An Exploration of Prevalence and Associated Factors of Nonalcoholic Fatty Liver Disease in the Taiwanese Police Service

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Abstract
Background: The purpose of this study was to explore any gender-related differences in prevalence of and condition-associated factors related to non-alcoholic fatty liver disease (NAFLD) amongst police population in Taipei, Taiwan.
Methods: We studied a total of 1016 healthy adults with police work (972 males and 44 females) voluntarily admitted to physical check-up between January 2006 and December 2006. Blood samples and ultrasound-proved fatty liver sonography results were collected.
Results: The prevalence of NAFLD for this sub-population was found to be 52.2%, the prevalence revealing a statistically significant decrease with increasing population age ($P<0.001$). Males exhibited a greater prevalence of NAFLD than did females (53.6% vs 20.5%, $P<0.0001$). Using multiple logistic regression analysis, in addition to male gender, an older age, higher BMI, higher ALT, presence of hyperuricemia, hypercholesterolemia, and hypertriglyceridemia were the significant factors associated with NAFLD. Gender-related differences as regards associated factors were also revealed. For males, hyperuricemia (OR=1.35, 95%CI: 1.07-1.86), higher ALT (OR=2.31, 95%CI: 1.50-3.56), hypercholesterolemia (OR=1.33, 95%CI: 1.01-1.82), and hypertriglyceridemia (OR=1.55, 95%CI: 1.01-2.37) were significantly related to NAFLD but these were not so for females.
Conclusion: several gender-related differences were noted pertaining to the prevalence of and relationship between hyperuricemia, higher ALT, hypercholesterolemia, and hypertriglyceridemia and NAFLD in the present study.

Keywords: Nonalcoholic fatty liver disease, Prevalence, Police Service, Gender Difference

Introduction

Fatty liver is a common condition and results in higher care utilization and costs and could be either alcoholic or nonalcoholic (1). Non-alcoholic fatty liver disease (NAFLD) is a clinic-pathological diagnosis characterized by macro-vesicular steatosis in hepatocytes and metabolic stress-related liver disorder, occurring in the absence of other causes of chronic liver disease (2). NAFLD now affects about 20-30% of the general population in industrialized Western countries (3,4). In additional, non-alcoholic steatohepatitis (NASH) is a syndrome characterized by the association of fatty liver and lobular hepatitis and chronically elevated alanine aminotransferase plasma levels (5). Eventually, NASH could be lead to nonalcoholic, nonchole-

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static cirrhosis and probably hepatocellular carcinoma (6). From the clinical viewpoint, increased NASH can develop liver fibrosis as much as reaching 50% (7). The early detection of this liver disorder by screening followed by appropriate intervention may offer a practical means for the prevention of condition-associated hepatocellular damage.

The police are empowered to enforce the law, protect property, and reduce civil disorder. Their powers include the legitimized use of force. Police work has been described as one of the most stressful occupations in the world (8). To the best of our knowledge, few studies explored the epidemiologic information of NAFLD among police work population. From the viewpoint of preventative medicine, it is not only important to be cognizant of the background prevalence of NAFLD in this highly pressure population, but also to explore the complete spectrum of demographic and biological markers which may be related to NAFLD. Further, some uncertainty still exists as regards whether the prevalence of and the associated risk factors for an NAFLD reveal gender difference amongst a sub-population. Thus, in order to identify the prevalence of and associated risk factors for NAFLD, the present study was designed so as to attempt to explore the potential for condition-related gender difference, because it was considered that such difference might underscore important implications for the understanding of the overall pathogenesis of NAFLD. The purpose of this study was to explore such gender difference in the context of prevalence of and associated risk factors for NAFLD amongst the police population, as determined by the application of a healthy volunteer subjects screening program health examination in Taipei, Taiwan.

