12

The Relationship Between AST/ALT Ratio and Metabolic Syndrome in Han Young Adults – AST/ALT Ratio and Metabolic Syndrome

Qiang Lu[1], Xiaoli Liu[1],
Shuhua Liu[2], Changshun Xie[3],
Yali Liu[4] and Chunming Ma[1]
[1]*Department of Endocrinology,*
[2]*Department of Cardiology,*
[3]*Department of Gastroenterology,*
[4]*Medical Examination Center,*
The First Hospital of Qinhuangdao,
Qinhuangdao, Hebei Province,
China

1. Introduction

In previous studies, the relationship between aspartate aminotransferase to alanine aminotransferase ratio(AST/ALT ratio) and liver disease has been evaluated. In viral hepatitis, alcoholic liver disease and primary biliary cirrhosis, AST/ALT ratio has been proven to be an indicator of liver cirrhosis.[1-3] AST/ALT ratio was a potential value in differentiating nonalcoholic steatohepatitis from alcoholic liver disease.The value < 1 suggestted nonalcoholic steatohepatitis, a ratio of ≥ 2 was strongly suggestive of alcoholic liver disease.[4]

Nonalcoholic fatty liver disease(NAFLD) is the most common cause of elevated liver enzymes and also one of the most common forms of liver disease in the world.[5] The AST/ALT ratio of the ultrasound-diagnosed NAFLD patients was lower than controls.[6] AST/ALT ratio < 1 was common NAFLD-related feature.[7] NAFLD is now considered the hepatic manifestation of the metabolic syndrome. When compared with individuals without NAFLD, individuals with NAFLD had significantly higher fasting glucose, insulin, low-density lipoprotein cholesterol, triglycerides, systolic blood pressure and diastolic blood pressure.[8] Recently, NAFLD marker the AST/ALT ratio have attracted great interest as potential novel marker of metabolic syndrome.[9]

Very little information was available about the association of AST/ALT ratio with metabolic syndrome in Han young adults. Thus, this study evaluated the relationship between AST/ALT ratio and metabolic syndrome in Han young adults.

2. Materials and methods

2.1 Subjects

After obtaining the informed consent from all subjects, a cross-sectional, population-based study was conducted. The study population was determined according to 2-stage cluster sampling. In the first stage, a random sample of universities in Qinhuangdao, Hebei Province, China, were obtained; in the second stage, young adults aged 19 to 24 years, randomly selected from these schools, were invited to participate. In the end, 425 Han young adults(males/females 216/209) participated in 2009. Subjects with evidence of alcohol intake, hepatitis B (hepatitis B surface antigen), hepatitis C (hepatitis C antibody), autoimmune hepatitis (antinuclear antibody and anti-smooth muscle antibody) and drug toxicity were excluded. The study protocol was approved and supervised by the ethical committee of the First Hospital of Qinhuangdao.

2.2 Measurements

Anthropometric measurements, including height, weight and waist circumference(WC) were performed when subjects were without shoes and in light clothing. Height and weight were measured to the nearest 0.1 cm and 0.1 kg, respectively. Standing height without shoes was measured three times with a stadiometer, and the three measurements were averaged for analysis. Body mass index (BMI) was defined as weight (kg) divided by height (m) squared. Blood pressure was measured three times with a mercury sphygmomanometer while the subjects were seated after 10 min of rest, and the three measurements were averaged for analysis.

After an overnight fast of 10–12h, blood samples were drawn from an antecubital vein in each subjects into vacutainer tubes. Fasting plasma glucose(FPG) concentration was measured using the glucose oxidase method, serum lipids and alanine aminotransferase (ALT) and aspartate alanine aminotransferase (AST) were measured using enzymatic procedures with an autoanalyzer (Hitachi, Tokyo, Japan). Serum true insulin(TI) was measured using enzyme linked immunosorbent assay(ELISA) with model 680 microplate reader(BIO-RAD, America).The ELISA kits were purchased from USCNLIFE company, America. The following equation for homeostasis model assessment of insulin resistance(HOMA-IR) was used: fasting insulin level (μU/ml) x fasting glucose level (mmol/l)/22.5.

