



# Prevalence of Non-Alcoholic Fatty Liver and its Related Factors in Birjand, During Year 2015

Ghodsieh Azarkar,<sup>1</sup> Tayebeh Zeinali,<sup>2</sup> Gholamreza Sharifzadeh,<sup>2</sup> Farshid Abedi,<sup>3</sup> Morteza Hajhosseini,<sup>4</sup> and Masood Ziaee<sup>3,\*</sup>

<sup>1</sup>Department of Radiology, School of Medicine, Birjand University of Medical Sciences, Birjand, Iran

<sup>2</sup>Birjand Social Determinants of Health Research Center, School of Health, Birjand University of Medical Sciences, Birjand, Iran

<sup>3</sup>Infectious Diseases Research Center, Birjand University of Medical Sciences, Birjand, Iran

<sup>4</sup>Birjand Cardiovascular Disease Research Center, Birjand University of Medical Sciences, Birjand, Iran

\*Corresponding author: Masood Ziaee, Professor of Infectious Diseases, Infectious Diseases Research Center, Department of Internal Medicine, Faculty of Medicine, Birjand University of Medical Sciences, Birjand, Iran. Tel: +98-9151613942, Fax: +98-985632433004, E-mail: dr.m.ziaee@gmail.com

Received 2015 October 29; Revised 2015 December 12; Accepted 2016 January 03.

## Abstract

**Background:** Fatty liver is one of the most common liver diseases across the world. Fatty Liver is characterized by deposition of fat in liver cells. Therefore, the aim of this study was to determine the prevalence of fatty liver and some related factors in Birjand, Iran.

**Methods:** This was a cross sectional study and was performed on 520 individuals in Birjand, Iran. Ultrasonography, cholesterol (CHOL), low density cholesterol (LDL), high density cholesterol (HDL), triglyceride (TG), fasting blood sugar (FBS), and tests of liver enzymes were performed. Results were analyzed using SPSS version16 software by Mann-Whitney, chi-square (Fischer exact test) and Kruskal-wallis with significance level of  $\alpha = 0.05$ .

**Results:** The mean age of participants was  $41.6 \pm 13.7$  (15 - 70). Males made up most of the subjects. Prevalence of fatty liver was estimated as 47.5% in Birjand. Results showed that fatty liver was associated with age, education, and marital status. People with primary education had a higher prevalence of fatty liver. Also, with elevated grade of fatty liver, Alanine aminotransferase (ALT) level had a significant increase ( $34.89 \pm 29.3$ ).

**Conclusions:** Several factors were associated with fatty liver that should be considered effectively. Also, increased awareness of the general population about non-alcoholic fatty liver is recommended.

**Keywords:** Fatty Liver, Prevalence, Non-Alcoholic Fatty Liver Disease

## 1. Background

Non-alcoholic fatty liver disease (NAFLD) is caused by excess of fat in liver cells more than 5% to 10% of body weight without consuming alcohol. This disease has been highly associated with obesity and overweightness as 70% to 80% of patients are obese (1). Prevalence of non-alcoholic fatty liver disease (NAFLD) is one of the growing problems of health (2). This is one of the commonest forms of chronic liver disease, globally (3). Fatty liver is one of the common causes of chronic liver disease and liver transplantation in western countries (4). This disease varies from simple steatosis (simple fatty acid which is a benign problem) to nonalcoholic steatohepatitis (excess of fat along with inflammation, damage and liver fibrosis), cirrhosis and hepatocellular carcinoma (HCC) (5). There is a higher mortality in fatty liver than healthy population and risk of cardiovascular disease are two times in them (6).

In Asia, prevalence of fatty liver varied between 12% and 24%, based on age, gender, residency and race. However, the prevalence of nonalcoholic fatty liver and nonalcoholic steatohepatitis is 2.9% to 7.1% in 7- to 18-year-old children and adolescents (7). Lankarani et al. (8) reported 21.5% prevalence of fatty liver through ultrasonography method in Iranian general population in Shiraz region (8). This reported prevalence was lower than Germany (40%) (9), Sri-lanka (32.6%) (10), and USA (33%) (11), and was higher than Italy (20%) (12), Taiwan (11.5%) (13), China (12.5% to 17.5%) (14, 15), Philippine (12.2%) (16), and Brazil (2.3%) (17). In another study, prevalence of ultrasonography diagnosed fatty liver was reported as 32.8% in overweight and obese children of Isfahan (18). In Iranian patients with elevated level of liver enzymes without any symptoms, it was reported as 43% (diagnosis with ultrasonography and biopsy) (4).

