Awareness of Non-Alcoholic Fatty Liver Disease among General Population in KSA: A Cross-Section Study

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Abstract: Objective: This research aims to determine the Awareness of Non-Alcoholic Fatty Liver Disease among the General Population in KSA.

Methods: This study will employ a cross-sectional design to assess the awareness of Non-Alcoholic Fatty Liver Disease (NAFLD) among the general population in Saudi Arabia. A structured questionnaire will gather data from a representative population sample.

Results: The study included 300 participants. The most frequent gender among them was female (n= 248, 82.6%) and male (n= 52, 17.3%). The most frequent age among study participants was 40 years and more (n= 114, 83%), followed by less than 25 years (n= 59, 19.6%), then 36-40 years (n=50, 16.6%), and 31-35 years (n=40, 16.6%), 25-30 years (n=37, 12.3%). The most frequent educational level among them was university (n=204, 68%), followed by high school (n=48, 16%), and then others (n=28, 9.3%), intermediate school (n=15, 5 The most frequent nationalities among study participants were Saudi (n=252, 84%) and non-Saudi (n=48, 16%). Participants were asked about the diseases of fatty liver. The most frequent inflammation (n=224, 74.7%), followed by swelling (n=43, 14.3%), then injury (n=33, 11%). The source of information about the most common non-alcoholic fatty liver disease was never heard about it (n=117, 33.5%), health professional (n=71, (20.3%),

social media (n=59, 16.9%), friend/relative (n=58, 16.6%), a previous study (n= 31(8.8%), and others (n=13, 3.7%).
Conclusion: There are significant relationships between the awareness of Non-Alcoholic Fatty Liver Disease (NAFLD) among the general population and other variables, including age, gender, and educational level.

1. Introduction

Hepatic steatosis, or the abnormal buildup of fat inside the liver, as well as NAFLD's absence of secondary causes, including excessive alcohol intake, define this complicated spectrum of liver illnesses. This spectrum encompasses a variety of liver conditions, from the mild and often harmless non-alcoholic fatty liver (NAFL) to the more serious and possibly progressing non-alcoholic steatohepatitis (NASH). The development of fibrosis and cirrhosis, which may result from NAFLD if not treated, is a major risk to public health [1,2].

Two separate forms of NAFLD exist. Metabolic syndrome is strongly linked to the first kind. Insulin resistance is largely believed to be the fundamental mechanism [3-5]. Metabolic syndrome, which includes conditions such systemic hypertension, dyslipidemia, insulin resistance, and overt diabetes, is often seen in individuals with NAFLD [6].

Worldwide, the prevalence of NAFLD has increased, impacting almost 30.05 percent of the population [7]. The majority of liver-related deaths [8] and end-stage liver disease [9] are caused by it, and liver transplantation is typically necessary [10]. Rising rates of obesity and type 2 diabetes mellitus have contributed to the increase in nonalcoholic fatty liver disease (NAFLD) [11,12]. From 1990 to 2019, the prevalence of NAFLD in the Middle East increased significantly, going from 36.53% to 42.62% [7]. A prevalence of 16.8% for NAFLD was found in Saudi Arabia in a comprehensive study [13]. Specifically, NAFLD is more common in Saudi Arabia since the country's obesity percentage is greater than the world average [14].

The terrible lack of knowledge on NAFLD persists despite the condition's increasing importance on a worldwide scale. Compared to other liver-related diseases, including viral hepatitis, the 4.4% level of knowledge of NAFLD in the US is shockingly low [15]. A similar lack of understanding was seen in European nations [16]. According to one research, only 2.4% of those with a NAFLD diagnosis knew they had the disease [17].

Nonetheless, it is crucial to emphasize the need of bringing attention to NAFLD. Increasing treatment uptake, supporting important behavioral adjustments including lifestyle alterations, and allowing informed choices all begin with elevated awareness. In addition to its obvious effects on health, non-alcoholic fatty liver disease (NAFLD) affects people financially and lowers their quality of life in general when it comes to their health [18-20]. The purpose of this research is to determine how well-informed adults in Saudi Arabia are about nonalcoholic fatty liver disease (NAFLD) and what variables contribute to their level of knowledge.

2. METHODS

Study design

This study will employ a cross-sectional design to assess the awareness of Non-Alcoholic Fatty Liver Disease (NAFLD) among the general population in Saudi Arabia. A structured questionnaire will be used to gather data from a representative sample of the population.