2.3 Definition for metabolic syndrome

Metabolic syndrome was defined as having ≥3 of the 5 factors with the following cut points: abdominal obesity (waist circumference ≥90cm in males and 80 cm in females); high triglycerides(≥1.70mmol/L [150mg/dL]); low high density lipoprotein cholesterol (HDL-C) (<1.03 mmol/L[40mg/dL] for males and <1.30 mmol/L [50 mg/dL] for females); elevated blood pressure (systolic blood pressure≥135mmHg and/or diastolic blood pressure≥85mmHg) and impaired fasting glucose(≥5.6mmol/L[100mg/dL]).[10]

2.4 Statistical analysis

Data are expressed as mean ± standard deviation(SD) or medians with interquartile ranges(IQR).When data was not normally distributed, they were ln transformed for

analysis. Continuous variables were analyzed with covariance adjustment for age and sex. To measure the strength of association between 2 variables, partial correlation analysis was used adjustment for age and sex. The χ^2 test was used to test for differences in proportions. To examine the association between AST/ALT ratio and metabolic syndrome, multivariate logistic regression was tested. The results of the logistic regression analysis were expressed as odds ratios with 95% confidence intervals(CI). Analyses were performed with the computer software SPSS version 11.5 software(SPSS Inc., Chicago, IL, U.S.A.). Statistical significance was established at $P<0.05$.

3. Results

3.1 Clinical and laboratory characteristics

In this sample, AST/ALT ratio < 1 was detected in 146 subjects (34.4%). Males had a significantly higher frequency of AST/ALT ratio < 1 than females(48.6% *vs* 19.6%,χ^2 = 39.595,P=0.000). The age was similar in two groups(20.3±0.8 *vs* 20.3±0.8, t=0.057,P=0.955). Table 1 showed clinical and laboratory characteristics in the study subjects. After adjustment for age and sex, young adults with AST/ALT ratio < 1 had higher BMI, WC, SBP, DBP, TG, TI and HOMA-IR than subjects with AST/ALT ratio ≥ 1. Subjects with AST/ALT ratio < 1 also had significantly lower HDL-C than subjects with AST/ALT ratio ≥ 1 (P<0.05). The level of FPG was similar between subjects with AST/ALT ratio < 1 and ≥ 1 (P>0.05).(Table 1)

Associations of AST/ALT ratio with anthropometric and metabolic variables were presented in Table 2. After adjustment for age and sex, AST/ALT ratio showed positive correlations with HDL-C and negative correlations with BMI, WC, TG，TI and HOMA-IR (P<0.05). (Table 2)

3.2 AST/ALT ratio and metabolic syndrome

The prevalence of metabolic syndrome was 2.1% and was similar in males and females(2.3% *vs* 1.9%,χ^2 = 0.082,P= 0.774). Subjects with AST/ALT ratio < 1 had a significantly higher frequency of abdominal obesity, high triglycerides, elevated blood pressure and metabolic syndrome(P<0.05). (Table 3) After adjustment for age, sex and BMI, the frequency of metabolic syndrome among young adults with AST/ALT ratio < 1 was 6.975(95%CI: 1.430 to 34.019, P=0.016) times compared with young adults with AST/ALT ratio ≥ 1.

4. Discussion

Using Adult Treatment Panel III criteria's definition, we estimated that approximately 2.1% of Han young adults have the metabolic syndrome. The prevalence of metabolic syndrome in this study was lower than previously report from Chinese adults and was similar to Chinese adolescents.[11,12] It was because of a positive effect of age on the prevalence of metabolic syndrome.[13,14] Abdominal obesity, elevated blood pressure and low HDL-C were common components of the metabolic syndrome in this sample. In the insulin resistance atherosclerosis study, NAFLD marker the AST/ALT ratio predict metabolic syndrome independently of potential confounding variables.[15] In this study, we found that the

metabolic syndrome was related with a lower AST/ALT ratio in Han young adults. Subjects with AST/ALT ratio < 1 had a significantly higher frequency of abdominal obesity, high triglycerides, elevated blood pressure and metabolic syndrome. The association was not modified by age, sex and BMI.

