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ORIGINAL CONTRIBUTION

Epidemiology of Serum Aminotransferase Activities in the Elderly

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Background: Our study used data collected in Chung-Hsing Village in May 1998 to explore the distribution of serum aminotransferase activities and the relationship between aminotransferase and its related factors in the elderly.

Methods: All individuals aged 65 and over were recruited as study subjects. A total of 1093 persons, out of 1774 registered residents, were contacted by face-to-face interview. The response rate was 61.6 percent. However, only 586 subjects had blood tests and completed questionnaires. Analysis in this study was based on these 586 subjects. In order to study the significant related factors of abnormal aminotransferase activities, the t-test, ANOVA, chi-square analysis, and multivariate logistic regression were used.

Results: There were 66 percent men and 34 percent women. The mean age was 73.1 ± 5.3 years. The mean values of aspartate aminotransferase (AST) were 29.3 ± 14.5 u/l in men and 27.8 ± 10.7 u/l in women ($p > .05$). The mean values of alanine aminotransferase (ALT) were 30.9 ± 25.2 u/l in men and 26.3 ± 12.6 u/l in women ($p < .01$). The abnormality rates of AST (≥ 40 u/l) were 10.5 percent in men and 12.2 percent in women ($p > .05$). The abnormality rates of ALT (≥ 40 u/l) were 16.7 percent in men and 12.6 percent in women ($p > .05$). After controlling for the other covariates, the multivariate logistic regression analysis showed that the significant related factor of abnormal AST was retirement status (odds ratio = 4.4; 95 percent confidence interval = 1.5-13.3; $p < .01$). The significant related factors of abnormal ALT were obesity (odds ratio = 2.2; 95 percent confidence interval = 1.1-4.2; $p < .05$) and hypertriglyceridemia (odds ratio = 2.7; 95 percent confidence interval = 1.5-4.9; $p < .01$).

Conclusions: We raise the hypothesis that evidence of liver disease with abnormal ALT may co-vary with other indicators of chronic diseases. A large-scale investigation will be suggested in the future to demonstrate the causal-effect issue between abnormal ALT and obesity or hypertriglyceridemia.

INTRODUCTION

Liver disease is a high prevalent cause of morbidity and mortality in Taiwan. In fact, chronic liver disease is the sixth leading cause of death in Taiwan [1]. Aspartate aminotransferase (AST)[b] and alanine

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[b] *Abbreviations:* AST, Aspartate aminotransferase; ALT, alanine aminotransferase.
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aminotransferase (ALT) are two serum transaminases for predicting liver disease clinically. Change of these serum enzyme activities usually indicates some diseases. AST catalyzes the transfer of the amino group of aspartic acid to ketoglutaric acid, forming glutamic acid and oxaloacetic acid. Elevated serum AST is a marker for cardiac muscle damage or liver damage [2]. ALT catalyzes the transfer of the amino group of alanine to glutaric acid, forming glutamic acid and pyruvic acid. Elevated serum ALT specifically indicates liver damage [2]. The ALT activity is a more sensitive indicator of hepatic dysfunction than the AST activity [3].

The population in Taiwan is over 21 million, and the population aged ≥ 65 years has exceeded 7 percent since 1994 [4]. In Lin's study, the mean values of AST were 17.5 ± 4.9 u/l in elderly men and 18.1 ± 6.8 u/l in elderly women. The mean values of ALT were 13.2 ± 5.1 u/l in elderly men and 13.3 ± 7.1 u/l in elderly women [5]. Up to now, there is scanty information about the association between aminotransferase activities and the cardiovascular risk factors or the sociodemographic factors in Taiwanese elderly people. As a result, recommendations for health promotion and disease prevention in the elderly remain uncertain.