Materials and Methods

Data resource and data collection
This cross-sectional study was conducted with a total of 1016 police officers (972 males and 44 females) voluntarily admitted to Central Clinic and Hospital for an annual physical check-up between January 2006 and December 2006. Blood samples and ultrasound sonography results were collected. Fasting blood samples were drawn via venipuncture from study participants by clinical nurses. Overnight-fasting serum and plasma samples (from whole blood preserved with EDTA and NaF) were kept frozen (-20°C) until ready for analysis. Definitions of the following diseases / conditions were high fasting plasma glucose (FPG)≥110mg/dl, obesity: a body mass index (BMI)≥27Kg/m^2, hypertension: a high systolic blood pressure (SBP) ≥140 mmHg or high diastolic blood pressure (DBP) ≥90 mmHg, hypercholesterolemia (≥200mg/dL), hypertriglyceridemia (≥200mg/dL), and hyperuricemia (≥7mg/dL for males or ≥6mg/dL for females). Serum ALT or AST level ≥40U/L were classified as elevated (9). Access to hospital records was approved by the hospital human subjects review board at Central Clinic and Hospital.

Ultrasound examination
Hepatic ultrasonography for all study police was performed by the well-trained ultrasonographist using a Toshiba Nemio (SSA-550A) ultrasound probe. The ultrasonographic criteria which were used to diagnose a fatty liver included liver and kidney echo discrepancy, presence of an increased liver echogenicity, echo penetration into the deep portion of the liver, and clarity of the liver blood vessel structures(10). All study subjects who were diagnosed as NAFLD at OPD by ultrasound and without disease history of chronic hepatitis and alcohol consumption were enrolled the study. In addition, the degree of NAFLD on ultrasonography was divided into mild or severe scales.

Interobserver reliability in ultrasound sonography
In order to set up a consistent diagnosis of NAFLD between specialists, the Kappa statistic was used to assess the agreement of inter-ob-

server reliability among study specialists. A pilot study was performed using 100 randomly selected healthy subjects other than the study participants. For inter-observer reliability, the Kappa value for diagnosis of NAFLDS between specialists was 0.78 (95%CI: 0.70-0.85).

Statistical analysis

Statistical analysis was performed using SAS for Windows, (SAS version 9.1; SAS Institute Inc., Cary, NC, USA). A p-value of <0.05 was considered to represent a statistically significant difference between two test populations. For univariate analysis, the two-sample, independent t-test method was adopted to assess differences in the mean value of continuous variables between subjects with and without NAFLD. Crude and adjusted odds ratios (adjustment for gender and age) were estimated and 95% confidence intervals were used. Multiple logistic regression was also performed in order to investigate the independence of risk factors associated with the prevalence of NAFLD.

Results

As table 1 shows, the overall prevalence of NAFLD for the test population was 52.2%, this parameter revealing a statistically significant decrease with increasing study-subject age by means of the χ^2 trend test ($P<0.001$). The prevalence of NAFLD for males proved to be substantially greater than it was for females (respectively, 53.6% vs 20.5%, p value for χ^2 test<0.0001). In addition, after stratifying data by age into one of four broad (age) groups, study-participating males exhibited a more-pronounced prevalence of NAFLD for all age groups than was the case for the female group. The age-specified prevalence of NAFLD revealed a significant positive relationship with age when applying the χ^2 trend test ($P<0.001$) for male study subjects but not so for females ($P=0.54$).

Table 2 illustrates the results of the comparison of a variety of test characteristics and their potential association with the specific (NAFLD) class value (yes or no) for study-included police screened subjects. Using the two-sample independent t-test, the associated factors that were significantly related to NAFLD included age, SBP, DBP, BMI, uric acid, AST, ALT, total cholesterol, triglyceride, and FPG. In addition to DBP, BMI, total cholesterol, and triglyceride were the significant factors associated with NAFLD for both in males and in females. Gender-related differences as regards associated factors were also revealed. Age, SBP, uric acid, AST, ALT and fasting plasma glucose were significantly related to NAFLD only for male police subjects. (Table 3)

Table 4 presents the crude and adjusted odds ratios for the association between certain relevant associated risk factors and NAFLD. Compared to individuals who exhibited without NAFLD, subjects featuring NAFLD revealed a more-pronounced prevalence of: hypertension (adjusted OR=2.37, 95%CI: 1.60-3.52), in addition to higher BMI (adjusted OR=5.85, 95%CI: 4.38-7.82), hyperuricemia (adjusted OR=2.01, 95%CI: 1.52-2.66), higher AST (adjusted OR=5.51, 95%CI: 2.29-13.29), higher ALT (adjusted OR=4.16, 95%CI: 2.84-6.09), hypercholesterolemia (adjusted OR=1.86, 95%CI: 1.42-2.44), hypertriglyceridemia (adjusted OR=3.15, 95%CI: 2.16-4.59), and higher fasting plasma glucose (adjusted OR=3.77, 95%CI: 1.07-13.28) subsequent to adjustment for gender and age.

