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ORIGINAL CONTRIBUTION

Hypercholesterolemia and Its Correlates in Taiwanese Elderly People

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Background: Our study used data collected in Chung-Shing-Shin-Tseun community in Taiwan in May 1998 to evaluate the relationship between hypercholesterolemia and the cardiovascular and sociodemographic risk factors in elderly people.

Methods: Individuals aged 65 and over were recruited as study subjects. A total of 1,093 persons, out of 1,774 registered residents, were contacted in face-to-face interview. The response rate was 61.6 percent. However, only 586 respondents took blood tests and completed questionnaires. Analysis in this study was based on these 586 subjects. The t-test, chi-square analysis, and multivariate logistic regression were used to study the significant correlates of hypercholesterolemia.

Results: Our results showed that 66 percent were men and 34 percent were women. The mean age was 73.1 ± 5.3 years. The mean total cholesterol value was 5.1 ± 1 mmol/l in elderly men and 5.5 ± 1.3 mmol/l in elderly women. The proportions of hypercholesterolemia were 43.7 percent in elderly men and 59.6 percent in elderly women. After controlling the other covariates, the multivariate logistic regression analysis showed that the significant related factors of hypercholesterolemia were age, hypertriglyceridemia, and hyperuricemia. No significant association was found between hypercholesterolemia and gender, obesity, high systolic pressure, high diastolic pressure, hyperglycemia, educational level, retirement status, or marital status.

Conclusion:. Hypercholesterolemia is significantly associated with hypertriglyceridemia and hyperuricemia in elderly people. It is important to determine other metabolic disorders if one metabolic disorder is disclosed.

INTRODUCTION

Elevated serum total cholesterol has been identified as one modifiable risk factor for the cardiovascular disease [1]. Reduced serum total cholesterol levels by 1 percent had been associated with 2 percent reduction in risk for the cardiovascular disease [2]. It has been estimated that about 60 percent of the elderly people may

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[e] *Abbreviations:* BMI, body mass index; CI, confidence interval; OR, odds ratio.

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have high serum total cholesterol levels [3] and be candidates for either dietary or pharmacological interventions [4]. In Taiwan, cardiovascular disease is the third leading cause of death after neoplasm and cerebrovascular disease [5]. The population aged ≥ 65 years has exceeded 7 percent in Taiwan since 1994, and a continued increase in numbers of elderly people is detected [6]. In Chen's report, serum total cholesterol values were 5 ± 0.9 mmol/l in male and 4.9 ± 0.9 mmol/l in female. The prevalence of hypercholesterolemia (≥ 6.2 mmol/L) was 11.5 percent in male and 10 percent in female [7]. Up to now, there is little information on the associations between hypercholesterolemia and the cardiovascular risk factors or the sociodemographic factors in Taiwanese elderly people. As a result, health promotion and disease prevention recommendations of elderly people remain uncertain. Thus, it is time to pay attention to the health status of elderly people in this country.

For early detection of hypercholesterolemia and early identification of risk factors and early intervention for hypercholesterolemia, under conduction of comprehensive health survey studies in elderly people living in Chung-Shing-Shin-Tseun community in Taiwan, the distribution of serum total cholesterol was investigated. The relationship between hypercholesterolemia and the cardiovascular and sociodemographic risk factors was also discerned.

MATERIALS AND METHODS

In May 1998, a cross-sectional study was conducted in Chung-Shing-Shin-Tseun community in Taiwan. All of individuals aged 65 and over were candidates for study, for a total of 1,774 subjects according to the official household registration records. A total of 1,093 persons, out of the possible 1,774 subjects, participated in the study. The response rate was 61.6 percent. However, only 586 respondents took blood tests and completed questionnaires. Analysis in this study was based on these 586 subjects. Information about the subjects' socioeconomic status, family structure, and educational level was collected by well-trained interviewers in face-to-face interviews.

The subjects' educational level were identified as junior high school or less, senior high school, professional training college, and undergraduate or graduate. If the subject had retired from work, that status was identified. If the subject still lived with a spouse, the marital status was defined as living together. If not, marital status was defined as living alone.

Blood pressure was measured by a mercury sphygmomanometer in the sitting position. Weight and height were measured. Blood samples were obtained in the morning after a 12-hour overnight fasting. A number of biochemical markers, such as cholesterol, triglyceride, fasting glucose, creatinine, and uric acid were analyzed by a biochemical autoanalyzer (Chem1$^+$, Technicon, USA) at the Department of Clinical Laboratory of Chung-Shing Hospital within four hours of collection.