Physical inactivity and unsuitable lifestyle leads to fatty liver (19). Genetics, physical activity (20), diabetes mellitus, obesity, resistance to insulin, dyslipidemia, and

hypertension directly contribute to NAFLD (1). One of the risk factors of NAFLD is increasing sedentary behavior (21), and behavioral interventions concentrate on change of behavior and lifestyle and increasing physical activity. In the recent decades in Iran, physical activity has decreased and on the other hand, overweightness and obesity are significant among males and females (22). With regards to difference of prevalence of NAFLD across geographical region and related risk factors, the aim of this study was to determine the prevalence of nonalcoholic fatty liver and some associated risk factors in Birjand.

## 2. Methods

This study was a cross sectional study, performed in Birjand, during 2015. Based on the 21.5% prevalence of fatty liver reported by Lankarani et al. (8), sample size was calculated as 450 persons, and by considering 15% loss of samples, 520 persons were included in the study. Cluster random sampling was used in this study. According to the city's postal areas, there are 26 clusters (23). In each cluster, between 9 and 11 male and 9 and 11 female subjects with an age range of 15 to 70 years, who signed the consent form, were selected. Enrolled subjects undertook ultrasonography and blood tests.

Ultrasonography (Madison, USA) was carried out by a radiologist. Venous blood (8 mL) was collected from each subject. The specimens were placed in sterile-covered storage tubes and stored at  $-30^{\circ}\text{C}$  until collection of all samples. Fasting blood sugar (FBS), total cholesterol (CHOL), low density cholesterol (LDL), high density cholesterol (HDL), triglyceride (TG), Alanine aminotransferase (ALT) and aspartate aminotransferase (AST) were measured with enzymatic photometry on blood samples. Height and weight were evaluated by the seca scale (GmbH, Germany) with accuracy of  $\pm 1$  centimeters and  $\pm 50$  gram without any shoes. Body mass index (BMI) was calculated with weight (in kilograms) over height squared (in meters). Persons with BMI of less than  $< 18.5$  and  $18.5$  to  $24.9$  was considered thin and normal, respectively. Persons with BMI of more than  $25$  up to  $29.99$  were considered overweight, and BMI of more than  $30$  were considered obese.

Fatty liver was classified in 3 main categories; Mild, Moderate and severe. In people with mild fatty liver disease, liver echo was raised in contrast to kidney cortex's echo yet, in the moderate form, portal vein echogenic branches were disappeared. Severe form of fatty liver was diagnosed based on disappearance of diaphragm.

### 2.1. Statistical Analysis

This project was approved by the ethics and scientific committee of Birjand University of Medical Sciences, Iran

(approval code: IR.BUMS.REC.1394.377). Data were analyzed using the SPSS software. In persons with mild fatty liver disease, liver ver. 21 (Chicago, IL, U.S.) by Mann-Whitney, chi-square (Fischer exact test), and Kruskal-wallis with significant level of  $\alpha = 0.05$ .

## 3. Results

This study was performed on 520 individuals from Birjand with average age of  $41.6 \pm 13.7$  (Min: 15 and Max: 70). Females consisted of 251 individuals (48.3%) and the rest (269, 51.7%) were male. Also, 512 (98.46%) of them were Persian, and 1 (0.2%), 4 (0.8%), and 3 (0.6%) were Kurd, Arab, and Afghan, respectively. Marital status and education level of participants are presented in Table 1.

Regarding liver size in sonography, 6.5% (34) had a large liver size. In the liver echo, 47.1% (245) had increased liver echo. Prevalence of fatty liver in the studied individuals was estimated as 47.5%, Table 2.

AST and ALT averages were  $20.7 \pm 7.6$  and  $23.46 \pm 2.15$  (mg/dL), respectively (Table 2). Cholesterol, LDL, HDL, TG and FBS were  $187.2 \pm 35.3$ ,  $119.7 \pm 33.1$ ,  $39.2 \pm 7.9$ ,  $152.2 \pm 77.8$  and  $98.3 \pm 27.4$  (mg/dL), respectively.

