Prevalence of Hypercholesterolemia and Its Related Factors in Middle-aged Taiwanese Adults---A Hospital-based Study

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Objectives. Hypercholesterolemia-related chronic diseases such as cardiovascular disease, cerebrovascular disease, and hypertension are major public health concerns in Taiwan. The aim of this study was to explore the prevalence of hypercholesterolemia and its related factors in middle-aged Taiwanese adults.

Methods. This was a cross-sectional hospital-based study. We analyzed the health status of adults who voluntarily visited the China Medical College Hospital in Taichung for preventive services from April to September 2000. The preventive services included history taking, physical examination, and measurement of fasting blood biochemistry. Of the 2745 persons, 39% were men and 61% were women (mean age, 50.2 ± 6.9 years). In order to determine the significant related factors of hypercholesterolemia, the *t* test, the chi-square test and logistic regression analysis were performed.

Results. The mean level of total serum cholesterol was 5.04 ± 0.95 mmol/L in men and 5.03 ± 0.98 mmol/L in women. The prevalence of hypercholesterolemia was 40.3% in men and 39.6% in women. According to our statistical analysis, hypercholesterolemia increased with age ($p < 0.01$). Logistic regression analysis showed that the statistically significant related factors of hypercholesterolemia were age (odds ratio [OR] = 1.03, 95% confidence interval [CI] = 1.02 – 1.04, $p < 0.001$), hypertension (OR = 1.22, 95% CI = 1.02 – 1.44, $p < 0.05$), hypertriglyceridemia (OR = 2.33, 95% CI = 1.94 – 2.81, $p < 0.001$) and hyperuricemia (OR = 1.38, 95% CI = 1.15 – 1.67, $p < 0.001$).

Conclusions. Hypercholesterolemia is a relatively common problem in middle-aged adults. When older individuals present with hypertension, hypertriglyceridemia or hyperuricemia, it is important to determine total serum cholesterol levels. **(Mid Taiwan J Med 2003;8:85-90)**

Key words

hypercholesterolemia, hypertension, hypertriglyceridemia, hyperuricemia, middle-aged

INTRODUCTION

Elevated total serum cholesterol is one of the modifiable risk factors of cardiovascular disease [1]. A reduction in total serum cholesterol by 1% has been shown to correlate with a 2% reduction in the risk of cardiovascular disease [2].

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In Chen's report, the mean level of total serum cholesterol was 5.0 ± 0.9 mmol/L in men and 4.9 ± 0.9 mmol/L in women [3]. The prevalence of hypercholesterolemia (≥ 6.22 mmol/L) was 11.5% in men and 10.0% in women [3], a condition which calls for either dietary or pharmacological intervention [4]. In order to understand the prevalence of hypercholesterolemia and to identify its related factors, we gathered and analyzed data of all middle-aged adults who came to the China Medical College

Table 1. Comparison of clinical characteristics between subjects with and without hypercholesterolemia by the *t* test

Variable	Normal	Hypercholesterolemia	*p*
Age (yr)	49.5 ± 6.9	51.2 ± 6.9	< 0.0001
BMI (kg/m^2)	23.9 ± 3.5	24.5 ± 3.4	< 0.0001
Systolic pressure (mmHg)	124.0 ± 17.6	127.8 ± 18.3	< 0.0001
Diastolic pressure (mmHg)	80.8 ± 11.2	83.7 ± 11.9	0.0001
Fasting glucose (mmol/L)	5.4 ± 1.3	5.7 ± 1.8	0.0005
Total cholesterol (mmol/L)	4.4 ± 0.5	6.0 ± 0.7	0.0001
Triglyceride (mmol/L)	1.3 ± 1.6	1.8 ± 2.1	0.0001
Uric acid (μmol/L)	335.8 ± 82.4	359.0 ± 86.2	< 0.0001

Hospital for preventive services from April to September, 2002.

