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RAPID COMMUNICATION

Prevalence of fatty liver disease and its risk factors in the population of South China

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Abstract

AIM: To investigate the population-based prevalence of fatty liver disease (FLD) and its risk factors in Guangdong Province, China.

METHODS: A cross-sectional survey with multiple-stage stratified cluster and random sampling of inhabitants over 7-year-old was performed in 6 urban and rural areas of Guangdong Province, China. Questionnaires, designed by co-working of epidemiologists and hepatologists, included demographic characteristics, current medication use, medical history and health-relevant behaviors, i.e., alcohol consumption, smoking habits, dietary habits and physical activities. Anthropometric measurements, biochemical tests and abdominal ultrasonography were carried out.

RESULTS: Among the 3543 subjects, 609 (17.2%) were diagnosed having FLD (18.0% males, 16.7% females, $P > 0.05$). Among them, the prevalence of confirmed alcoholic liver disease (ALD), suspected ALD and nonalcoholic fatty liver disease (NAFLD) were 0.4%, 1.8%, and 15.0%, respectively. The prevalence rate (23.0%) was significantly higher in urban areas than (12.9%) in rural areas. After adjustment for age, gender and residency, the standardized prevalence of FLD in adults was 14.5%. Among them, confirmed ALD, suspected ALD and NAFLD were 0.5%, 2.3%, and 11.7%, respectively, in adults and 1.3% (all NAFLD) in children at the age of 7-18 years. The overall prevalence of FLD increased with age in both genders to the peak of 27.4% in the group of subjects at the age of 60-70 years. The prevalence rate was significantly higher in men than in women under the age of 50 years (22.4% *vs* 7.1%, $P < 0.001$). However, the opposite phenomenon was found over the age of 50 years (20.6% *vs* 27.6%, $P < 0.05$). Multivariate and logistic regression analysis indicated that male gender, urban residency, low education, high blood pressure, body mass index, waist circumference, waist to hip ratio, serum triglyceride and glucose levels were the risk factors for FLD.

CONCLUSION: FLD, especially NAFLD, is prevalent in South China. There are many risk factors for FLD.

Key words: Fatty liver disease; Prevalence; Epidemiology; Risk factors

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INTRODUCTION

Fatty liver disease (FLD), defined as lipid accumulation exceeding the normal range of 5% of liver wet weight, is a chronic disorder, which includes alcoholic liver disease (ALD) and nonalcoholic fatty liver disease (NAFLD). FLD encompasses a morphological spectrum consisting of hepatic steatosis and steatohepatitis which can progress to cirrhosis and hepatocellular carcinoma[1]. In the past, excess alcohol consumption accounted for most cases of FLD, but recently nonalcoholic causes of fatty liver have attracted considerable attention. In addition to alcohol consumption, factors such as insulin resistance (IR), oxidative stress, mitochondrial dysfunction, immune deregulation, and adipokines play an important role in the pathogenesis of FLD[2,3].

FLD has become a common problem in both developed and developing countries. According to the

Office for National Statistics in the United Kingdom, liver disease mainly FLD ranks the fifth most common cause of death after heart disease, stroke, pulmonary disease and cancer[4]. In recent years, due to alterations in life style and dietary habits, the incidence of FLD has increased dramatically in China. It is thus of importance to assess the epidemiological features of FLD in this country in order to facilitate its prevention and treatment. Although some epidemiological studies concerning FLD have been reported in China, most of them were based on clinical settings or on health check-up groups, which do not represent population data. So far only one population-based study from Shanghai, an eastern city of China, has been published in English[5]. The data from rural areas and other parts of this country are still lacking.

In this study, we investigated the prevalence of FLD in population of South China and identified its major risk factors. Since the random sampling method and high response rate limited the selection and responder biases, our results reflect the population-based data in both urban and rural areas.