Prevalence of fatty liver was higher in people with primary education. Also, with increase of age, prevalence of fatty liver had a significant increase yet, regarding gender, no significant difference was found. Moreover, fatty liver was increased with higher body mass index (Table 1).

Kruskal-wallis test showed that there was a significant difference between mean ALT and AST level in different kinds of fatty liver (Table 2). Two by two comparison of Mann-Whitney test showed that the average ALT ( $P < 0.001$ ) and AST ( $P = 0.013$ ) in mild fatty liver was higher than normal. Also, the mean level of ALT in moderate form of fatty liver had a significant difference with normal liver ( $P < 0.001$ ).

## 4. Discussion

This study was carried out on 520 people of Birjand with mean age of  $41.6 \pm 31.7$  years. Prevalence of nonalcoholic fatty liver was estimated as 47.5%. In the Amol adult population, prevalence of r NAFLD was 43.8% (24), and in a study on Iranian patients with elevated liver enzymes without any symptoms, this was 43% (22).

In Southern Iran, prevalence of fatty liver was estimated as 21.5% in the adult population and had a significant association with age, gender, and BMI status of subjects (8). Results of the present study indicated that fatty liver is associated with age and is most prevalent at 50 to 59 years old, which is in agreement with other studies in 2007

**Table 1.** Comparison of the Prevalence of Fatty Liver Regarding Demographic and Clinical Variables in the Studied Individuals<sup>a</sup>

Variable	Number of Studied Persons	Fatty Liver Frequency	P Value
<b>Gender</b>			P: 0.31
Female	251 (48.3)	125 (49.8)	
male	269 (51.7)	122 (45.4)	
<b>Age (year)</b>			P<0.001 <sup>b</sup>
< 30	143 (27.5)	21 (14.7)	
30 - 39	90 (17.3)	40 (44.4)	
40 - 49	112 (21.53)	67 (59.8)	
50 - 59	121 (23.26)	83 (68.6)	
≥ 60	54 (10.38)	36 (66.7)	
<b>Education level</b>			P<0.001 <sup>b</sup>
uneducated	50 (9.6)	23 (46)	
primary	101 (19.4)s	71 (70.3)	
Middle	42 (8.1)	22 (52.4)	
High school	172 (33.1)	75 (43.6)	
academic	155 (29.8)	56 (36.1)	
<b>Marital status</b>			P<0.001 <sup>b</sup>
single	83 (16)	6 (7.3)	
married	428 (82.3)	237 (55.4)	
widow	9 (1.7)	4 (44.4)	
<b>BMI status</b>			P<0.001 <sup>b</sup>
thin	55 (10.57)	6 (10.9)	
normal	156 (30)	26 (16.7)	
overweight	177 (34.03)	107 (60.5)	
obese	95 (18.26)	87 (91.6)	

<sup>a</sup>Values are expressed as No. (%).<sup>b</sup>Is significant at  $\alpha = 0.05$ **Table 2.** Comparison of Aspartate Aminotransferase and Alanine Aminotransferase Based on Grade of Fatty Liver in the Studied Individuals

Variables	Number (%)	ALT, X <sup>-</sup> ± SD	AST, X <sup>-</sup> ± SD
<b>Normal</b>	273 (52.5)	19.26 ± 0.5	19.52 ± 0.3
<b>Fatty liver mild</b>	179 (34.4)	27.25 ± 1.2 <sup>a</sup>	21.66 ± 0.6 <sup>a</sup>
<b>Fatty liver moderate</b>	59 (11.3)	31.17 ± 3.1 <sup>a</sup>	22.64 ± 1.2
<b>Fatty liver severe</b>	9 (1.8)	34.89 ± 9.7	24.22 ± 3.6
<b>Kruskall-wallis</b>		< 0.001	0.040

<sup>a</sup>Means that values had significant difference with normal values.

and 2013 (8, 25). However, Savadkoobi et al. (26), Alavian et al. (4), and Marchcieni et al. (27) didn't find a significant relationship between age and prevalence of fatty liver. Amarpurkar et al. (28) reported that the highest prevalence of

NAFLD was in the age group of 40 to 60 years. Also, in their study, it was more common in males than females (28).