The effect of independent associated risk factors upon NAFLD was examined using the multiple logistic regression model. As is depicted in Table 5, subsequent to adjustment for confounding factors, gender (male vs female, OR=1.99, 95%CI: 1.12-4.58), age (OR=1.07, 95%CI: 1.05-1.09), and the presence of higher BMI (yes vs no, OR=4.41, 95%CI: 3.25-5.97), hyperuricemia (yes vs no, OR=1.40, 95%CI: 1.02-1.91), higher ALT (yes vs no, OR=2.30, 95%CI: 1.49-5.34), hypercholesterolemia (yes vs no, OR=1.36, 95%CI: 1.02-1.84), and hypertriglyceridemia

(yes vs no, OR=1.54, 95%CI: 1.01-2.36) appeared to be statistically significantly related to NAFLD. The data presented in Table 5 also show the dramatically different results of multiple logistic regression of the data as stratified by gender. For males, the statistically significantly associated risk factors related to an NAFLD included age (OR=1.07, 95%CI: 1.05-1.09), and the presence of higher BMI (yes vs no, OR=4.39, 95%CI: 3.23-5.98), hyperuricemia (yes vs no, OR=1.35, 95%CI: 1.07-1.86), higher ALT (yes vs no, OR=2.31, 95%CI: 1.50-3.56), hypercholesterolemia (yes vs no, OR=1.33, 95%CI: 1.01-1.82), and hypertriglyceridemia (yes vs no, OR=1.55, 95%CI: 1.01-2.37). For female study participants, the statistically significant associated risk factors related to NAFLD included age (OR=1.03, 95%CI: 1.00-1.10), and presence of higher BMI (yes vs no, OR=1.10, 95%CI: 1.01-6.05).

Table 1: The gender and age specific prevalence of NAFLD among police screened subjects (n=1016)

Variables	Screened No.	NAFLD NAFLD No.	Prevalence (%)	*P*-value for trend test
Male (n=972)				
20-29	220	58	26.6	
30-39	463	263	56.2	<0.001
≧40	286	200	69.3	
Total	972	521	53.6	
Female (n=44)				
20-29	16	2	12.5	
30-39	10	2	20.0	0.54
≧40	18	5	27.8	
Total	44	9	20.5	
Total (n=1016)				
20-29	236	60	25.4	
30-39	473	265	56.0	<0.001
≧40	307	205	66.8	
Total	1016	530	52.2	

Table2: Comparisons of characteristics of NAFLD among police screened subjects

Variables	No (n=486) Mean±SD	Yes (n=530) Mean±SD	Total (n=1016) Mean±SD	*P*-value
Age(yr)	33.38±7.64	37.75±6.76	35.66±7.52	<0.001
SBP(mmHg)	121.74±6.76	126.37±14.32	124.16±13.65	<0.001
DBP(mmHg)	75.25±9.66	80.88±11.48	78.19±11.01	<0.001
BMI(Kg/m^2)	22.97±2.73	26.52±3.34	24.82±3.54	<0.001
Uric acid(mg/dl)	6.56±1.34	7.14±1.41	6.86±1.41	<0.001
AST(U/L)	20.06±6.46	25.60±14.51	22.95±11.73	<0.001
ALT(U/L)	22.80±13.58	39.57±30.34	31.55±25.26	<0.001
Total cholesterol (mg/dl)	185.37±32.97	203.37±39.00	194.76±37.33	<0.001
Triglyceride (mg/dl)	114.87±136.95	190.80±194.01	154.48±173.26	<0.001
Fasting plasma glucose (mg/dl)	87.42±13.15	92.10±22.27	89.86±18.62	<0.001