MATERIALS AND METHODS

This was a cross-sectional hospital-based study. We analyzed the health status of adults who voluntarily visited the China Medical College Hospital in Taichung for preventive services from April to September 2000. All individuals aged 40 to 64 were candidates. In total, 2745 people were included in this study (39% were men and 61% were women). The mean age was 50.2 ± 6.9 years. The items of preventive services included a self-administrated questionnaire, history taking, physical examination, and measurement of fasting blood biochemistry. Subjects who had never smoked or had quit smoking before the time of preventive services were defined as nonsmokers. Subjects who smoked at the time of preventive services were defined as smokers. Subjects who did not drink alcohol or drank alcohol occasionally were classified as nondrinkers. Subjects who habitually drank alcohol were classified as drinkers.

Blood pressure was measured in the sitting position by a mercury sphygmomanometer. Blood samples were obtained in the morning after a 12-hour overnight fast. A number of biochemical markers, such as total serum cholesterol, triglyceride, fasting glucose, and uric acid were analyzed by a biochemical autoanalyser within 4 hours after collecting the samples (Hitachi 736-15, Tokyo, Japan) at the Department of Clinical Laboratory of the China Medical College Hospital.

Body mass index (BMI) was measured as follows: weight (kg) ÷ height (m)^2. BMI ≥ 27 was defined as obese [5]. Hypercholesterolemia was defined as a total serum cholesterol level ≥ 5.18 mmol/L and hypertriglyceridemia was defined as a triglyceride level ≥ 1.70 mmol/L [6]. Hyperglycemia was defined as a fasting glucose level ≥ 6.05 mmol/L or when subjects had a history of diabetes [7]. Subjects were considered hypertensive if the blood pressure reading exceeded 140 mmHg systolically and/or 90 mmHg diastolically or subjects had a history of hypertension [8]. Hyperuricemia was defined as a serum uric acid level ≥ 416.5 μmol/L in men and ≥ 386.8 μmol/L in women [9].

Statistical analyses were performed by the SAS package (version 6.12, SAS Institute Inc., Cary, North Carolina) and included the *t* test, the chi-square test and logistic regression. A *p* value < 0.05 was considered statistically significant.

RESULTS

The mean level of total serum cholesterol was 5.04 ± 0.95 mmol/L in men and 5.03 ± 0.98 mmol/L in women ($p > 0.05$). The prevalence of hypercholesterolemia was 40.3% in men and 39.6% in women ($p > 0.05$).

There were significant differences in the mean age, body mass index, systolic blood pressure, diastolic blood pressure, fasting glucose, triglyceride and uric acid levels between the normal and hypercholesterolemia groups ($p < 0.001$) (Table 1).

The clinical characteristics of hypercholesterolemia in middle-aged adults analyzed by the

Table 2. Comparison of clinical characteristics between subjects with and without hypercholesterolemia by the chi-square test

Variable	Normal	Hypercholesterolemia	*p*
	N (%)	N (%)	
Sex			
Men	634 (59.8)	427 (40.2)	0.747
Women	1018 (60.5)	666 (39.5)	
Age (yr)			
40–49	974 (65.2)	520 (34.8)	0.001
50–59	489 (54.4)	490 (45.6)	
60–64	189 (53.5)	164 (46.5)	
Obesity			
No	1367 (61.0)	874 (39.0)	0.073
Yes	285 (56.6)	219 (43.4)	
Hypertension			
No	1159 (63.9)	656 (36.1)	0.001
Yes	493 (53.0)	437 (47.0)	
Hyperglycemia			
No	1472 (61.2)	935 (38.8)	0.007
Yes	180 (53.3)	158 (46.7)	
Hypertriglyceridemia			
No	1361 (66.1)	697 (33.9)	0.001
Yes	291 (42.4)	396 (57.6)	
Hyperuricemia			
No	1329 (63.5)	763 (36.5)	0.001
Yes	323 (49.5)	330 (50.5)	
Smoker			
No	1397 (60.8)	902 (39.2)	0.172
Yes	255 (57.2)	191 (42.8)	
Drinker			
No	1575 (60.1)	1045 (39.9)	0.812
Yes	77 (61.6)	48 (38.4)	

Table 3. The related factors of hypercholesterolemia in middle-aged adults by logistic regression analysis

Variable	OR	95% CI
Age	1.03	1.02 – 1.04**
Hypertension	1.22	1.02 – 1.44*
Hyperglycemia	1.00	0.78 – 1.27
Hypertriglyceridemia	2.33	1.94 – 2.81**
Hyperuricemia	1.38	1.15 – 1.67**

*$p < 0.05$, **$p < 0.001$. OR = odds ratio; CI = confidence interval.

chi-square test are shown in Table 2. The prevalence of hypercholesterolemia increased with age ($p < 0.01$). The statistically significant related factors of hypercholesterolemia were age, hypertension, hyperglycemia, hypertriglyceridemia and hyperuricemia.