In the present study, fatty liver occurrence was higher in females (49.8%) than males (45.4%), however, it was not

significant yet, in the study of Lankarani et al., fatty liver was more prevalent in males (8). Pourshams et al. (29) reported higher prevalence of nonalcoholic steatohepatitis in males than females, which is in disagreement with the present study. Regarding fatty liver in both genders, Adibi et al. (18) did not find any difference between them (18).

Also, in the present study, marital status had a significant association with fatty liver (55.4%), which is disagreement with the study Alavian et al. (4). However, Dehghan et al. (2) reported that 80% of fatty liver patients were married. Moreover, education showed a significant relationship with fatty liver yet Alavian et al. (4) did not find a significant difference.

Sohrabpour et al. (30) observed that, male gender, urban lifestyle, and being overweight or obese had a significant association with presumed non-alcoholic steatohepatitis (NASH).

Furthermore, in the present study, BMI was associated with fatty liver, which is in agreement with Kolahi et al. (31). In the study of Dehghan et al. (2), BMI ( $\geq 25$ ) was higher in patients with fatty liver (95.6%) compared with individuals with a clinically healthy liver (41.3%). In one study, fatty liver was higher in obese children when compared with overweight or normal individuals (18).

Severity of fatty liver was associated with ALT level of the blood serum (2, 30, 32). In one study, it was shown that elevation of ALT and AST increased death by 4.08% and 4.33%, respectively. However, this was not similar with a study from Turkey (33-35). Also, Pourshams et al. (29) showed that one of the most common causes of persistently elevated serum ALT in asymptomatic Iranian blood donors in Tehran is NASH.

One of the risk factors of fatty liver is increased physical inactivity (21). One study reported that people with NAFLD spent extra time in a day being sedentary and walked fewer steps. Also, compared with controls, they had a lower number of transitions from being sedentary to active (21). Furthermore, a healthy diet and physical activity had benefits beyond weight reduction for NAFLD patients (20).

One of the main constrains of this study was the incorporation of participants in sonography, which was solved by explanation of the consequences of fatty liver and advantages of diagnosis of disease to the participants. Further researches are suggested to determine the influence of life style and nutrition dietary on the incidence of fatty liver in this area.

#### 4.1. Conclusion

In the present study, prevalence of fatty liver was estimated as 47.5%, which was higher than the normal prevalence of fatty liver in Iran. Age, marital status, education level, BMI, and ALT level had a significant relationship with

fatty liver. Therefore, several factors were associated with fatty liver that should be considered effectively. Also, increased awareness of the general population about non-alcoholic fatty liver is recommended.