MATERIALS AND METHODS

Study design

Guangdong Province with a population of about 85 millions (mainly Han nationality people) is located in an economically advanced region in South China. Its capital city, Guangzhou, has 8-million residents. The heterogeneity of economy, geography, and culture in different areas inside the province influences the life styles of the people.

Between April and November of 2005, a cross-sectional survey with multiple-stage stratified cluster and random sampling was performed on the basis of a previous analysis of the population distribution in this province[6,7]. In order to represent the data in general population, sampling clusters were randomly drawn from urban and rural areas all over the province. Six areas with 4365 residents over 7 years of age were selected, i.e., 2 communities from downtown of Guangzhou city (Yuanzhongyuan community of the Liwan district and the Xinyi community of the Baiyun district, with a total of 1436 urban residents) and four units within the province, i.e., a village in central area of the province (Huadu county, 822 rural residents), a village in southern area (Huizhou county, 1037 rural residents), a village in western area (Zhanjiang county, 351 rural residents) and a community in northern area (Shaoguan city, 719 urban residents).

Of the 4365 potential participants, 3903 agreed to take part in this investigation with a responder rate of 89.6%. Among them, 3543 subjects (90.6%, 1311 males and 2232 females, at the age of 7-100 years) provided their complete information, accounting for approximately 44.3/100 000 of the total population of Guangdong Province[7]. Interview, physical examination, laboratory assessment and ultrasonographic examination were performed for each subject on the same day at a mobile examination center. The study was approved and supported by Guangzhou Health Bureau. Written consent was obtained from each participant.

Interview and physical examination

A face-to-face interview was carried out by specially trained post-graduate students of Guangzhou Medical College and supervised by experienced investigators. Standard questionnaires, designed by co-working of epidemiologists and hepatologists, included the following items: demographic characteristics, current medication use, medical history and health-relevant behaviors, i.e., alcohol consumption, smoking habits, dietary habits and physical activities. Physical examination covered body height, weight, blood pressure, waist circumference (WC), waist-to-hip ratio (WHR) and routine anthropometric parameters in healthy check-up.

Biochemical tests

Intravenous blood samples were collected from fasting subjects by routine methods. Fasting serum glucose levels and lipid profiles were measured with an automatic chemistry- immuno-analyzer (Olympus Corporation, Tokyo, Japan). Serum asparatate aminotransferase (AST), and alanine aminotransferase (ALT), serum bilirubin (BIL) and albumin levels were measured by standard laboratory methods. Tests for the serum makers of hepatitis A virus (HAV), hepatitis B virus (HBV) and hepatitis C virus (HCV) were also carried out.

Ultrasonography

Real-time ultrasonography (US) of the upper abdominal organs was performed for each subject by 2 experienced physicians using a scanner equipped with a 3.5 mmHz transducer (Siemens Adama, German). The physicians performing the US were unaware of the clinical and laboratory results.

Diagnostic criteria

FLD, NAFLD and ALD were diagnosed according to the guidelines for diagnosis and treatment of nonalcoholoic and alcoholoic fatty liver diseases issued by Fatty Liver and Alcoholic Liver Disease Study Group of the Chinese Liver Disease Association[8,9], which were adapted from the American Gastroenterological Association[10]. Briefly, the diagnosis of FLD, NAFLD and ALD was based on the combination of medical history, clinical symptoms, laboratory and US findings. Viral hepatitis and other chronic liver diseases needed to be ruled out. Liver biopsy was taken when the diagnosis was suspected. In this epidemiological study, only 12 subjects underwent biopsy. In most cases FLD was diagnosed and staged by US findings. ALD was diagnosed when a subject fulfilling the FLD criteria drank more than 40 g (male) or 20 g (female) alcohol per day over 5 years. Suspected ALD was defined when the alcohol consumption was 20-40 g (male) or 10-20 g (female). NAFLD was diagnosed when the alcohol consumption was less than these amounts.