variable	AST/ALT level ratio≥1 (n=279)	AST/ALT level ratio< 1 (n=146)	*P*
Age(years) mean(SD)	20.3(0.8)	20.3(0.8)	0.955
Sex(male/female)	111/168	105/41	0.000
BMI(kg/m²) mean(SD)	22.9(3.8)	26.3(4.0)	0.000
WC(cm) mean(SD)	70.8(9.3)	81.4(12.3)	0.000
SBP(mmHg) mean(SD)	109.3(10.7)	115.2(11.5)	0.004
DBP(mmHg) mean (SD)	73.1(8.2)	76.7(9.9)	0.030
FPG(mmol/L) mean (SD)	4.30(0.44)	4.38(0.40)	0.101
TG(mmol/L) mean (SD)	0.69(0.24)	0.83(0.46)	0.000
HDL-C(mmol/L) mean (SD)	1.42(0.22)	1.30(0.24)	0.001
TI(uU/ml) median (IQR)	6.58(3.88)	7.75(4.86)	0.014
HOMA-IR median(IQR)	1.25(0.76)	1.53(1.08)	0.006
ALT(U/L) mean(SD)	10.6(5.0)	30.6(17.3)	0.000
AST(U/L) mean(SD)	17.9(6.0)	20.6(8.5)	0.223

Data are expressed as mean ± standard deviation(SD) or medians with interquartile ranges(IQR). Continuous variables were analyzed with covariance adjustment for age and sex. When data was not normally distributed, they were ln transformed for analysis. ALT: alanine aminotransferase; AST: aspartate aminotransferase; BMI: body mass index; WC: waist circumference; SBP: systolic blood press; DBP: diastolic blood press; FPG: fasting plasma glucose; TG: triglycerides; HDL-C: high density lipoprotein cholesterol; TI: true insulin; HOMA-IR: homeostasis model assessment of insulin resistance; SD: standard deviation; IQR:indicates interquartile range.

Table 1. Clinical and laboratory characteristics of the subjects in different levels of AST/ALT ratio.

variable	*r*	*P**	*r*	*P***
BMI(kg/m²)	-0.296	0.000	-0.281	0.000
WC(cm)	-0.310	0.000	-0.264	0.000
SBP(mmHg)	-0.141	0.004	-0.072	0.134
DBP(mmHg)	-0.102	0.036	-0.048	0.321
FPG(mmol/L)	-0.051	0.295	-0.039	0.413
TG(mmol/L)	-0.134	0.006	-0.134	0.006
HDL-C(mmol/L)	0.174	0.000	0.125	0.010
TI(uU/ml)	-0.154	0.001	-0.118	0.015
HOMA-IR	-0.158	0.001	-0.121	0.012

*Pearson correlation.**Partial correlation analysis, adjustment for age and sex. ALT: alanine aminotransferase; AST: aspartate aminotransferase; BMI: body mass index; WC: waist circumference; SBP: systolic blood press; DBP: diastolic blood press; FPG: fasting plasma glucose; TG: triglycerides; HDL-C: high density lipoprotein cholesterol; TI: true insulin; HOMA-IR: homeostasis model assessment of insulin resistance.

Table 2 Correlation analysis of AST/ALT ratio with anthropometric and metabolic variables in Han young aduts.

Factor	AST/ALT level ratio≥1 (n=279)	AST/ALT level ratio< 1 (n=146)	*P*
abdominal obesity(%)	9.7	32.2	0.000
high triglycerides(%)	0.0	3.4	0.008
low high density lipoprotein cholesterol(%)	15.1	21.2	0.109
elevated blood pressure(%)	12.9	25.3	0.001
impaired fasting glucose(%)	0.7	0.0	0.548
metabolic syndrome(%)	0.7	4.8	0.016

The χ^2 test was used to test for differences in proportions. ALT: alanine aminotransferase; AST: aspartate aminotransferase.

Table 3 Prevalence of metabolic syndrome in different levels of AST/ALT ratio(%).

In our study, AST/ALT ratio showed negative correlation with HOMA-IR. Insulin resistance is a central feature in the pathogenesis of metabolic syndrome,while insulin resistance is now considered the main link between metabolic disturbances and liver enzymes. Hanley AJ et al.[16] reported that AST/ALT ratio was associated with directly measured insulin sensitivity when conventionally availables were adjusted. This result can be explained by the following possible mechanism. Liver markers were known to be significantly correlated with increased hepatic fat content.[17] Liver fat content was a significant risk factor of HOMA-IR while BMI and waist circumference were not.[18]