For detecting the distribution of aminotransferase activities and finding the related factors, and for exploring the hypothesis whether evidence of liver disease may co-vary with other indicators of chronic diseases, under conduction of comprehensive health survey studies in the elderly living in Chung-Hsing Village in Taiwan, the distribution of aminotransferase activities was revealed and the relationship between aminotransferase activities and the cardiovascular risk factors and the sociodemographic factors was also revealed.

SUBJECTS AND METHODS

In May 1998, a cross-sectional study was conducted in Chung-Hsing Village in Taiwan. All individuals aged 65 and over were subjects for study, a total of 1774 subjects according to the official household registration records. A total of 1093 persons, out of a potential 1774 subjects, participated in this study. The response rate was 61.6 percent. 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 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, 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 AST, ALT, total cholesterol, triglyceride, fasting glucose, and uric acid were analyzed by a biochemical autoanalyser (Chem1$^+$, Technicon, Tarrytown, New York) at the Department of Clinical Laboratory at Chung-Hsing Hospital within 4 hours of collection.

The abnormal aminotransferase activities were defined as AST ≥ 40 u/l and ALT ≥ 40 u/l [6]. Body mass index (BMI) 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

Table 1. Aminotransferase level (u/l) in elderly people by age and gender.

Variable	AST		ALT	
Age (years)	Men	Women	Men	Women
65-69	30.8 ± 14.8*	26.3 ± 10.7*	33.5 ± 24.0*	26.1 ± 11.8*
70-74	30.4 ± 18.0	28.7 ± 11.6	33.3 ± 32.0	26.9 ± 13.5
75-79	28.2 ±10.9	30.1 ± 10.5	29.0 ± 20.7	28.5 ± 12.6
≥ 80	26.1 ± 9.0	25.4 ± 7.1	23.8 ± 13.0	21.4 ± 10.1
Subtotal	29.3 ± 14.5	27.8 ± 10.7	30.9 ± 25.2**	26.3 ± 12.6**

* P < .01, at aged 65-69, there was statistic significance of the mean values of AST and ALT between gender
** P < .01, The mean values of ALT were higher in men than in women

underweight [7]. Hypercholesterolemia was defined as total cholesterol ≥ 200 mg/dl and hypertriglyceridemia was defined as triglyceride ≥ 200 mg/dl [8]. Hyperglycemia was defined as fasting glucose ≥ 110 mg/dl [9]. Subjects were considered to have high blood pressure if the average of three readings exceeded 140 mmHg systolically and/or 90 mmHg diastolically [10]. Hyperuricemia was defined as serum uric acid ≥ 7 mg/dl in men and ≥ 6.5 mg/dl in women [11].

The statistical analysis was performed by the aid of a SAS package (Version 6.12, SAS Institute Inc., Cary, North Carolina). The methods of statistical analysis applied in this study were t-test, ANOVA, chi-square analysis, and multivariate logistic regression. Statistical significance was defined as p value less than .05.

RESULTS

Among 586 subjects, there were 66 percent men and 34 percent women. The mean age was 73.1 ± 5.3 years.

The mean values of aminotransferase in the elderly by age and gender are shown in Table 1. People aged 80 and over had the lowest values of aminotransferase. The mean values of AST were 29.3 ± 14.5 u/l in men and 27.8 ± 10.7 u/l in women (p > .05). The mean values of AST were not significantly related to age in either men or women (p > .05). At aged 65 to 69, there was statistic significance of the mean value of AST between gender (p < .01), but in other age group no statistic significance was noted between gender (p > .05). The mean values of ALT were 30.9 ± 25.2 u/l in men and 26.3 ± 12.6 u/l in women (p < .01). The mean values of ALT were not significantly related to age in either men or women (p > .05). At age 65 to 69, there was statistic significance of the mean value of ALT between gender (p < .01), but in other age group no statistic significance was noted between gender (p > .05).

The results of chi-square analysis for abnormal AST among the cardiovascular risk factors and the sociodemographic factors are shown in Table 2. The abnormality rates of AST (≥ 40 U/L) were 10.5 percent in men and 12.2 percent in women (p > .05).

