996 (NAHSIT 1993-1996) also indicated that the frequency of eating fried foods decreased with increasing age in Taiwan.[17] Loss of teeth is a major age-related change that can influence food intake. As a result, elderly people tend to avoid meat and other foods which are difficult to chew and eat softer or high carbohydrate foods.[20,21] Researchers have also reported that losses in taste and smell perception occur as part of normal aging in addition to certain disease states and pharmacological interventions. Sensory decrements can not only reduce the enjoyment of food but can alter food intake.[22] Many people have suggested that this is the reason why the elderly have an increased intake of salt and sugar.[22,23] This may also explain why fewer elderly Taiwanese avoided fermented foods, pickled foods, high sugar or high starch foods than other types of foods in this study. Horwath[24] pointed out that as age increases, elderly people decrease their intake of red meat, eggs, fried and high-fat foods, increase their intake of vegetables, chicken and fish, and use oil rich in PUFA to replace oil rich in SFA.

The major sources of nutrition information for the Taiwanese elderly included offspring or relatives, TV, and medical practitioners. Because 80% of the elderly have either no formal education or only primary school education, this may limit their accessibility to written educational materials. Therefore, the offspring or other family members of older persons should be included in elderly nutrition education programs. Dietitians were not as an important source of information compared to medical practitioners and nurses; this might reflect the fact that Taiwanese people seldom seek nutrition counselling from dietitians because it is not covered by the National Health Insurance policy. As a result, medical practitioners or nurses have become the major sources of nutrition information when the elderly visit hospital. Many studies have indicated that the nutrition knowledge of doctors and nurses is not satisfactory.[25-28] Lin *et al*., and other Taiwanese researchers[29-31] have also found that the nutrition knowledge of Taiwanese interns, residents, primary care physicians and nurses is poor. Therefore medical practitioners and nurses may not be appropriate as the major source of nutrition information. Re-evaluating the National Health Insurance Policy to include nutrition counselling may be a way to increase the number of elderly persons seeking nutrition information from dietitians. Grotkowski and Sims reported that there were no significant associations between TV as a dietary and nutrition information source and nutrition knowledge and attitudes.[11] However, since elderly Taiwanese spend a lot of time watching TV and stated that TV was a popular source of dietary and nutrition information, how to better use TV as a medium for nutrition education of the elderly could be important for nutrition educators.

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Appendix 1

Examples of questions of the nutrition knowledge, attitudes and dietary restriction behaviour scales

Nutrition knowledge

1. Relationship between nutrition and disease

Is diet high in fat related to high blood cholesterol?
Is diet low in iron related to anemia?

2. The requirements of different food groups

Do you think that elderly people should eat dairy products every day (e.g. cow's milk or goat's milk)?
How many glasses should you drink?

3. The comparison of foods in terms of specific nutrients and cooking method

Compare the nutritional content of the two types of fat and cooking methods below:
Which type of cooking fat has more cholesterol: lard or soy bean oil?
Which cooking method is higher in fat: deep-frying with crumb and flour or braising?

Nutrition attitudes

1. Health-care related attitudes

Healthy foods sold in the market are higher in nutritional value than regular foods
Eating healthy foods can make you live longer

2. General eating attitudes

I have already lived to be this old so I don't have to think about nutritional problems any more
In order to be healthy, I should eat some foods that I have never had before

3. Chinese traditional or food-texture-related dietary restriction attitudes

Elderly people should avoid eating rough foods (e.g. brown rice and some types of vegetables)
Elderly people should avoid eating cooling foods

Dietary restriction behavior

Do you avoid or eat only small amounts of:

1. Chinese traditional or food-texture-related dietary restriction behavior

Coarse or rough foods? Cooling foods?

2. High fat/cholesterol food restriction behavior

Red meat (e.g. pork, beef, lamb etc); organ meat

3. Pickled or fermented food restriction behavior

Pickled vegetables, fermented soybean curd and other fermented products
Gherkin or other vegetables pickled in soy sauce

4. High starch and/or high sugar food restriction behavior

Sweet foods; Foods high in starch