The US diagnostic patterns of FLD were based on the presence of a 'bright' liver (brightness and posterior attenuation) with stronger echoes in the hepatic parenchyma than in the renal parenchyma, vessel blurring and narrowing of the lumen of hepatic veins in the absence of findings suggestive of other chronic liver

Table 1 Age and sex-specific prevalence of fatty liver disease

	Total		Male		Female		*P*
	n	*n* (%)	*n*	*n* (%)	*n*	*n* (%)	
7-	379	5 (1.3)	210	4 (1.9)	169	1 (0.6)	0.265
18-	349	20 (5.7)	129	14 (10.9)	220	6 (2.7)	0.002
30-	477	53 (11.1)	155	31 (20.0)	322	22 (6.8)	0.000
40-	667	101 (15.1)	193	46 (23.8)	474	55 (11.6)	0.000
50-	809	214 (26.5)	230	53 (23.0)	579	161 (27.8)	0.166
60-	551	151 (27.4)	277	65 (23.5)	274	86 (31.4)	0.037
70-	311	65 (20.9)	117	23 (19.7)	194	42 (21.6)	0.676
Total	3543	609 (17.2)	1311	236 (18.0)	2232	373 (16.7)	0.326

Table 2 Sex-specific prevalence in fatty liver disease subgroups

	n	Confirmed ALD *n* (%)	Suspected ALD *n* (%)	NAFLD *n* (%)	Total (FLD) *n* (%)
Male	1311	12 (0.9)	53 (4.0)	171 (13.1)	236 (18.0)
Female	2232	2 (0.1)	12 (0.5)	359 (16.1)	373 (16.7)
Total	3543	14 (0.4)	65 (1.8)	530 (15.0)	609 (17.2)
P		< 0.001	< 0.001	< 0.05	> 0.05

FLD: Fatty liver disease; ALD: Alcoholic liver disease; NAFLD: Non-alcoholic fatty liver disease.

Table 3 Residence-specific prevalence in FLD subgroups

	n	Confirmed ALD *n* (%)	Suspected ALD *n* (%)	NAFLD *n* (%)	Total (FLD) *n* (%)
Rural	2047	11 (0.5)	27 (1.3)	227 (11.1)	265 (12.9)
Urban	1496	3 (0.2)	38 (2.5)	303 (20.3)	344 (23.0)
Total	3543	14 (0.4)	65 (1.8)	530 (15.0)	609 (17.2)
P					< 0.001

FLD: Fatty liver disease; ALD: Alcoholic liver disease; NAFLD: Non-alcoholic fatty liver disease.

diseases. The degree of FLD evaluated by US reflected the degree of steatosis. A liver displaying increased but homogenous dot reflection, blurred but still discernible vascular profiles and weak portal vein echogenicity was defined as early-stage. A medium-stage FLD was characterized by disappearance of the portal vascular wall and slightly increased liver volume. Patients with nebulous optical appearance in the liver, little portal vein echogenicity in more than 1/3-1/2 of the liver area and increased liver volume were considered to be in the advanced stage[11-13].

Obesity was categorized according to the body mass index (BMI) criteria for Asians issued by the Regional Office for Western Pacific Region of the World Health Organization[14]. Subjects with BMI ⩾ 25 were considered as obese, BMI ⩾ 23 but < 25 as overweight, BMI ⩾ 18.5 but < 23 as normal, BMI < 18.5 as underweight. Central (or abdominal) obesity was estimated by waist circumference (WC) and waist-to-hip ratio (WHR). A WHR value ⩾ 0.9 (male) or ⩾ 0.8 (female) was considered as central obesity. Dyslipidemia was considered when having one of following serum lipid profiles: total cholesterol (TC) ⩾ 5.72 mmol/L, triglycerides (TG) ⩾ 1.70 mmol/L, high-density lipoprotein cholesterol (HDL-C) < 0.91 mmol/L, and low-density lipoprotein cholesterol (LDL-C) ⩾ 3.64 mmol/L. Subjects with their fasting serum glucose (FSG) value of ⩾ 7.0 mmol/L and/or with a history of diabetes were considered to have diabetes mellitus. Hypertension was defined as systolic or diastolic blood pressure above 140 mmHg or 90 mmHg, respectively. Smokers in this study were defined as those smoking more than one cigarette each day for at least one year or more than 20 packages of cigarettes in total. Alcohol drinkers were defined as those drinking more than 2 times each month for more than 5 years. Heavy tastes meant the habits of preferring salted and spiced foods. Extraverted character meant the active personal characters of subjects. The definitions of urban and rural areas were in accordance with the publication of the Fifth Chinese National Population Census in 2000[7].