#### References

- Safarpour M, Kohan L, Porkhajah AH. Comparative study of anthropometric parameters in non-alcoholic fatty liver disease patients and healthy subjects [In Persian]. *Q J Sabzevar Univ Med Sci*. 2015;**22**(2):231-25.
- Dehghan P, Miwechi M, Izadi E, Mohammadi F, Sohrabi MR. Comparison of physical activity and body mass index in patients with and without non-alcoholic fatty liver disease [In Persian]. *Commun Health*. 2015;**1**(2):81-8.
- St George A, Bauman A, Johnston A, Farrell G, Chey T, George J. Independent effects of physical activity in patients with non-alcoholic fatty liver disease. *Hepatology*. 2009;**50**(1):68-76. doi: [10.1002/hep.22940](https://doi.org/10.1002/hep.22940). [PubMed: [19444870](https://pubmed.ncbi.nlm.nih.gov/19444870/)].
- Alavian S, Ramezani M, Bazzaz A, Azuzabadi Farahani M, Behnavi B, Keshvari M. Frequency of fatty liver and some of its risk factors in asymptomatic carriers of HBV attending the Tehran blood transfusion organization hepatitis clinic [In Persian]. *Iran J Endocrinol Metab*. 2008;**10**(2):99-106.
- Nikroo H, Mohammadian M, Nematy M, Sima HR, Attarzadeh Hosseini SR. The effect of diet and exercise on improvement of quality of life in patients with nonalcoholic steatohepatitis [In Persian]. *J Keraman Univ Med Sci*. 2015;**22**(1):61-72.
- Ballestri S, Lonardo A, Bonapace S, Byrne CD, Loria P, Targher G. Risk of cardiovascular, cardiac and arrhythmic complications in patients with non-alcoholic fatty liver disease. *World J Gastroenterol*. 2014;**20**(7):1724-45. doi: [10.3748/wjg.v20.i7.1724](https://doi.org/10.3748/wjg.v20.i7.1724). [PubMed: [24587651](https://pubmed.ncbi.nlm.nih.gov/24587651/)].
- Alavian SM, Mohammad-Alizadeh AH, Esna-Ashari F, Ardalan G, Harjizadeh B. Non-alcoholic fatty liver disease prevalence among school-aged children and adolescents in Iran and its association with biochemical and anthropometric measures. *Liver Int*. 2009;**29**(2):159-63. doi: [10.1111/j.1478-3231.2008.01790.x](https://doi.org/10.1111/j.1478-3231.2008.01790.x). [PubMed: [18492015](https://pubmed.ncbi.nlm.nih.gov/18492015/)].
- Lankarani KB, Ghaffarpasand F, Mahmoodi M, Lotfi M, Zamiri N, Heydari ST, et al. Non alcoholic fatty liver disease in southern Iran: a population based study. *Hepat Mon*. 2013;**13**(5). e9248. doi: [10.5812/hepatmon.9248](https://doi.org/10.5812/hepatmon.9248). [PubMed: [23922564](https://pubmed.ncbi.nlm.nih.gov/23922564/)].
- Kirovski G, Schacherer D, Wobser H, Huber H, Niessen C, Beer C, et al. Prevalence of ultrasound-diagnosed non-alcoholic fatty liver disease in a hospital cohort and its association with anthropometric, biochemical and sonographic characteristics. *Int J Clin Exp Med*. 2010;**3**(3):202-10. doi: [10.1055/s-0029-1246560](https://doi.org/10.1055/s-0029-1246560). [PubMed: [20827318](https://pubmed.ncbi.nlm.nih.gov/20827318/)].
- Dassanayake AS, Kasturiratne A, Rajindrajith S, Kalubowila U, Chakravarthy S, De Silva AP, et al. Prevalence and risk factors for non-alcoholic fatty liver disease among adults in an urban Sri Lankan population. *J Gastroenterol Hepatol*. 2009;**24**(7):1284-8. doi: [10.1111/j.1440-1746.2009.05831.x](https://doi.org/10.1111/j.1440-1746.2009.05831.x). [PubMed: [19476560](https://pubmed.ncbi.nlm.nih.gov/19476560/)].
- Browning JD, Szczepaniak LS, Dobbins R, Nuremberg P, Horton JD, Cohen JC, et al. Prevalence of hepatic steatosis in an urban population in the United States: impact of ethnicity. *Hepatology*. 2004;**40**(6):1387-95. doi: [10.1002/hep.20466](https://doi.org/10.1002/hep.20466). [PubMed: [15565570](https://pubmed.ncbi.nlm.nih.gov/15565570/)].
- Bedogni G, Miglioli L, Masutti F, Tiribelli C, Marchesini G, Bellentani S. Prevalence of and risk factors for nonalcoholic fatty liver disease: the Dionysos nutrition and liver study. *Hepatology*. 2005;**42**(1):44-52. doi: [10.1002/hep.20734](https://doi.org/10.1002/hep.20734). [PubMed: [15895401](https://pubmed.ncbi.nlm.nih.gov/15895401/)].
- Chen CH, Huang MH, Yang JC, Nien CK, Yang CC, Yeh YH, et al. Prevalence and risk factors of nonalcoholic fatty liver disease in an adult population of taiwan: metabolic significance of nonalcoholic fatty liver disease in nonobese adults. *J Clin Gastroenterol*. 2006;**40**(8):745-52. doi: [10.1097/00004836-200609000-00016](https://doi.org/10.1097/00004836-200609000-00016). [PubMed: [16940890](https://pubmed.ncbi.nlm.nih.gov/16940890/)].