The results of chi-square analysis for abnormal ALT among the cardiovascular risk factors and the sociodemographic factors are shown in Table 3. The abnormality rates of ALT (≥ 40 U/L) were 16.7 percent in men and 12.6 percent in women(p > .05). The significant related factors of abnormal ALT were obesity, hypertriglyceridemia and hyperglycemia (p < .05, p < .01, and p < .05, respectively).

Table 2. Correlates of abnormal aspartate aminotransferase in the elderly.

Variable	Total number	Abnormal number (%)	P value
Gender:			
Men	382	40 (10.5)	.63
Women	197	24 (12.2)	
Body mass index (BMI $\geq$ 28 kg/m^2):			
No	495	52 (10.5)	.43
Yes	69	10 (14.5)	
Systolic pressure $\geq$ 140 (mmHg):			
No	378	40 (10.6)	.73
Yes	193	23 (11.9)	
Diastolic pressure $\geq$ 90 (mmHg):			
No	448	51 (11.4)	.73
Yes	123	12 (9.8)	
Total cholesterol $\geq$ 200 (mg/dl):			
No	292	37 (12.7)	.26
Yes	287	27 (9.4)	
Triglyceride $\geq$ 200 (mg/dl):			
No	450	49 (10.9)	.87
Yes	126	15 (11.9)	
Fasting glucose $\geq$ 110 (mg/dl):			
No	461	50 (51.8)	.88
Yes	118	14 (11.9)	
Uric acid (men $\geq$ 7, women $\geq$ 6.5 [mg/dl]):			
No	281	27 (9.6)	.33
Yes	296	37 (12.5)	
Educational level:			
Junior high school or less	164	22 (13.4)	.47
Senior high school	150	15 (10.0)	
Professional training college	72	8 (11.1)	
Undergraduate or graduate	129	10 (7.8)	
Retirement status:			
Non-retired	150	12 (8.0)	.22
Retired	429	52 (12.1)	
Marital status:			
Living together	420	48 (11.4)	.77
Living alone	158	16 (10.1)	

The results of multivariate logistic regression for abnormal AST among the cardiovascular risk factors and the sociodemographic factors are shown in Table 4. After controlling for the other covariates, the significant related factor of abnormal AST was retirement status (odds ratio = 4.4; 95 percent confidence interval

Table 3. Correlates of abnormal alanine aminotransferase in the elderly.

Variable	Total number	Abnormal number (%)	P value
Gender:			
Men	384	64 (16.7)	.25
Women	198	25 (12.6)	
Body mass index (BMI ≥ 28 kg/m^2):			
No	497	68 (13.7)	**.01**
Yes	70	18 (25.7)	
Systolic pressure ≥ 140 (mmHg):			
No	379	58 (15.3)	1.0
Yes	195	30 (15.4)	
Diastolic pressure ≥ 90 (mmHg):			
No	450	70 (15.6)	.89
Yes	124	18 (14.5)	
Total cholesterol ≥ 200 (mg/dl):			
No	294	51 (17.4)	.21
Yes	287	38 (13.2)	
Triglyceride ≥ 200 (mg/dl):			
No	452	58 (12.8)	**.002**
Yes	126	31 (24.6)	
Fasting glucose ≥ 110 (mg/dl):			
No	464	62 (13.4)	**.02**
Yes	118	27 (22.9)	
Uric acid (men ≥ 7, women ≥ 6.5 [mg/dl]):			
No	280	41 (14.6)	.72
Yes	299	48 (16.1)	
Educational level:			
Junior high school or less	164	27 (16.5)	.85
Senior high school	152	21 (13.8)	
Professional training college	71	12 (16.9)	
Undergraduate or graduate	131	18 (13.7)	
Retirement status:			
Non-retired	151	19 (12.6)	.35
Retired	431	70 (16.2)	
Marital status:			
Living together	422	68 (16.1)	.46
Living alone	159	21 (13.2)	

= 1.5-13.3; $p < .01$). No significant association was found between abnormal AST and gender, age, obesity, high blood pressure, hypercholesterolemia, hypertriglyceridemia, hyperglycemia, hyperuricemia, educational level, or marital status.