Body mass index (BMI^e) was measured as follows: weight (kg) ÷ height (m)^2. BMI ≥ 28 was defined as obesity; 25 ≤ BMI < 28 as overweight; 20 ≤ BMI < 25 as normal; and BMI < 20 as underweight [8]. Hypercholesterolemia was defined as total cholesterol ≥ 5.2 mmol/l and hypertriglyceridemia was defined as triglyceride ≥ 2.3 mmol/l [9]. Hyperglycemia was defined as fasting glucose ≥ 6.1 mmol/l [10]. Subjects were considered to have high blood pressure if the average of three readings exceeded 140 mmHg systolically and/or 90 mmHg diastolically [11]. Hyperuricemia was defined as serum uric acid ≥ 416.5 μmol/l in men and ≥ 386.8 μmol/l in women [12].

Table 1. Total cholesterol levels (mmol/L) in elderly people by age and gender.

Variate	Age			
	65-69[a]	70-74[b]	75-79	≥80
Gender:				
Men	5.2 ± 1.1	5.1 ± 1.1	5.0 ± 1.0	4.8 ± 0.9
Women	5.6 ± 1.3	5.7 ± 1.3	5.3 ± 1.5	5.0 ± 1.0

[a] $p < .05$
[b] $p < .001$

The statistical analyses were performed with the aid of a SAS package (version 6.12, SAS Institute, Inc., Cary, NC). The methods of statistical analysis applied in this study were t-test, chi-square analysis and multivariate logistic regression. A p-value less than .05 was considered statistically significant.

RESULTS

Among 1,093 subjects, 65.7 percent were men and 34.3 percent were women. The mean age was 73.5 ± 5.6 years. Our study disclosed that 66 percent were men and 34 percent were women out of 586 subjects. The mean age was 73.1 ± 5.3 years. We performed t-test and chi-square analysis to examine the gender and age distributions between these two samples. No significant difference was observed. Therefore, the potential non-response bias could be minimized. For those elderly people included in the current study, the mean values of total cholesterol were 5.1 ± 1 mmol/l in men and 5.5 ± 1.3 mmol/l in women ($p < .001$). The proportions of hypercholesterolemia (≥ 5.2 mmol/l) were 43.7 percent in men and 59.6 percent in women ($p < .01$).

In Table 1, although the mean values of total cholesterol decreased with age in men, no statistical significance was revealed ($p > .05$). Women at age 65 to 69 and age 70 to 74 had higher cholesterol values than men of similar ages ($p < .05$ and $p < .001$, respectively).

Table 2. Prevalence of hypercholesterolemia in elderly people by age and gender.

Age (years)	Normal Number (%)	Hypercholesterolemia Number (%)	χ^2 value
Men:			
65-69	43 (44.8)	53 (55.2)	8.96[a]
70-74	72 (56.3)	56 (43.8)	
75-79	71 (61.2)	45 (38.8)	
≥80	32 (68.1)	15 (31.9)	
Women:			
65-69	27 (38.6)	43 (61.4)	2.90
70-74	22 (35.5)	56 (64.5)	
75-79	16 (44.4)	20 (55.6)	
≥80	14 (53.9)	12 (46.2)	

[a] $p < .05$

Table 3. Correlates of hypercholesterolemia in elderly people.

Variate	Total number	Hypercholesterolemia number (%)	χ^2 value
Obesity (BMI ≥ 28 kg/m^2):			
No	500	247 (49.4)	0.01
Yes	70	35 (50.0)	
Systolic pressure ≥ 140 (mmHg):			
No	380	181 (47.6)	0.51
Yes	197	100 (50.8)	
Diastolic pressure ≥ 90 (mmHg):			
No	453	226 (49.9)	1.19
Yes	124	55 (44.4)	
Triglyceride ≥ 2.3 (mmol/l):			
No	456	198 (43.4)	27.57[b]
Yes	126	88 (69.8)	
Fasting glucose ≥ 6.1 (mmol/l):			
No	466	220 (47.2)	3.45
Yes	118	67 (56.8)	
Uric acid (men ≥ 416.5; women ≥ 386.8 μmol/l):			
No	283	124 (43.8)	6.04[a]
Yes	300	162 (54.0)	
Educational level:			
Junior high school or less	164	91 (55.5)	9.09[a]
Senior high school	152	72 (47.4)	
Professional training college	72	43 (59.7)	
Undergraduate or graduate	133	55 (41.4)	
Retirement status:			
Non-retired	151	91 (60.3)	10.23[b]
Retired	434	196 (45.2)	
Marital status:			
Living together	425	196 (46.1)	5.09[a]
Living alone	159	90 (56.6)	

[a] $p < .05$; [b] $p < .01$

In Table 2, hypercholesterolemia was associated with age in men. The proportion of hypercholesterolemia also decreased with age in men ($p < .05$). There was no relationship between age and hypercholesterolemia in women.

The results of chi-square analysis for hypercholesterolemia among the cardiovascular and sociodemographic risk factors were shown in Table 3. The significant correlates of hypercholesterolemia were hypertriglyceridemia, hyperuricemia, educational level, retirement status, and marital status. No significant association was found between hypercholesterolemia and obesity, high

Table 4. Multivariate logistic regression of hypercholesterolemia in elderly people.