14. Zhou YJ, Li YY, Nie YQ, Ma JX, Lu LG, Shi SL, et al. Prevalence of fatty liver disease and its risk factors in the population of South China. *World J Gastroenterol*. 2007;**13**(47):6419-24. doi: [10.3748/wjg.v13.i47.6419](https://doi.org/10.3748/wjg.v13.i47.6419). [PubMed: [18081233](https://pubmed.ncbi.nlm.nih.gov/18081233/)].
15. Li H, Wang YJ, Tan K, Zeng L, Liu L, Liu FJ, et al. Prevalence and risk factors of fatty liver disease in Chengdu, Southwest China. *Hepatobiliary Pancreat Dis Int*. 2009;**8**(4):377-82. [PubMed: [19666406](https://pubmed.ncbi.nlm.nih.gov/19666406/)].
16. De Lusong MA, Labio E, Daez L, Gloria V. Non-alcoholic fatty liver disease in the Philippines: comparable with other nations?. *World J Gastroenterol*. 2008;**14**(6):913-7. doi: [10.3748/wjg.v14.i6.913](https://doi.org/10.3748/wjg.v14.i6.913). [PubMed: [18240349](https://pubmed.ncbi.nlm.nih.gov/18240349/)].
17. Rocha R, Cotrim HP, Bitencourt AG, Barbosa DB, Santos AS, Almeida Ade M, et al. Nonalcoholic fatty liver disease in asymptomatic Brazilian adolescents. *World J Gastroenterol*. 2009;**15**(4):473-7. doi: [10.3748/wjg.v15.i4.473](https://doi.org/10.3748/wjg.v15.i4.473). [PubMed: [19152453](https://pubmed.ncbi.nlm.nih.gov/19152453/)].
18. Adibi A, Kelishadie R, Beihaghi A, Salehi HR, Talaei M12. Prevalence of sonographic fatty liver in overweight and obese children; a cross sectional study in Isfahan [In Persian]. *J Shaheed Sadoughi Univ Med Sci*. 2009;**17**(4):270-80.
19. Johnson NA, Keating SE, George J. Exercise and the liver: implications for therapy in fatty liver disorders. *Semin Liver Dis*. 2012;**32**(1):65-79. doi: [10.1055/s-0032-1306427](https://doi.org/10.1055/s-0032-1306427). [PubMed: [22418889](https://pubmed.ncbi.nlm.nih.gov/22418889/)].
20. Nseir W, Hellou E, Assy N. Role of diet and lifestyle changes in nonalcoholic fatty liver disease. *World J Gastroenterol*. 2014;**20**(28):9338-44. doi: [10.3748/wjg.v20.i28.9338](https://doi.org/10.3748/wjg.v20.i28.9338). [PubMed: [25071328](https://pubmed.ncbi.nlm.nih.gov/25071328/)].
21. Hallsworth K, Thoma C, Moore S, Ploetz T, Anstee QM, Taylor R, et al. Non-alcoholic fatty liver disease is associated with higher levels of objectively measured sedentary behaviour and lower levels of physical activity than matched healthy controls. *Frontline Gastroenterol*. 2015;**6**(1):44-51. doi: [10.1136/flgastro-2014-100432](https://doi.org/10.1136/flgastro-2014-100432). [PubMed: [25580206](https://pubmed.ncbi.nlm.nih.gov/25580206/)].
22. Moghimi-Dehkordi B, Safaee A, Vahedi M, Pourhoseingholi MA, Pourhoseingholi A, Zali MR. The prevalence of obesity and its associated demographic factors in Tehran, Iran [In Persian]. *Journal of Health Development*. 2012;**1**(1):22-30.
23. Ziaee M, Ebrahimzadeh A, Azarkar Z, Namaei MH, Saburi A, Fereidouni M, et al. Seroprevalence and Risk Factors for Hepatitis B in an Adult Population: The First Report from Birjand, South Khorasan, Iran. *Hepat Mon*. 2016;**16**(9). e36452. doi: [10.5812/hepatmon.36452](https://doi.org/10.5812/hepatmon.36452). [PubMed: [27822260](https://pubmed.ncbi.nlm.nih.gov/27822260/)].
24. Amirkalali B, Poustchi H, Keyvani H, Khansari MR, Ajdarkosh H, Maadi M, et al. Prevalence of Non-Alcoholic Fatty Liver Disease and Its Predictors in North of Iran. *Iran J Public Health*. 2014;**43**(9):1275-83. [PubMed: [26175982](https://pubmed.ncbi.nlm.nih.gov/26175982/)].