The results of multivariate logistic regression for abnormal ALT among the

Table 4. Results of multivariate logistic regression for abnormal aspartate aminotransferase in the elderly.

Variate	EP (SE)	OR	95% CI
Intercept	0.8 (2.5)		
Gender (men as reference):			
Women	0.7 (0.4)	2.1	0.9-4.9
Age (years):	-0.06 (0.03)	0.9	0.9-1.0
BMI (non-obese as reference)			
Obesity	0.4 (0.4)	1.5	0.7-3.4
Systolic pressure (< 140 mmHg as reference):			
≥ 140	0.09 (0.3)	1.1	0.6-2.2
Diastolic pressure (< 90 mmHg as reference):			
≥ 90	-0.07 (0.4)	0.9	0.4-2.0
Total cholesterol (< 200 mg/dl as reference):			
≥ 200	-0.4 (0.3)	0.7	0.4-1.3
Triglyceride (< 200 mg/dl as reference):			
≥ 200	0.03 (0.4)	1.0	0.5-2.2
Fasting glucose (< 110 mg/dl as reference):			
≥ 110	0.05 (0.4)	1.1	0.5-2.2
Uric acid (men < 7, women < 6.5 mg/dl as reference):			
≥ 7 (women ≥ 6.5 mg/dl)	0.5 (0.3)	1.6	0.9-3.1
Educational level (junior high school or less as a reference):			
Senior high school	-0.5 (0.4)	0.6	0.3-1.3
Professional training college	-0.2 (0.5)	0.8	0.3-2.0
Undergraduate or graduate	-0.8 (0.5)	0.4	0.2-1.1
Retirement (non-retired as reference):			
Retired	1.5 (0.6)	4.4	**1.5-13.3***
Marital status (living together as reference):			
Living alone	-0.2 (0.4)	0.8	0.3-1.8

*$p < .01$.
EP, Estimated parameter; SE, Standard error; OR, Odds ratio; CI, confidence interval

cardiovascular risk factors and the sociodemographic factors are shown in Table 5. After controlling for the other covariates, the significant related factors of abnormal ALT were obesity (odds ratio = 2.2; 95 percent confidence interval = 1.1-4.2; p < .05) and hypertriglyceridemia (odds ratio = 2.7; 95 percent confidence interval =1.5-4.9; p

Table 5. Results of multivariate logistic regression for abnormal alanine aminotransferase in the elderly.

Variate	EP (SE)	OR	95% CI
Intercept	1.2 (2.0)		
Gender (men as reference):			
Women	-0.7 (0.5)	0.5	0.2-1.2
Age (years):	-0.04 (0.03)	1.0	0.9-1.0
BMI (non-obese as reference)			
Obesity	0.8 (0.3)	2.2	**1.1-4.2***
Systolic pressure (< 140 mmHg as reference):			
≥ 140	-0.2 (0.3)	0.8	0.4-1.5
Diastolic pressure (< 90 mmHg as reference):			
≥ 90	0.05 (0.3)	1.1	0.5-2.0
Total cholesterol (< 200 mg/dl as reference):			
≥ 200	-0.4 (0.3)	0.7	0.4-1.1
Triglyceride (< 200 mg/dl as reference):			
≥ 200	1.0 (0.3)	2.7	**1.5-4.9****
Fasting glucose (< 110 mg/dl as reference):			
≥ 110	0.5 (0.3)	1.6	0.9-3.0
Uric acid (men < 7, women < 6.5 mg/dl as reference):			
≥ 7 (women ≥ 6.5 mg/dl)	-0.06 (0.3)	0.9	0.6-1.6
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	0.08 (0.4)	1.1	0.5-2.5
Undergraduate or graduate	-0.4 (0.4)	0.7	0.3-1.5
Retirement (non-retired as reference):			
Retired:	0.03 (0.5)	1.0	0.4-2.7
Marital status (living together as reference):			
Living alone	-0.08 (0.4)	0.9	0.5-1.8