Table 3: Comparisons of characteristics of NAFLD stratified by gender among police screened subjects

	Male			Female		
	With NAFLD Mean±SD	**Without NAFLD Mean±SD**	***P*-value**	**With NAFLD Mean±StD**	**Without NAFLD Mean±SD**	***P*-value**
Age(year)	33.24±7.47	37.74±6.73	<0.001	35.11±9.54	38.22±8.60	0.38
SBP(mmHg)	122.94±11.82	126.59±14.29	<0.001	106.34±10.12	113.78±10.52	0.06
DBP(mmHg)	76.00±9.45	81.03±11.48	<0.001	65.54±6.56	72.22±7.14	0.01
BMI(kg/m^2)	23.10±2.67	26.56±3.33	<0.001	21.20±2.93	24.20±2.62	0.01
Uric acid(mg/dl)	6.71±1.24	7.17±1.39	<0.001	4.67±1.07	5.26±1.42	0.18
AST (mg/dl)	20.31±6.56	25.77±14.58	<0.001	16.74±3.74	15.78±2.68	0.47
ALT(mg/dl)	23.55±13.72	39.95±30.45	<0.001	13.11±5.86	17.11±4.70	0.07
Total cholesterol (mg/dl)	185.03±33.06	203.18±39.15	<0.001	189.74±31.93	214.33±28.04	0.04
Triglyceride (mg/dl)	118.76±141.15	192.44±195.21	<0.001	64.77±32.98	95.89±41.52	0.02
Fasting plasma glucose (mg/dl)	87.55±13.61	92.18±22.45	<0.001	85.77±3.51	87.22±1.86	0.24

Table 4: Crude and adjusted odds ratio of associated factors for NAFLD among police screened subjects

Item		With NAFLD (n=530)	Without NAFLD (n=486)	Crude odds ratio	Adjusted odds ratio1
Gender	female	9	35	0.22	---
	male	521	451	(0.11-0.47)	---
Age (yr)	20-29	60	176	1.00	---
	30-39	265	208	3.74	---
				(2.65-5.28)	
	≥40	205	102	5.90	---
				(4.04-8.60)	
Hypertension	yes	412	445	3.11	2.37
	no	118	41	(2.13-4.54)	(1.60-3.52)
Higher BMI	yes	119	322	6.78	5.85
	no	411	164	(5.14-8.95)	(4.38-7.82)
Hyperuricemia	yes	151	212	1.94	2.01
	no	379	274	(1.50-2.52)	(1.52-2.66)
Higher AST	yes	487	480	7.06	5.51
	no	43	6	(2.98-16.75)	(2.29-13.29)
Higher ALT	yes	363	445	4.99	4.16
	no	167	41	(3.45-7.22)	(2.84-6.09)
Hyper-cholesterolemia	yes	258	331	2.25	1.86
	no	272	155	(1.74-2.91)	(1.42-2.44)
Hyper-triglyceridemia	yes	376	443	4.22	3.15
	no	154	43	(2.93-6.08)	(2.16-4.59)
Higher fasting plasma glucose	yes	513	483	5.34	3.77
	no	17	3	(1.55-18.32)	(1.07-13.28)

[1]Aujestment for gender and age

Table 5: Multiple logistic regression of associated factors for NAFLD among police screened subjects

	Male (n=972)		Female (n=44)		Total (n=1016)	
	OR	95%CI	OR	95%CI	OR	95%CI
Gender(male vs female)	---	---	---	---	1.99	1.12-4.58
Age(yrs)	1.07	1.05-1.09	1.03	1.00-1.10	1.07	1.05-1.09
Hypertension (yes vs no)	1.24	0.79-1.93	---	---	1.24	0.79-1.94
Higher BMI (yes vs no)	4.39	3.23-5.98	1.10	1.01-6.05	4.41	3.25-5.97
Hyperuricemia (yes vs no)	1.35	1.07-1.86	3.45	0.63-18.97	1.40	1.02-1.91
Higher AST (yes vs no)	2.15	0.80-5.74	---	---	2.14	0.80-5.73
Higher ALT(yes vs no)	2.31	1.50-3.56	---	---	2.30	1.49-5.34
Hypercholerolemia (yes vs no)	1.33	1.01-1.82	2.02	0.38-10.85	1.36	1.02-1.84
Hypertriglyceridemia (yes vs no)	1.55	1.01-2.37	---	---	1.54	1.01-2.36
Higher fasting plasma glucose (yes vs no)	2.01	0.48-8.39	---	---	2.05	0.49-8.57