Statistical analysis

Data were examined with the SPSS 13.0 for Windows. P < 0.05 was considered statistically significant. Exposure ratio comparison and multivariate regression analyses were performed to evaluate the risk factors.

RESULTS

Age and gender-specific prevalence of FLD

Data are shown in Tables 1 and 2. Of the 3543 subjects, 609 (17.2%) were diagnosed having FLD, among them 367 (10.4%), 218 (6.1%) and 24 (0.7%) fell into early, medium and advanced degrees by US staging. The overall prevalence of FLD increased to the peak of 27.4% in the group at the age of 60- years and then decreased in both genders (P < 0.01). There was no prevalent difference between males and females (18.0% *vs* 16.7%, P > 0.05). However, FLD was more common in males than in females under 50 years of age. An opposite trend was noted over 50 years of age (P < 0.05). The prevalence of FLD in children at the age of 7-18 years (5/379, 1.3%) differed significantly from that in adults (604/3164, 19.1%, P < 0.001). The overall prevalence of ALD, suspected ALD and NAFLD was 0.4%, 1.8% and 15%, respectively, accounting for 2.3%, 10.7% and 87.0% of the 609 FLD subjects, respectively. In subgroup comparison, the prevalence of confirmed ALD and suspected ALD was significantly higher in males (0.9% and 4.0%) than in females (0.1% and 0.5%, P < 0.001). Nevertheless, the prevalence of NAFLD was lower in males than in females (13.0% *vs* 16.1%, P < 0.05).

Prevalence of FLD in urban and rural areas

The prevalence of FLD was significantly lower in rural areas than in urban areas (12.9% *vs* 23.0%, P < 0.001), mainly due to the difference in NAFLD (11.1% *vs* 20.3%, P < 0.001). A slight difference was observed in rural areas between ALD and suspected ALD subjects compared with urban areas, but it was not significant (P > 0.05) (Table 3).

Prevalence of FLD and serum lipid profiles

High serum levels of TG, TC, LDL-C and FSG were all positively associated with FLD (P < 0.01), but HDL-C did not reach significance (P > 0.05) (Table 4). The prevalence of FLD in dyslipidemia subjects was 3.65 (95% CI = 2.87-4.65) folds higher than that in normal controls. High TG levels were the most prominent factor for dyslipidemia

Table 4 Serum levels and lipid profiles in FLD patients and controls (mean ± SE)

	n	TG (mmol/L)	TC (mmol/L)	HDL-C (mmol/L)	LDL-C (mmol/L)	FSG (mmol/L)
FLD	609	2.81 ± 2.55	5.52 ± 1.11	1.72 ± 1.25	3.06 ± 0.91	6.01 ± 2.68
Controls	2934	1.63 ± 1.59	5.19 ± 1.07	1.67 ± 0.57	2.90 ± 0.81	4.95 ± 1.56
P		< 0.001	< 0.01	> 0.05	< 0.01	< 0.01

FLD: Fatty liver disease; TC: Total cholesterol; TG: Triglycerides; HDL-C: High-density lipoprotein cholesterol; LDL-C: Low-density lipoprotein cholesterol.