The results of logistic regression analysis for hypercholesterolemia are displayed in Table 3. Five independent variables were analyzed according to the results of the *t* test and the chi-square test. After controlling for the covariables, the significantly related factors of hypercholesterolemia were age (odds ratio [OR] = 1.03, 95% confidence interval [CI] = 1.02 – 1.04, $p < 0.001$), hypertension (OR = 1.22, 95% CI = 1.02 – 1.44, $p < 0.05$), hypertriglyceridemia (OR = 2.33, 95% CI = 1.94 – 2.81, $p < 0.001$) and hyperuricemia (OR = 1.38, 95% CI = 1.15 – 1.67, $p < 0.001$). No significant association was found between hypercholesterolemia and hyperglycemia.

DISCUSSION

Although the volunteers were not representative of Taiwanese adults and the sample size was small, we hoped that this study could still provide basic information for further studies on the epidemiology of hypercholesterolemia in Taiwanese adults.

In Chou's community-based study, the prevalence of hypercholesterolemia (≥ 6.22 mmol/L) was 33.5% in men and 31.5% in women [10]. In this hospital-based study, the prevalence of hypercholesterolemia (≥ 5.18 mmol/L) was 40.3% in men and 39.6% in women ($p > 0.05$). The prevalence in our study was higher than that in Chou's study becasue the cholesterol level used for the definition of hypercholesterolemia in our study was lower than that used in Chou's study. Other factors related to the differences in results include the different populations studied and the different detection methods used.

This study also found that the prevalence of hypercholesterolemia increases with age, which is consistent with the study by Chou et al [11]. Hypercholesterolemia, hypertriglyceridemia, obesity, essential hypertension, and hyperuricemia are common in people with insulin resistance [9,12-17]. Therefore, this notable association suggests the same pathogenesis for hypercholesterolemia, hypertriglyceridemia, glucose intolerance/diabetes mellitus, essential hypertension, and hyperuricemia [9,12-20]. In this study, hypercholesterolemia was significantly associated with hypertension, hypertriglyceridemia, and hyperuricemia. These findings further indicate that multiple metabolic disorders can often cluster within the same individual [9,12-20]. Undoubtedly, it is particularly important to determine other metabolic disorders if one metabolic disorder is detected.

In conclusion, hypercholesterolemia is very common in middle-aged adults and is significantly associated with age, hypertension, hypertriglyceridemia and hyperuricemia. We suggest measuring total serum cholesterol levels when older individuals present with hypertension, hypertriglyceridemia, or hyperuricemia.