Discussions

Prevalence of non-alcoholic fatty liver disease

Police are part of society, must cope with the pulse of society and seek to catch up with the times. In Taiwan, the police are the well educated, trained, and selected population. The selection criteria for admission are completion of high school and physical and mental tests. During the study period, the recruits are trained thoroughly in specific tasks and prepare them for operational duties. Undoubtedly, the requirements of good health and appropriate training to be a police officer are necessary. Because the police officers work around the clock in order to maintain our security and stability. The long hours or irregular working hours, may cause some adverse health effects. To the best of our knowledge, however, there would appear to have been published only few community-based studies attempting to determine the prevalence and possible etiology of NAFLD for the general Chinese population, which also faced to the burden of liver disease (11).

One of the important benefits of the NAFLD screening program was that chronic liver disease was often identified by the detection of this syndrome; as such a screening test was commonly included in the serum chemistry panels conducted upon healthy individuals. Further, the relative significance of such results was often ignored when the NAFLD was deemed to be only just slightly abnormal. It has become clear that NAFLD is an increasingly common problem in worldwide although the limitation of the widely used diagnostic tools. The majority of studies excluded patients with a history of alcohol consumption and hepatitis on the basis of self-report data, however, the criteria varied widely (11). In the Chinese population, the median prevalence of ultrasonographic steatosis was about 10% and ranged from 1-30%. The prevalence of NAFLD for our study population (52.2%) was higher than the corresponding figure presented in a previous population-based study conducted in general Chinese populations (12-14). The police always face to the hard work, job stress, and reversed working and resting time. Irregular lifestyle and eating habits and careless their own health are also major problems. Both daily hassles and police operational duties could influence the police health and increase the risk of many chronic diseases such as hypertension, hyperlipidemia, diabetes, obesity, and metabolic syndrome. This might partially explain the apparently high prevalence of NAFLD observed in our study. Further, another possible reason for such difference between the results of the general population-based studies and our results may simply have been related to

the different study populations. In addition, previous epidemiologic studies also explore that the prevalence of fatty liver varied by occupation and found highest in administrative officers and white collars, followed by labourers, peasants, and monks (12). The diet habits, physical activity or other related factors should be taken into consideration.

The implications of gender difference as regards associated risk factors for NAFLD

Our results have revealed that male gender and an older age both represented significant risk factors related to the likelihood of NAFLD. Such a finding would appear to be consistent with the results of other population-based studies conducted elsewhere (10, 11). In addition, previous study has also demonstrated that NAFLD has a more even distribution between male and female and the possible reason was female hormones protect against NAFLD has been postulated and supported by evidence that NAFLD is twice as common in postmenopausal women as in premenopausal women (11,15). In this study, the mean age of female police was younger and this may be why the NAFLD was not more common in the female study subjects.

A growing body of evidence appears to indicate that significant liver disease may accompany (seemingly) mild serum aminotransferase level elevations (9). Consistent with the results of other studies (12), our results revealed that a higher ALT was highly associated with NAFLD. The determination of serum ALT level constitutes the most-frequently applied test for the identification of patients suffering from liver disease, this parameter also acting as a surrogate marker for disease severity and/or as an index of hepatic activity (16). The prevalence of fatty liver in patients with elevated ALT increased from 26% to 51% and revealed the substantially increased prevalence of fatty liver in the studied population (12, 17). In the mainland China and Taiwan, now NAFLD is becoming one of major causes of asymptomatic elevation of liver en-

zymes among those participating in regular health examinations (17, 18).

