ORIGINAL ARTICLE

# Epidemiology of Hypertriglyceridemia in the Elderly Taiwanese Population

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**ABSTRACT Our study used data collected in Chung-Hsing Village in Taiwan in May 1998 to evaluate the distribution of triglycerides and the association between hypertriglyceridemia and its correlates in elderly people. All individuals aged 65 and over were recruited as study subjects. A total of 1093 persons, out of 1774 registered residents, were contacted in face-to-face interviews. The response rate was 61.6%. However, only 586 respondents had blood tests and completed questionnaires. Analysis in this study was based on these 586 subjects. To study the significant correlates of hypertriglyceridemia, t-tests, ANOVAs, chi-square analysis and multivariate logistic regression were used. Among the study population, 66.0% were men and 34.0% were women. The mean age was 73.1 ± 5.3 years. The mean triglyceride values were 1.65 ± 0.93 mmol/L in men and 2.02 ± 1.44 mmol/L in women ($p < 0.01$). The proportions of hypertriglyceridemia were 18.7% in men and 27.6% in women ($p < 0.05$). After controlling the other covariates, analysis by multivariate logistic regression showed that the factors significantly related to hypertriglyceridemia were high systolic pressure, abnormal glutamic pyruvic transaminase, hypercholesterolemia and hyperglycemia. Thus, these results support the hypothesis that it is important to examine the other cardiovascular risk factors if one cardiovascular risk factor is observed. The data also suggest one should determine the triglyceride level when abnormal glutamic pyruvic transaminase is identified in an elderly subject.**

## INTRODUCTION

Risk factors for cardiovascular disease include hypertriglyceridemia, hypercholesterolemia, low serum high density lipoprotein (HDL) cholesterol, hypertension, diabetes mellitus, obesity, cigarette smoking, physical inactivity, increased age, prior cardiovascular disease, and left ventricular hypertrophy (1). The greater the number of the cardiovascular risk factors, the higher the incidence of new cardiovascular events (1). In Taiwan, cardiovascular disease is the third leading cause of death after neoplasm and cerebrovascular disease (2). The population of Taiwan is over 21 million and the population aged 65 and over has exceeded 7.0% since 1994 (3). Hypertriglyceridemia has been identified as a modifiable risk factor for the cardiovascular disease in elderly people (4). Up to now, there is little information on the

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**Table 1.** Triglyceride levels (mmol/L) and proportion of hypertriglyceridemia (%) by age and gender in the elderly

| Age (years) | Triglyceride | *p* | Hypertriglyceridemia | *p* |
|---|---|---|---|---|
| Men | | | | |
| 65-69 | 1.79 ± 1.05 | NS | 21.9 | NS |
| 70-74 | 1.66 ± 1.00 | NS | 20.3 | NS |
| 75-79 | 1.54 ± 0.74 | <0.05 | 17.2 | NS |
| ≥80 | 1.57 ± 0.90 | NS | 10.9 | NS |
| subtotal | 1.65 ± 0.93 | <0.01 | 18.7 | <0.05 |
| Women | | | | |
| 65-69 | 1.94 ± 1.20 | NS | 24.3 | NS |
| 70-74 | 1.99 ± 1.40 | NS | 24.6 | NS |
| 75-79 | 2.32 ± 1.89 | <0.05 | 40.0 | NS |
| ≥80 | 1.58 ± 0.81 | NS | 19.2 | NS |
| subtotal | 2.02 ± 1.44 | <0.01 | 27.6 | <0.05 |

**NS**: not significant

association between hypertriglyceridemia and its correlates in elderly Taiwanese people. As a result, health promotion and disease prevention recommendations for elderly people remain uncertain. Thus, it is clearly time to pay closer attention to the health status of elderly people in this country.

Triglyceride levels were investigated through a comprehensive health survey in elderly people living in Chung-Hsing village in Taiwan in order to allow early detection of hypertriglyceridemia, identification of its related risk factors and early intervention for hypertriglyceridemia. The associations between hypertriglyceridemia and other variables were also reported.

## MATERIALS AND METHODS

In May 1998, a cross-sectional study was conducted in Chung-Hsing Village in Taiwan. All individuals aged 65 and over were considered for the study, totaling 1774 subjects according to the official household registration records. A total of 1093 persons participated in this study giving a response rate of 61.6%. However, only 586 respondents had blood tests and completed questionnaires. Analysis in this study was based on these 586 subjects. Information about the subject's socioeconomic status, family structure, and educational level was collected by well-trained interviewers in face-to-face interviews.

The subject's educational level was classified as: junior high school or less; some senior high school; some professional training college; and undergraduate or graduate degrees. 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, the 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 fast. A number of biochemical markers, such as glutamic pyruvic transaminase (GPT; also known as alanine aminotransaminase), total cholesterol, triglyceride, fasting glucose and uric acid were analyzed using a biochemical autoanalyser (Chem1$^+$, Technicon, USA) at the Department of Clinical Laboratory of Chung-Hsing Hospital within 4 hours of collection.