In our study, we found that young adults with AST/ALT ratio < 1 had higher TI than subjects with AST/ALT ratio ≥ 1. But the level of FPG was similar between subjects with AST/ALT ratio < 1 and ≥ 1. The liver plays an important role in maintaining normal glucose concentrations during fasting as well as postprandially. The loss of a direct effect of insulin to suppress hepatic glucose production and glycogenolysis in the liver causes an increase in hepatic glucose production.[19] Increased insulin levels with increasing insulin resistance in subjects with AST/ALT ratio < 1 suggested that elevated insulin concentrations reflected increased beta cell output to the elevated insulin concentrations. The hyperinsulinemia can thus be seen as a compensatory mechanism for the preexisting insulin resistance, which represents a mechanism for protection against the development of impaired fasting glucose and diabetes. T2DM will result when there is insufficient insulin secretion to counter preexisting insulin resistance.[20]

Diet habit modifies the relationship of the liver enzymes ratio with metabolic syndrome. For example, Mediterranean diet moderates the association of the liver enzymes ratio with the prevalence of the metabolic syndrome.[9] In China, people's eating habits are quite different in different area. Regrettably, diet habit was not evaluated in our study. This is a limitation of our study.

In conclusion, the prevalence of metabolic syndrome was low in Han young adults. AST/ALT ratio was related with metabolic syndrome in Han young adults.

5. References

[1] Nyblom H, Björnsson E, Simrén M, Aldenborg F, Almer S, Olsson R. The AST/ALT ratio as an indicator of cirrhosis in patients with PBC. Liver Int. 2006;26:840-845.

[2] Giannini E, Risso D, Botta F, Chiarbonello B, Fasoli A, Malfatti F, Romagnoli P, Testa E, Ceppa P, Testa R. Validity and clinical utility of the aspartate aminotransferase-alanine aminotransferase ratio in assessing disease severity and prognosis in patients with hepatitis C virus-related chronic liver disease. Arch Intern Med. 2003;163:218-224.

[3] Nyblom H, Berggren U, Balldin J, Olsson R. High AST/ALT ratio may indicate advanced alcoholic liver disease rather than heavy drinking. Alcohol Alcohol. 2004;39:336-339.

[4] Sorbi D, Boynton J, Lindor KD. The ratio of aspartate aminotransferase to alanine aminotransferase: potential value in differentiating nonalcoholic steatohepatitis from alcoholic liver disease. Am J Gastroenterol. 1999;94:1018-1022.

[5] Kim CH, Younossi ZM. Nonalcoholic fatty liver disease: a manifestation of the metabolic syndrome. Cleve Clin J Med. 2008;75:721-728.

[6] Lee S, Jin Kim Y, Yong Jeon T, Hoi Kim H, Woo Oh S, Park Y, Soo Kim S.Obesity is the only independent factor associated with ultrasound-diagnosed non-alcoholic fatty liver disease: a cross-sectional case-control study. Scand J Gastroenterol. 2006;41:566-572.

[7] Khurram M, Ashraf MM. A clinical and biochemical profile of biopsy-proven non-alcoholic Fatty liver disease subjects. J Coll Physicians Surg Pak. 2007;17:531-534.

[8] Schwimmer JB, Pardee PE, Lavine JE, Blumkin AK, Cook S. Cardiovascular risk factors and the metabolic syndrome in pediatric nonalcoholic fatty liver disease. Circulation. 2008;118:277-283.

[9] Tzima N, Pitsavos C, Panagiotakos DB, Chrysohoou C, Polychronopoulos E, Skoumas J, Stefanadis C. Adherence to the Mediterranean diet moderates the association of aminotransferases with the prevalence of the metabolic syndrome; the ATTICA study. Nutr Metab (Lond). 2009;6:30.

[10] Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults. 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;285:2486-2497.

[11] Gu D, Reynolds K, Wu X, Chen J, Duan X, Reynolds RF, Whelton PK, He J; InterASIA Collaborative Group. Prevalence of the metabolic syndrome and overweight among adults in China. Lancet. 2005;365:1398-1405.

[12] Li Y, Yang X, Zhai F, Kok FJ, Zhao W, Piao J, Zhang J, Cui Z, Ma G. Prevalence of the metabolic syndrome in Chinese adolescents. Br J Nutr. 2008;99:565-570.

[13] Ford ES, Giles WH, Dietz WH. Prevalence of the metabolic syndrome among US adults: findings from the third National Health and Nutrition Examination Survey. JAMA. 2002;287:356-359.