Hypercholesterolemia and hypertriglyceridemia, the components of metabolic syndrome, are significantly related to NAFLD in this study. It is now agreed that the well established term 'metabolic syndrome' remains the most useful and widely accepted description of this cluster of metabolically related cardiovascular risk factors which also predict a high risk of developing diabetes (19). Metabolic syndrome could be viewed as a strong predictor of NAFLD and NAFLD is also a good predictor for the clustering of components of risk factors for metabolic syndrome (20-22).

Hyperuricemia was also significantly related to male with NAFLD in the present study. Clinical study showed that a fructose load might lead to a more-substantial increase in serum uric-acid level amongst patients suffering chronic hepatitis than would be the case for normal subjects (23). Serum uric-acid level has also been reported to have been elevated amongst subjects suffering from chronic liver lesions, especially those of a non-infectious origin (9). In addition, the extent of such serum-level elevation appears to be dependent upon the specific severity of the hepatic lesions (9, 24). We were not able to determine the degree to which could have occurred or to what extent the increase in serum uric acid level had arisen prior to liver disease having developed from the cross-sectional nature of our study design in this screening program. Further epidemiological and etiological investigations are clearly needed in order to clarify the pathophysiological mechanisms of gender difference between uric acid and NAFLD.

Perceived limitations

One of major limitations to the present study was potential selection bias due to one area police population screened. The potential impact on the prevalence and the study-observed NAFLD-associated risk factors were, in our estimation, inevitable. Nevertheless, given the rather large sample size of this study, we still did

retain sufficient statistical power to be able to effectively evaluate the presence of any gender differences between the various associated risk factors for NAFLD subsequent to adjustment for confounding factors. Secondly, because it would appear that, to the best of our knowledge, no standard diagnostic elevation has yet been internationally accepted to constitute NAFLD, different studies may elect to set slightly different definition, such that our estimation of what constituted NAFLD could have suffered from some level of misclassification-bias identification. Thirdly, for the cost consideration, we did not collect the information of liver biopsy to confirm, diagnose, and stage of NAFLD, and ultrasonography results as a part of our study, such that the "true" causes of observed NAFLD for study-participating individuals were not able to be determined. Finally, our measurements were conducted at only a single point in time and, by clear inference, would not be able to be used to reflect long-term exposure to various demographic or biochemical aspects or factors, which might be important influencers of NAFLD. The solution to such a quandary would best be accomplished by conducting a number of prospective longitudinal analogous studies, the results of which would be expected to complement the community-based (cross-sectional) findings of this study.

In conclusion, as a consequence of the conduct of this study, several gender-related dissimilarities were noted as regards the relationship between hyperuricemia, higher ALT, hypercholesterolemia, and hypertriglyceridemia and NAFLD for study-included individuals, as also in regard to the actual prevalence of such level elevation. Further studies are not only needed in order to elucidate the temporal sequence of events that typically lead to NAFLD and thus develop more-satisfactory non-invasive indicators of liver pathology, but also to in order to further explore the realm of gender-related differences that appear to be involved with NAFLD among police population.

Ethical Considerations

Ethical issue principles including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc. have been completely observed by the authors.

Acknowledgements

References

1. Baumeister SE, Volzke H, Marschall *P*, John U, Schmidt CO, Flessa S, et al (2008). Impact of fatty liver disease on health care utilization and costs in a general population: a 5-year observation. *Gastroenterology*, 134 (1): 85-94.
2. Barshop NJ, Sirlin CB, Schwimmer JB, Lavine JE (2008). Review article: epidemiology, pathogenesis and potential treatments of paediatric non-alcoholic fatty liver disease. *Aliment Pharmacol Ther*, 28 (1): 13-24.
3. Williams R (2006). Global changes in liver disease. *Hepatology,* 44 (3): 521-26.
4. Angulo *P* (2007). GI epidemiology: non-alcoholic fatty liver disease. *Aliment Pharmacol Ther,* 25 (8): 883-89.
5. Su CC, Wang K, Hsia TL, Chen CS, Tung TH (2006). Association of nonalcoholic fatty liver disease with abnormal aminotransferase and postprandial hyperglycemia. *J Clin Gastroenterol,* 40 (6): 551-54.
6. Brunt EM (2004). Nonalcoholic steatohepatitis. *Semin Liver Dis,* 24 (1): 3-20.
7. Sheth SG, Gordon FD, Chopra S (1997). Nonalcoholic steatohepatitis. *Ann Intern Med*, 126 (2): 137-45.
8. Berg AM, Hem E, Lau B, Ekeberg Ø (2006). An exploration of job stress and health in the Norwegian police service: a cross sectional study. *J Occup Med Toxicol,* 1: 26.