Body mass index (BMI) was obtained using the formula: weight/height$^2$ (kg/m$^2$). BMI ≥28 was defined as obese, BMI 25-27.9 as overweight, BMI 20-24.9 as normal and BMI <20 as underweight (5). Abnormal GPT were defined as GPT >30 U/L (6). Hypercholesterolemia was defined as total cholesterol ≥5.18 mmol/L and hypertriglyceridemia was defined as triglyceride ≥2.26 mmol/L (7). Hyperglycemia was defined as fasting glucose ≥6.05 mmol/L (8). Subjects were considered to have high blood pressure if the average of three readings exceeded 140 mmHg systolically and/or 90 mmHg diastolically (9). Hyperuricemia was defined as serum uric acid ≥416.5 mmol/L in men and ≥386.8 mmol/L in women (10).

The statistical analysis was performed with the aid of a SAS package (Version 6.12, SAS Institute Inc., Cary, North Carolina). The methods of the statistical analysis applied in this study included the t-test, ANOVA, chi-square analysis and multivariate logistic regression. A *p* value less than 0.05 was considered statistically significant.

## RESULTS

Among the original 1093 subjects, 65.7% were men and 34.3% were women with a mean age of 73.5 ± 5.6 years. Among the final study population of 586 subjects, 66.0% were men and 34.0% were women with a mean age of 73.1 ± 5.3 years. We performed chi-square analysis and t-test to examine the gender and age distributions between these two samples. No significant difference was observed, suggesting that any bias introduced by non-responders was minimal.

In Table 1, the mean triglyceride value was 1.65 ± 0.93 mmol/L in men and 2.02 ± 1.44 mmol/L in women ($p < 0.01$). Although women seemed to have higher triglyceride values than men of similar ages, the difference was statistically significant only at age 75-79 ($p < 0.05$). The proportions of hypertriglyceridemia were 18.7% in men and 27.6% in women ($p < 0.05$). The proportion of hypertriglyceridemia decreased with age in men, but no statistical significance was noted. There was also no

**Table 2.** Correlates of hypertriglyceridemia in the elderly by chi-square analysis

| Variable | Total | Hypertriglyceridemia Number (%) | *p* |
|---|---|---|---|
| Body mass index (kg/m$^2$) | | | |
| <28 | 498 | 101 (20.28) | 0.042 |
| ≥28 | 69 | 22 (31.88) | |
| Systolic pressure (mm Hg) | | | |
| <140 | 378 | 66 (17.46) | 0.004 |
| ≥140 | 196 | 55 (28.06) | |
| Diastolic pressure (mm Hg) | | | |
| <90 | 451 | 96 (21.29) | 0.915 |
| ≥90 | 123 | 25 (20.33) | |
| GPT (U/L) | | | |
| ≤30 | 413 | 79 (19.13) | 0.019 |
| >30 | 165 | 47 (28.48) | |
| Total cholesterol (mmol/L) | | | |
| <5.18 | 296 | 38 (12.84) | 0.001 |
| ≥5.18 | 286 | 88 (30.77) | |
| Fasting glucose (mmol/L) | | | |
| <6.05 | 464 | 83 (17.89) | 0.001 |
| ≥6.05 | 117 | 43 (36.75) | |
| Uric acid (μmol/L) | | | |
| men <416.5, women <386.8 | 281 | 50 (17.79) | 0.035 |
| men ≥416.5, women ≥386.8 | 300 | 76 (25.33) | |
| Educational level | | | |
| junior high school or less | 164 | 41 (25.00) | 0.251 |
| senior high school | 151 | 29 (19.21) | |
| professional training college | 72 | 10 (13.89) | |
| undergraduate or graduate | 132 | 27 (20.45) | |
| Retirement status | | | |
| non-retired | 150 | 41 (27.33) | 0.065 |
| retired | 432 | 85 (19.68) | |
| Marital status | | | |
| living together | 424 | 82 (19.34) | 0.047 |
| living alone | 157 | 43 (27.39) | |

**Table 3.** Results of multivariate logistic regression for hypertriglyceridemia in the elderly

| Variable | EP (SE) | OR | 95% CI |
|---|---|---|---|
| Intercept | -3.11 (0.38) | | |
| Gender | | | |
| women (men as ref.) | 0.46 (0.31) | 1.58 | 0.86-2.92 |
| Body mass index | | | |
| Obese (normal as ref.) | 0.15 (0.35) | 1.17 | 0.59-2.30 |
| Systolic pressure | | | |
| ≥140 (<140 as ref.) | 0.83 (0.29) | 2.29 | 1.30-4.03** |
| Glutamic pyruvic transaminase | | | |
| >30 (≤30 as ref.) | 0.69 (0.32) | 1.99 | 1.07-3.70* |
| Total cholesterol | | | |
| ≥5.18 (<5.18 as ref.) | 0.96 (0.30) | 2.62 | 1.45-4.74** |
| Fasting glucose | | | |
| ≥6.05 (<6.05 as ref.) | 0.80 (0.33) | 2.22 | 1.16-4.26* |
| Uric acid (men, women ) | | | |
| ≥416.5 (<416.5 as ref. in men) ≥386.8 (<386.8 as ref. in women) | 0.55 (0.30) | 1.73 | 0.97-3.10 |
| Marital status | | | |
| living alone (living together as ref.) | 0.29 (0.33) | 1.34 | 0.71-2.54 |