Table 5 Exposure ratios of variables in adult FLD patients compared with controls

n	Male	Urban	Primary school and below	Extraverted character	Alcohol drinkers	Smokers
Total 3164	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)
FLD 604	232 (38.4[1])	344 (57.0)	245 (40.6)	214 (35.4[a])	141 (23.3)	160 (26.5[a])
Controls 2560	869 (33.9)	1140 (44.5)	783 (30.6)	787 (30.7)	457 (17.9)	553 (21.6)
χ^2	4.295	30.282	22.112	4.966	9.619	6.665
n	Heavy tastes	Overweight	Obesity	Hypertension	WHR	WC
Total 3164	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)
FLD 604	208 (34.4)	478 (79.4)	120 (19.9)	287 (47.6)	531 (87.9)	432 (71.5)
Controls 2560	689 (26.9)	650 (25.5)	79 (3.1)	658 (25.7)	1469 (57.8)	558 (21.8)
χ^2	13.616	616.708	235.812	110.141	189.387	560.357

[a]$P < 0.05$ *vs* controls and all the others; $P < 0.01$ *vs* controls. FLD: Fatty liver disease; WC: Waist circumference; WHR: Waist-to-hip ratio.

with an odd ratio (OR) of 4.49 (95% CI = 3.56-5.66). The OR of high TC was 1.95 (95% CI = 1.56-2.44). The OR of elevated FSG and combined dyslipidemia was 4.93 (95% CI = 3.55-6.84) and 6.64 (95% CI = 4.83-9.12), respectively.

Adjusted prevalence of FLD

After adjustment for gender, age and residence area according to the demographic characteristics of the Fifth Chinese Census[7], the age-, gender- and residency- specific standardized prevalence of FLD was 14.5%. Confirmed ALD, suspected ALD and NAFLD were 0.5%, 2.3% and 11.7% respectively in adults (over 18 years of age). The overall prevalence of FLD was 11.3% and confirmed ALD, suspected ALD and NAFLD were 0.4%, 1.8% and 9.1% respectively, in all people over 7 years of age.

Exposure ratio and logistic regression analysis

The exposure ratio (%) analysis of anthropometric and clinical parameters in adults (above 18 years of age, *n* = 3164) with and without FLD was carried out to screen for the relevant factors for FLD (Table 5). The ratios of all variables for FLD and controls were significantly different ($P < 0.01$). In order to identify the risk factors, we further

Table 6 Multivariate regression logistic analysis for FLD (*n* = 3543)

Variables	β	SE	χ^2	*P*	OR	OR 95%CI
Male	0.628	0.218	5.361	0.002	0.765	0.321-0.921
Urban	0.212	0.128	28.219	< 0.001	0.332	0.211-0.291
Education level	-0.351	0.105	11.124	0.001	0.704	0.573-0.865
Hypertension	0.362	0.158	5.277	0.022	1.436	1.055-1.957
BMI	1.234	0.130	90.488	< 0.001	3.435	2.664-4.430
WHR	0.811	0.228	12.648	< 0.001	2.250	1.439-3.518
WC	1.017	0.174	33.987	< 0.001	2.765	1.964-3.892
TG	0.623	0.158	15.535	< 0.001	1.864	1.367-2.540
FSG	0.788	0.129	37.187	< 0.001	2.200	1.708-2.835
Alcohol-drinking	0.373	0.212	3.112	0.078	1.452	0.959-2.198
Heavy tastes	0.307	0.169	3.286	0.070	1.360	0.975-1.895

FLD: Fatty liver disease; BMI: Body mass index; WHR: w-to-hip ratio; WC: Waist circumference; TC: Total cholesterol; FSG: Fasting serum glucose.

performed a multivariate regression logistic analysis with probability for entry 0.05 and removal 0.1 (Table 6). Male gender, urban inhabitation, hypertension, high BMI, WC, WHR, serum TG, and FSG were found to be independent risk factors for FLD, and education was a protective factor for FLD. Alcoholic consumption and heavy tastes in food were marginally but not significantly related to FLD. Smoking and extraverted character were excluded from the risk factors for FLD ($P > 0.05$).