25. Lee JY, Kim KM, Lee SG, Yu E, Lim YS, Lee HC, et al. Prevalence and risk factors of non-alcoholic fatty liver disease in potential living liver donors in Korea: a review of 589 consecutive liver biopsies in a single center. *J Hepatol*. 2007;**47**(2):239-44. doi: [10.1016/j.jhep.2007.02.007](https://doi.org/10.1016/j.jhep.2007.02.007). [PubMed: [17400323](https://pubmed.ncbi.nlm.nih.gov/17400323/)].
26. Savadkoobi F, Hosseini Tabatabaei MT, Shahabi Nezhad S. The frequency of fatty liver in sonography of patients without liver diseases background and its correlation with blood cholesterol and triglyceride [In Persian]. *Tabib-e-Shargh J Zahedan Univ Med Sci*. 2003;**4**(3):177-83.
27. Marchesini G, Brizi M, Bianchi G, Tomassetti S, Bugianesi E, Lenzi M, et al. Nonalcoholic fatty liver disease: a feature of the metabolic syndrome. *Diabetes*. 2001;**50**(8):1844-50. [PubMed: [11473047](https://pubmed.ncbi.nlm.nih.gov/11473047/)].
28. Amarapurkar D, Kamani P, Patel N, Gupte P, Kumar P, Agal S, et al. Prevalence of non-alcoholic fatty liver disease: population based study. *Ann Hepatol*. 2007;**6**(3):161-3. [PubMed: [17786142](https://pubmed.ncbi.nlm.nih.gov/17786142/)].
29. Pourshams A, Malekzadeh R, Monavvari A, Akbari MR, Mohamadkhani A, Yarahmadi S, et al. Prevalence and etiology of persistently elevated alanine aminotransferase levels in healthy Iranian blood donors. *J Gastroenterol Hepatol*. 2005;**20**(2):229-33. doi: [10.1111/j.1440-1746.2004.03511.x](https://doi.org/10.1111/j.1440-1746.2004.03511.x). [PubMed: [15683425](https://pubmed.ncbi.nlm.nih.gov/15683425/)].
30. Sohrabpour A, Rezvan H, Amini-Kafiabad S, Dayhim M, Merat S, Pourshams A. Prevalence of Nonalcoholic Steatohepatitis in Iran: A Population based Study. *Middle East J Dig Dis*. 2010;**2**(1):14-9. [PubMed: [25197507](https://pubmed.ncbi.nlm.nih.gov/25197507/)].
31. Kolahi AA, Pakdaman R, Mivehchi M, Dehghan P. Comparison of nutritional behaviors and body mass index in patients with and without non-alcoholic fatty liver diseases. *Commun Health*. 2015;**2**(1):9-16.
32. Joven J, Espinel E, Rull A, Beltran-Debon R, Aragones G, Rodriguez-Gallego E, et al. Serum fatty acid synthase concentration is increased in patients with hepatitis viral infection and may assist in the prediction of liver steatosis. *J Clin Virol*. 2011;**51**(3):199-201. doi: [10.1016/j.jcv.2011.04.003](https://doi.org/10.1016/j.jcv.2011.04.003). [PubMed: [21555238](https://pubmed.ncbi.nlm.nih.gov/21555238/)].
33. Shiasi Arani K, Haghshenas M, Talari HR, Akbari H, Hami K. Prevalence of fatty liver disease in obese children and adolescents who referred to pediatric clinic of Kashan University of Medical Sciences, Iran (2012-2013) [In Persian]. *J Babol Univ Med Sci*. 2013;**15**(5):77-83.
34. Altıparmak E, Koklu S, Yalınkılıç M, Yuksel O, Cicek B, Kayacetin E, et al. Viral and host causes of fatty liver in chronic hepatitis B. *World J Gastroenterol*. 2005;**11**(20):3056-9. [PubMed: [15918189](https://pubmed.ncbi.nlm.nih.gov/15918189/)].
35. Bedogni G, Bellentani S, Miglioli L, Masutti F, Passalacqua M, Castiglione A, et al. The Fatty Liver Index: a simple and accurate predictor of hepatic steatosis in the general population. *BMC Gastroenterol*. 2006;**6**:33. doi: [10.1186/1471-230X-6-33](https://doi.org/10.1186/1471-230X-6-33). [PubMed: [17081293](https://pubmed.ncbi.nlm.nih.gov/17081293/)].