Variate	EP (SE)	OR	95% CI
Gender (men as reference):			
Women	0.4 (0.4)	1.5	0.7-3.2
Age (65-69 as reference):			
70-74	-0.1 (0.3)	0.9	0.5-1.6
75-79	-0.5 (0.4)	0.6	0.3-1.2
≥ 80	-1.1 (0.5)	0.4	0.1-0.9[a]
BMI (kg/m^2, normal as reference)			
Obesity	-0.4 (0.3)	0.7	0.2-1.2
Systolic pressure (< 140 mmHg as reference):			
≥ 140	0.3 (0.3)	1.3	0.7-2.3
Diastolic pressure (< 90 mmHg as reference):			
≥ 90	-0.5 (0.4)	0.6	0.3-1.2
Triglyceride (< 2.3 mmol/l as reference):			
≥ 2.3	0.9 (0.3)	2.4	1.2-4.5[a]
Fasting glucose (< 6.1 mmol/l as reference):			
≥ 6.1	0.1 (0.3)	1.1	0.6-2.2
Uric acid (men < 416.5; women < 386.8 μmol/l as reference):			
Men ≥ 416.5; women ≥ 386.8	0.7 (0.3)	2.0	1.2-3.4[b]
Educational level (junior high school or less as a reference):			
Senior high school	-0.2 (0.4)	0.8	0.4-1.6
Professional training college	0.7 (0.4)	2.0	0.9-4.7
Undergraduate or graduate	0.1 (0.4)	1.1	0.6-2.4
Retirement (non-retired as reference):			
Retired:	-0.6 (0.5)	0.5	0.2-1.4
Marital status (living together as reference):			
Living alone	0.5 (0.3)	1.6	0.9-3.0

[a] $p < .05$; [b] $p < .01$

systolic pressure, high diastolic pressure, or hyperglycemia.

The results of multivariate logistic regression for hypercholesterolemia were shown in Table 4. After controlling the other covariates, the significant related factors of hypercholesterolemia were hypertriglyceridemia (Odds ratio [OR] = 2.4; 95 percent confidence intervals [CI] = 1.2-4.5) and hyperuricemia (OR = 2.0; 95 percent CI = 1.2-3.4). That is, people with hypertriglyceridemia were more likely to have hypercholesterolemia than people with normal triglyceride. People with hyperuricemia were more likely to have hypercholesterolemia than people with normal uric acid. Hypercholesterolemia was negatively associated with subjects

aged 80 and over (OR = 0.4; 95 percent CI = 0.1-0.9). That is, people at age 65-69 were more likely to have hypercholesterolemia than people aged 80 and over. No significant association was found between hypercholesterolemia and gender, obesity, high systolic pressure, high diastolic pressure, hyperglycemia, education level, retirement status, or marital status.

DISCUSSION

Most of people living in Chung-Shing-Shin-Tseun community moved to Taiwan from Mainland China after the civil war during their military service. Because most of them were male, the proportion of male in this sample was higher than that of female.

In Weijenberg's report, total cholesterol diminished with age among elderly men [13]. In Ranieri's report, mean cholesterol levels were also significantly lower in men [14]. In Huang's report, 24.5 percent of men and 44.6 percent of women over the age of 65 years had serum total cholesterol over 5.7 mmol/l [15]. In our present report, elderly women had higher total cholesterol values than elderly men of similar ages. That might be explained by the different hormonal status of men and women, especially estrogen. Estrogen had protective effect in premenopausal women [16]. After menopause, this protective effect might diminish [17]. However, the real cause needed further evaluation.

In our present report, people at age 65 to 69 were more likely to have hypercholesterolemia than people aged 80 and over. This might be explained by the mechanism that people with hypercholesterolemia died at their early age because hypercholesterolemia increased the possibility of the cardiovascular diseases [1-2]. Thus, people surviving longer were more likely to have lower serum total cholesterol values.

Hyperlipidemia was often associated with obesity, diabetes, hyperuricemia, and hypertension [12, 18-19] Hypercholesterolemia, hypertriglyceridemia, hyperuricemia, and hypertension were noted in people with insulin resistance [20-21]. Therefore, this association suggested the same pathogenesis for hyperlipidemia, hyperglycemia, hyperuricemia, and hypertension [12, 18-22]. In Chen's report, hypercholesterolemia was significantly correlated with hyperuricemia [7]. In our previous report, serum uric acid was significantly correlated with serum total cholesterol and triglyceride [23]. In our present report, hypercholesterolemia was significantly correlated with hypertriglyceridemia and hyperuricemia. These findings further indicated that multiple metabolic disorders would often cluster within the same individual. Thus, it is important to determine other metabolic disorders if one metabolic disorder is observed.

In conclusion, hypercholesterolemia is significantly associated with hypertriglyceridemia and hyperuricemia in elderly people. Therefore, it is important to determine other metabolic disorders if one metabolic disorder is disclosed.

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