REFERENCES

1. Soons KR, Little DN, Harvey J. Cholesterol screening in the elderly: changing attitudes. *Gerontology* 1995;41:57-62.
2. The Lipids Research Clinics Coronary Primary Prevention Trial results. I. Reduction in incidence of coronary heart disease. *JAMA* 1984;251:351-64.
3. Chen TJ, Yu BT. Report on survey of serum glucose, cholesterol, uric acid and creatinine values in adults of Taipei city. *J Nephrology ROC* 1995;9:109-18.
4. Manolio TA, Furberg CD, Wahl PW, et al. Eligibility for cholesterol referral in community-dwelling older adults. The Cardiovascular Health Study. *Ann Intern Med* 1992;116:641-9.
5. Department of Health, Taiwan. http://www.doh.gov.tw/newverprog/proclaim/content.asp?class_no=25&doc_no=32
6. Executive Summary of The Third Report of The National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, And Treatment of High Blood Cholesterol In Adults (Adult Treatment Panel III). *JAMA* 2001;285:2486-97.
7. Report of the Expert Committee on the Diagnosis and Classification of Diabetes Mellitus. *Diabetes Care* 2000;23(Suppl 1):4-19.
8. Summary of 1993 World Health Organisation-International Society of Hypertension guidelines for the management of mild hypertension. Subcommittee of WHO/ISH Mild Hypertension Liaison committee. *BMJ* 1993;307:1541-6.
9. Saggiani F, Pilati S, Targher G, et al. Serum uric acid and related factors in 500 hospitalized subjects. *Metabolism* 1996;45:1557-61.
10. Chou P, Hsiao KJ, Lin JW, et al. Community-based survey on blood pressure, blood biochemistry and dietary habits in Pu-Li, Taiwan. *Zhonghua Yi Xue Za Zhi (Taipei)* 1992;50:279-87.
11. Chou P, Shaw CK, Lai MY. Community-based study on the relationship between serum cholesterol/triglyceride and dietary habits/life styles in Pu-Li, Taiwan. *Zhonghua Yi Xue Za Zhi (Taipei)* 1993;52:155-60.
12. Woo J, Swaminathan R, Cockram C, et al. Association between serum uric acid and some cardiovascular risk factors in a Chinese population. *Postgrad Med J* 1994;70:486-91.
13. Agamah ES, Srinivasan SR, Webber LS, et al. Serum uric acid and its relation to cardiovascular disease risk factors in children and young adults from a biracial community: the Bogalusa Heart Study. *J Lab Clin Med* 1991;118:241-9.
14. Lin CC, Li TC, Lai SW, et al. Hypertriglyceridemia and the Related Factors in Middle-Aged Adults in Taiwan. *Mid Taiwan J Med* 2001;6:1-6.
15. Ng KC, Lin CC, Lai SW, et al. Obesity and the Related Factors in Middle-Aged Adults in Chung-Hsing Village in Taiwan. *Mid Taiwan J Med*

2001;6:35-9.
16. Collantes Estevez E, Pineda Priego M, Anon Barbudo J, et al. Hyperuricemia-hyperlipidemia association in the absence of obesity and alcohol abuse. *Clin Rheumatol* 1990;9:28-31.
17. Vuorinen MH, Yki JH. Hyperuricemia and insulin resistance. *J Clin Endocrinol Meta* 1994;78:25-9.
18. Bonora E, Kiechl S, Willeit J, et al. Prevalence of insulin resistance in metabolic disorders: the Bruneck Study. *Diabetes* 1998;47:1643-9.
19. Tan CC, Ng KC, Lai SW, et al. The results of preventive services for adults at a medical center in Taichung. *Mid Taiwan J Med* 2001;6:233-7
20. Lai SW, Tan CC, Ng KC. Hepatic effects in hyperlipidemic patients. *Mid Taiwan J Med* 2002; 7:160-4.

台灣地區中年人高膽固醇血症之盛行率及其相關因子之研究

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背景 爲了瞭解台灣地區中年人高膽固醇血症的盛行率與其相關因子。

方法 本研究爲一橫斷面研究，是以西元2000年4月至9月期間，到中國醫藥學院附設醫院做成人健康檢查的2745位40歲至64歲中年民衆爲研究對象，其中男性佔38.7%，女性佔61.3%，平均年齡爲50.2±6.9歲。統計方法採用 t 檢定，卡方檢定與羅吉斯迴歸分析。

結果 總膽固醇的平均值在男性爲5.04±0.95 mmol/L，在女性爲5.03±0.98 mmol/L。高膽固醇血症的盛行率在男性爲40.3%，在女性爲39.6%。高膽固醇血症的盛行率隨著年齡之增加而遞增。以羅吉斯迴歸分析來看，高膽固醇血症的相關因子爲年齡(勝算比是1.03倍，95%信賴區間爲1.02至1.04，$p<0.001$)、高血壓(勝算比是1.22倍，95%信賴區間爲1.02至1.44，$p<0.05$)、高三酸甘油脂血症(勝算比是2.33倍，95%信賴區間爲1.94至2.81，$p<0.001$)與高尿酸血症(勝算比是1.38倍，95%信賴區間爲1.15至1.67，$p<0.001$)。

結論 高膽固醇血症在中年人是常見的疾病，中年人定期測量血清總膽固醇值是有必要的，特別是合併高血壓，高三酸甘油脂血症或高尿酸血症。（中台灣醫誌 **2003;8:85-90**）

關鍵詞

高膽固醇血症，高血壓，高三酸甘油脂血症，高尿酸血症，中年人

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