[14] Sharifi F, Mousavinasab SN, Saeini M, Dinmohammadi M. Prevalence of metabolic syndrome in an adult urban population of the west of Iran. Exp Diabetes Res. 2009;2009:136501.

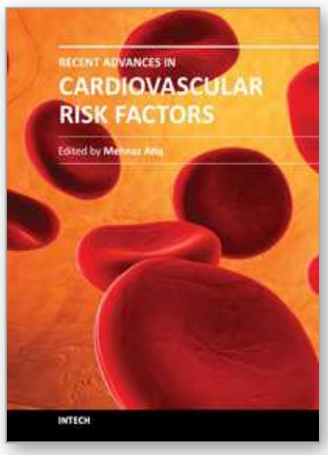
[15] Hanley AJ, Williams K, Festa A, Wagenknecht LE, D'Agostino RB Jr, Haffner SM. Liver markers and development of the metabolic syndrome: the insulin resistance atherosclerosis study. Diabetes. 2005;54:3140-3147.

[16] Hanley AJ, Wagenknecht LE, Festa A, D'Agostino RB Jr, Haffner SM. Alanine aminotransferase and directly measured insulin sensitivity in a multiethnic cohort: the Insulin Resistance Atherosclerosis Study. Diabetes Care. 2007;30:1819-1827.

[17] Browning JD, Szczepaniak LS, Dobbins R, Nuremberg P, Horton JD, Cohen JC, Grundy SM, Hobbs HH. Prevalence of hepatic steatosis in an urban population in the United States: impact of ethnicity. Hepatology. 2004;40:1387-1395.

[18] Yan HM, Gao X, Liu M, Gu Q, Zhang B, Li X. Relationship of liver fat content to insulin resistance and metabolic syndrome.Zhonghua Yi Xue Za Zhi 2008;88:1255-1258.

[19] Michael MD, Kulkarni RN, Postic C, Previs SF, Shulman GI, Magnuson MA, Kahn CR. Loss of insulin signaling in hepatocytes leads to severe insulin resistance and progressive hepatic dysfunction. Mol Cell 2000,6:87–97.
[20] Ten S, Maclaren N. Insulin resistance syndrome in children. J Clin Endocrinol Metab 2004;89:2526-2539.



Recent Advances in Cardiovascular Risk Factors

Edited by Prof. Mehnaz Atiq

ISBN 978-953-51-0321-9
Hard cover, 522 pages
Publisher InTech
Published online 21, March, 2012
Published in print edition March, 2012

Among the non-communicable diseases, cardiovascular disorders are the leading cause of morbidity and mortality in both the developed and the developing countries. The spectrum of risk factors is wide and their understanding is imperative to prevent the first and recurrent episodes of myocardial infarction, stroke or peripheral vascular disease which may prove fatal or disabling. This book has tried to present an update on risk factors incorporating new research which has thrown more light on the existing knowledge. It has also tried to highlight regional diversity addressing such issues. It will hopefully be resourceful to the cardiologists, general practitioners, family physicians, researchers, graduate students committed to cardiovascular risk prevention.

How to reference

In order to correctly reference this scholarly work, feel free to copy and paste the following:

Qiang Lu, Xiaoli Liu, Shuhua Liu, Changshun Xie, Yali Liu and Chunming Ma (2012). The Relationship Between AST/ALT Ratio and Metabolic Syndrome in Han Young Adults - AST/ALT Ratio and Metabolic Syndrome, Recent Advances in Cardiovascular Risk Factors, Prof. Mehnaz Atiq (Ed.), ISBN: 978-953-51-0321-9, InTech, Available from: http://www.intechopen.com/books/recent-advances-in-cardiovascular-risk-factors/the-relationship-between-ast-alt-ratio-and-metabolic-syndrome-in-han-young-adults

INTECH
open science | open minds

InTech Europe
University Campus STeP Ri
Slavka Krautzeka 83/A
51000 Rijeka, Croatia
Phone: +385 (51) 770 447
Fax: +385 (51) 686 166
www.intechopen.com

InTech China
Unit 405, Office Block, Hotel Equatorial Shanghai
No.65, Yan An Road (West), Shanghai, 200040, China
中国上海市延安西路65号上海国际贵都大饭店办公楼405单元
Phone: +86-21-62489820
Fax: +86-21-62489821

IntechOpen