** $p < .05$; ** $p < .01$.*
EP, Estimated parameter; SE, Standard error; OR, Odds ratio; CI, confidence interval

< .01). That is, body mass index did vary with abnormal ALT. People with hypertriglyceridemia were more likely to show abnormal ALT than people with normal triglyceride. No significant association was found between abnormal ALT and gender, age, high blood pressure, hypercholesterolemia, hyperglycemia, hyperuricemia,

educational level, retirement status or marital status.

DISCUSSION

Most of people living in Chung-Hsing Village moved to Taiwan from Mainland China after the civil war during their military service. Most of them were male, so the proportion of male in this sample was higher than that of female.

Though information was collected by well-trained interviewers via face-to-face interviews, if the subjects declined, we could not force them to perform interview. Thus, the subjects in this study were volunteers. That was why the response rate was only 61.6 percent. Because not all of the respondents received blood tests, only 586 respondents had blood tests and completed questionnaires.

Among 1093 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 there were 66 percent men and 34 percent women. The mean age was 73.1 ± 5.3 years. However, We performed chi-square analysis and t-test to examine the gender and age distributions between the respondent and the non-respondent. No significant difference was observed. Therefore, the potential non-response bias could be minimized. So it is justified to look at the respondents as representative subjects in Chung-Hsing Village.

In this study, because we did not have enough funds, we did not perform ECG to show any evidence of heart disease or any test for viral hepatitis on the blood samples. Similarly, due to lack of reliable data, subjects with underlying diseases, including heart disease or viral hepatitis, could not be excluded by questionnaires. These potential factors might be a reflection of missed heart disease or liver disease. Thus, whether these factors affected this study results deserved further large-scale investigation. Because the sample was small and this was a community-based study, we thought that the subjects really could not be representative of the Taiwanese elderly. However, this study could provide the basic information for further studies on the epidemiology of serum aminotransferase in Taiwanese elderly.

The mean values of aminotransferase in this study were higher than that in the previous report [5]. We thought this might be due to the different autoanalyzer, but the real cause needs further evaluation.

In previous reports, significant correlations were found between aminotransferase activities and fasting glucose, age, body mass index, serum lipid, heart rate, and blood pressure levels [2, 6, 12-14]. In Burns's report, people gaining weight showed a significant increase in ALT activity compared with those who did not gain weight [15]. In our report, obese people were more likely to have abnormal ALT. People with hypertriglyceridemia were more likely to show abnormal ALT than people with normal triglyceride. This might be largely explained by the higher prevalence of fatty liver in obese people or people with hypertriglyceridemia [12, 16]. Fat accumulation in the cytoplasm of fatty hepatocytes caused a leakage of cytoplasmic ALT into the blood [6]. As a result, increased ALT was detected. Elevated serum ALT specifically indicates liver damage [2]. The ALT activity is a more sensitive indicator of hepatic dysfunction than the AST activity [3]. Thus, we raise the hypothesis that evidence of liver disease with abnormal ALT may co-vary with other indicators of chronic diseases. That can also explain why no significant association was found between abnormal AST and gender, age, obesity, high blood pressure, hypercholesterolemia, hypertriglyceridemia, hyperglycemia, or hyperuricemia.

In conclusion, the significant related factors of abnormal ALT were obesity and hypertriglyceridemia. We raise the hypothesis that evidence of liver disease with abnormal ALT may co-vary with other indicators of chronic diseases. Because of its inherent limitation of a cross-sectional study, we cannot address any causal-effect relationship between abnormal ALT and obesity or hypertriglyceridemia. A large-scale investigation will be suggested in the future.

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