9. Liu CM, Tung TH, Liu JH, Chen VT, Lin CH, Hsu CT, Chou *P* (2005). A community-based epidemiological syudy of elevated serum alanine aminotransferase levels in Kinmen, Taiwan. *World J Gastroenterol,* 11 (11): 1616-22.

10. Dai HF, Shen Z, Yu CH, Zhang XC, Li YM (2008). Epidemiology of fatty liver in an islander population of China: a population-based case-control study. *Hepatobiliary Pancreat Dis Int,* 7 (4): 373-78.

11. Lazo M, Clark JM (2008). The epidemiology of nonalcoholic fatty liver disease: a global perspective. *Semin Liver Dis,* 28 (4): 339-50.

12. Fan JG, Farrell GC (2009). Epidemiology of non-alcoholic fatty liver disease in China. *J Hepatol,* 50 (1): 204-10.

13. Zhou YJ, Li yy, Nie YQ, Ma JX, Lu LG, Shi SL, et al (2007). Prevalence of fatty liver disease and its risk factors in the population of South China. *World J Gastroenterol,* 13 (47): 6419-24.

14. Fan JG, Zhu j, Li XJ, Chen L, Li L, Dai F, et al (2005). Prevalence of and risk factors for fatty liver in a general population of Shanghai, China. *J Hepatol,* 43 (3): 508-14.

15. Carulli L, Lonardo A, Lombardini S, Marchesini G, Loria *P* (2006). Gender, fatty liver and GGT. *Hepatology,* 44 (1): 278-79.

16. Pratt DS, Kaplan MM (2000). Evaluation of abnormal liver-enzyme results in asymptomatic patients. *N Engl J Med,* 342 (17): 1266-71.

17. Fan JG, Li f, Cai XB, Peng YD, Ao QH, Gao Y (2007). The important of metabolic factors for the increasing prevalence of fatty liver in Shanghai factory workers. *J Gastroenterol Hepatol,* 22 (5): 663-68.

18. Chen CH, Huang MH, Yang JC, Nien CK, Yang CC, Yeh YH, et al (2007). Prevalence and etiology of elevated serum alanine aminotransferase level in an adult population in Taiwan. *J Gastroenterol Hepatol,* 22 (9): 1482-89.

19. Alberti KG, Zimmet *P*, Shaw J (2006). Metabolic syndrome—a new world-wide definition. A Consensus Statement from the International Diabetes Federation. *Diabet Med,* 23 (5): 469-80.

20. Fan JG, Peng YD (2007). Metabolic syndrome and non-alcoholic fatty liver disease: Asian definitions and Asian studies. *Hepatobiliary Pancreat Dis Int,* 6 (6): 572-78.

21. Huang HL, Lin WY, Lee LT, Wang HH, Lee WJ, Huang KC (2007). Metabolic syndrome is related to nonalcoholic steatohepatitis in severely obese subjects. *Obes Surg,* 17 (11): 1457-63.

22. Fan JG, Zhu J, Li XJ, Chen L, Lu YS, Li L, et al (2005). Fatty liver and the metabolic syndrome among Shanghai adults. *J Gartroenterol Hepatol,* 20 (12): 1825-32.

23. Loguercio C, Nardone G, Sicolo *P*, Cuomo R, Del Vecchio C, Budillon G (1996). Intravenous load of fructose and fructose 1,6-diphosphate: effects on uricemia in patients with nonalcoholic liver disease. *Am J Gastroenterology,* 91 (3): 559-64.

24. Bruckert E, Giral *P*, Ratziu V, Poynard T, Chapman MJ, Opolon *P*, Turpin G (2002). A constellation of cardiovascular risk factors is associated with hepatic enzyme elevation in hyperlipidemic patients. *Metabolism,* 51 (8): 1071-76.