DISCUSSION

FLD is a common disease. NAFLD has been increasingly recognized as the most common liver disease in Western countries. So far no accurate incidence is available. The prevalent data obtained from clinical series and autopsy studies suggest that 20%-30% of individuals in the Western world have FLD. In general population, the prevalence of NAFLD ranges 3%-24% in the world[15-17], 20%-25% in Italy[18], 30% in Israel[19], 16% in Korea[20], 14% in Japan[21] and 15% (18% for FLD) in Shanghai, China[25]. The discrepancy among the studies is probably due to the methods of sample selection, modalities used for diagnosis and diversity of life styles and dietary habits in different areas. Since China is a developing country, it is not surprising that the standardized prevalence of FLD (14.5%) and NAFLD (11.7%) is lower in China than in developed countries. The urban prevalence is lower in Guangdong Province than in Shanghai city[5]. It seems that the rapid modernization of Shanghai has brought about its inhabitants more metabolic problems than that of Guangdong Province. Our results in adults and children are comparatively close to those in Japan, probably because the inhabitants in South China share the similar dietary habits (sea food preference) with Japanese[21]. In this study, only 24 cases (0.7% in general population) had advanced stage of FLD diagnosed by US, accounting for 3.9% of the 609 FLD cases. Although US is reasonably accurate as compared with biopsy, it cannot provide precise information about the histological features associated with disease progression especially inflammation[15]. The results in this study roughly reflect the lower severity of FLD in this area.

There are conflicting results regarding the relation of NAFLD to age and gender[15-18]. Bedogni *et al*[18] found that the prevalence of NAFLD increases with age in both genders and then significantly decreases over 66 years of age[18]. However, it was reported that hepatic triglyceride is correlated with age only in white women[16]. The variations between studies can be attributed to the differences in social, cultural and environmental backgrounds among the target subjects. In this study, the highest prevalence of FLD (mainly NAFLD) was observed in the sixth decade of life. The prevalence of FLD in males increased stably with age, and steadily from 50-60 years of age in females. The peak prevalence was observed in females (31.4%) at the age of 60 years, which was 20 years later than that in males (23.8%), which might be due to the menopausal status and lack of physical exercise in this period of time.

In developed countries, alcoholism, obesity and diabetes are the most common causes for FLD. Alcohol drinking plays a role in FLD[22,23]. In this study, only 0.5% adults in Guangdong Province suffered from ALD, reflecting the low alcohol consumption in South China. For this reason, multivariate analyses failed to demonstrate the role of alcohol drinking in FLD (P = 0.078). NAFLD is a manifestation of metabolic syndrome in liver, including obesity, type 2 diabetes, hypertension and dyslipidemia[15,24-28]. Metabolic syndrome, a common disorder in Western countries, has become a severe problem in China due to alterations in life styles and dietary habits. In this study, the prevalence of FLD increased with BMI and HWR, an index for central obesity. These findings are consistent with the reported data[5,19,29,30]. Our results indicate that dyslipidemia, especially high serum level of TG is a major risk factor for FLD, which also agrees with the results in most studies that the role of TG is more important than TC in the pathogenesis of metabolic syndrome and NAFLD[18,23]. When the serum level of TC in this area is relatively low, it fails to reach the significant level as a risk factor for FLD. The education background is related to the prevalence of FLD, probably because the people with a higher education level have paid more attention to their health and they are more likely to adjust their diet habits and exercise for the prevention of obesity.