**EP**: Estimated Parameter; **SE**: Standard Error; **OR**: Odds Ratio; **CI**: Confidence Interval. $^*p < 0.05$, $^{**}p < 0.01$

relationship between hypertriglyceridemia and age in women.

The results of chi-square analysis for hypertriglyceridemia and its correlates are shown in Table 2. The significant correlates of hypertriglyceridemia were obesity, high systolic pressure, abnormal GPT, hypercholesterolemia, hyperglycemia, hyperuricemia and marital status.

The results of multivariate logistic regression for hypertriglyceridemia and its correlates are shown in Table 3. After controlling for other covariates, the significant correlates of hypertriglyceridemia were high systolic pressure (odds ratio [OR] = 2.29, 95% confidence intervals [CI] = 1.30-4.03, $p < 0.01$), abnormal GPT (OR = 1.99, 95% CI = 1.07-3.70, $p < 0.05$), hypercholesterolemia (OR = 2.62, 95% CI = 1.45-4.74, $p < 0.01$), hyperglycemia (OR = 2.22, 95% CI = 1.16-4.26, $p < 0.05$). In other words, people with high systolic pressure were more likely to have hypertriglyceridemia than people with normal systolic pressure. People with abnormal GPT were more likely to have hypertriglyceridemia than people with normal GPT. People with hypercholesterolemia were more likely to have hypertriglyceridemia than people with normal total cholesterol. People with hyperglycemia were more likely to have hypertriglyceridemia than people with normal fasting glucose.

## DISCUSSION

Most people living in Chung-Hsing Village 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 our study was higher than that of female.

In Larosa's report, triglyceride levels increase in the elderly and is one predictor of cardiovascular disease in elderly people (11). In the present study, we found no relationship between triglyceride levels and age in elderly people. This might be due to genetic, racial, environmental, or dietary differences in the sampling population, but the real cause needs further investigation.

In Chou's study, the mean triglyceride values were 1.92 ± 1.32 mmol/L in men and 1.76 ± 1.28 mmol/L in women. The prevalence of hypertriglyceridemia (≥2.26 mmol/L) was 26.7% in men and 23.8% in women (12). In Huang's report, The prevalence of hypertriglyceridemia (>1.86 mmol/L) was 15.7% in elderly men and 26.0% in elderly women (13).

However, in our present report, the prevalence of hypertriglyceridemia was 18.7% in men and 27.6% in women. Differences in prevalence of hypertriglyceridemia might be due to the different measurement tools, different diagnostic criteria or different population though, in general, hypertriglyceridemia was commonly found in the elderly population in all three studies. Therefore, it is important to examine serum triglyceride levels periodically in elderly people. Early detection of hypertriglyceridemia and early intervention for hypertriglyceridemia should be performed.

In our report, hypertriglyceridemia was significantly associated with high systolic pressure, hypercholesterolemia and hyperglycemia. In previous studies, hyperlipidemia was often associated with obesity, diabetes, and hyperuricemia (10,14-17). In our previous report, hyperglycemia was significantly correlated with hypertriglyceridemia (18). In Austin's report, hypertriglyceridemia was a risk factor for the cardiovascular disease (19). Other studies indicate that the cardiovascular risk factors often cluster within the same individual (10,14-20). Thus, it is important to determine the other cardiovascular risk factors if one cardiovascular risk factor is observed.

GPT catalyzes the transfer of the amino group of alanine to glutaric acid, forming glutamic acid and pyruvic acid. Elevated serum GPT usually indicates liver damage (21). In our report, hypertriglyceridemia was significantly associated with abnormal GPT. This might be explained by a mechanism whereby hypertriglyceridemia resulted in fatty change in the liver and fat accumulation in the cytoplasm of hepatocytes, leading to leakage of cytoplasmic GPT into the blood (6). As a result, increased serum GPT activities would be detected.

In conclusion, hypertriglyceridemia is significantly associated with high systolic pressure, hypercholesterolemia, and hyperglycemia in elderly Taiwanese people. Thus, it is important to examine the other cardiovascular risk factors if one cardiovascular risk factor is demonstrated. It is also suggested that one determine triglyceride levels when abnormal GPT is disclosed in the elderly people.

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