There are several methodological limitations in this study. First, although participants were randomly selected, the enrollment of a greater proportion of females and elderly subjects in the study may bring about bias to the results. Second, the large number of immigrant population in Guangdong Province, especially in cities may have also confounded the study. In order to limit these biases, the prevalence rate was standardized for age, gender and residency areas. Multivariate regression analyses were performed to strengthen the reliability of our findings. Third, although histology remains the gold standard for the pathological diagnosis of FLD[31,32], imaging modalities like ultrasonography with a reasonably high sensitivity can identify FLD[32-35]. In this study, the diagnosis of fatty liver was based on ultrasonography. For the ethical reason, it is impossible to perform biopsy in an epidemiological study. In addition, the influence of exercise was not taken into account in this study.

In summary, FLD, especially NAFLD, is common in South China and many risk factors are related to the pathogenesis of this metabolic syndrome.

COMMENTS

COMMENTS

Background

Fatty liver disease (FLD) has become a common problem in both developed and developing countries. In recent years, due to alterations in life style and dietary habits, the incidence of FLD has increased dramatically in China. It is thus of importance to assess the epidemiological features of FLD in this country in order to facilitate its prevention and treatment. Although some epidemiological studies concerning FLD have been reported in China, most of them were based on clinical settings or on health check-up groups, which do not represent the population data. So far only one population-based study from Shanghai, an eastern city of China, has been published in English. The data from rural areas and other parts of this country are still lacking.

Research frontiers

FLD encompasses a morphological spectrum consisting of hepatic steatosis and steatohepatitis which can progress to cirrhosis and hepatocellular carcinoma. In the past, excess alcohol consumption accounted for most cases of FLD, but recently nonalcoholic causes for fatty liver have attracted considerable attention. In addition to alcohol consumption, factors such as insulin resistance (IR), oxidative stress, mitochondrial dysfunction, immune deregulation, and adipokines play an important role in the pathogenesis of FLD. Although FLD has been reported worldwide, it is difficult to determine the true prevalence because of problems in interpreting data from various studies due to referral bias, population heterogeneity, study design, imaging modalities, and liver biopsies. These studies on the FLD epidemiology have improved the detailed knowledge about the prevalence of FLD and the metabolic risk factors associated regional (e.g., urban *vs* rural) and ethnic differences, as they may provide clues to pathogenesis and individual risk factors for liver disease and metabolic complications. Further studies are also required to confirm the impact of fatty liver on chronic liver diseases.

Innovations and breakthroughs

The incidence of FLD is likely to rise steadily in China in urban areas owing to the westernization of the diet, excessive food intake, increased elderly population, changes in life style and lack of exercise. Because the majority of people live in rural areas of China, it is necessary to investigate the prevalence of FLD in China. In this study, since the random sampling method and high response rate limited the selection and responder biases, our results reflect the population-based data and the major risk factors for FLD in both urban and rural areas. This study assessed the prevalence of and risk factors for NAFLD in China.

Applications

With regards to increasing obesity, FLD, especially NAFLD, is believed to be the most common form of chronic liver diseases, which can progress to cirrhosis. Because there is no proven management for NAFLD, identification of important risk factors for this condition will provide valuable information on both risk stratification and development of risk-reduction strategies.

Terminology

Fatty liver disease (FLD), defined as lipid accumulation exceeding the normal range of 5% of liver wet weight, is a kind of chronic disorders, including alcoholic liver disease (ALD) and nonalcoholic fatty liver diseases (NAFLD). Briefly, the diagnosis of FLD, NAFLD and ALD is based on the combination of medical history, clinical symptoms, laboratory and imaging modalities (ultrasonography, computed tomography scans, and magnetic resonance imaging). Viral hepatitis and other chronic liver diseases need to be ruled out. ALD is diagnosed when a subject fulfilling the FLD criteria drinks more than 40 g (male) or 20 g (female) alcohol per day over 5 years. NAFLD is diagnosed when alcohol consumption is less than 40 g (male) or 20 g (female).

Peer review

This is an interesting, well written and generally well designed study. Although it does not identify fundamentally new or unexpected findings with respect to the incidence of FLD, the data highlighting the nonalcohol - related incidence of FLD in developing areas are important.

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