Study approach

The study will be conducted across various regions in Saudi Arabia, including urban, suburban, and rural areas, to ensure a diverse and representative sample. Data collection will occur in public places such as shopping malls, community centers, and healthcare facilities, as well as through online platforms.

Study population

The study population will consist of Saudi Arabian residents aged 18 years and above, representing various socio-economic backgrounds, educational levels, and geographic locations. Both male and female participants will be included to provide a comprehensive overview of NAFLD awareness across the population.

Study sample

A sample size of approximately 300 participants will be targeted to achieve statistical significance and adequate power for analysis. A stratified random sampling technique will be used to ensure representation from different demographic groups, including age, gender, education level, and region. This method will help minimize selection bias and enhance the generalizability of the findings.

Study tool

For the current study, a questionnaire was adopted for data collection, which was also categorized as a study tool.

Data collection

Data will be collected using a structured, self-administered questionnaire designed to assess awareness and knowledge of NAFLD. The questionnaire will be available in both Arabic and English and will be distributed both online and in person. Trained data collectors will assist participants in completing the survey, ensuring clarity and accuracy in responses.

Data analysis

Data will be analyzed using SPSS software (version 26.0). Descriptive statistics will summarize the demographic characteristics of the sample and the levels of awareness about NAFLD. Chi-square tests will be used to assess associations between socio-demographic factors and awareness levels. Logistic regression analysis will be conducted to identify predictors of NAFLD awareness among the general population. A p-value of <0.05 will be considered statistically significant.

Ethical considerations

The study will be conducted in accordance with ethical principles outlined in the Declaration of Helsinki. Ethical approval will be obtained from the Institutional Review Board (IRB) of the participating institutions. Participants will be informed about the study's purpose, procedures, and their rights, including the right to withdraw at any time without penalty. Informed consent will be obtained from all participants prior to data collection. Confidentiality and anonymity will be maintained throughout the study, with data securely stored and only accessible to the research team.

3. RESULTS

The study included 300 participants. The most frequent gender among them was female (n= 248, 82.6%) and male (n= 52, 17.3%). Figure 1 shows the gender distribution among study participants. The most frequent age among study participants was 40 years and more (n= 114, 83%), followed by less than 25 years (n= 59, 19.6%), then 36-40 years (n=50, 16.6%), and 31-35 years (n=40, 16.6%), 25-30 years (n=37, 12.3%). Figure 2 shows the age distribution among study participants. The most frequent nationalities among study participants were Saudi (n=252, 84%) and non-Saudi (n=48, 16%). Figure 3 shows the distribution of nationality among study participants.

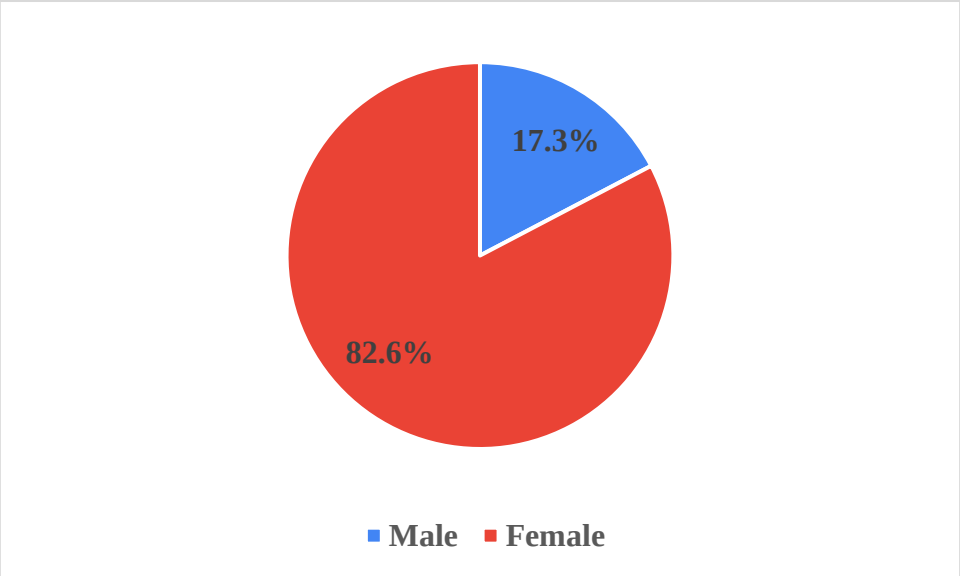

Figure 1: Gender distribution among study participants

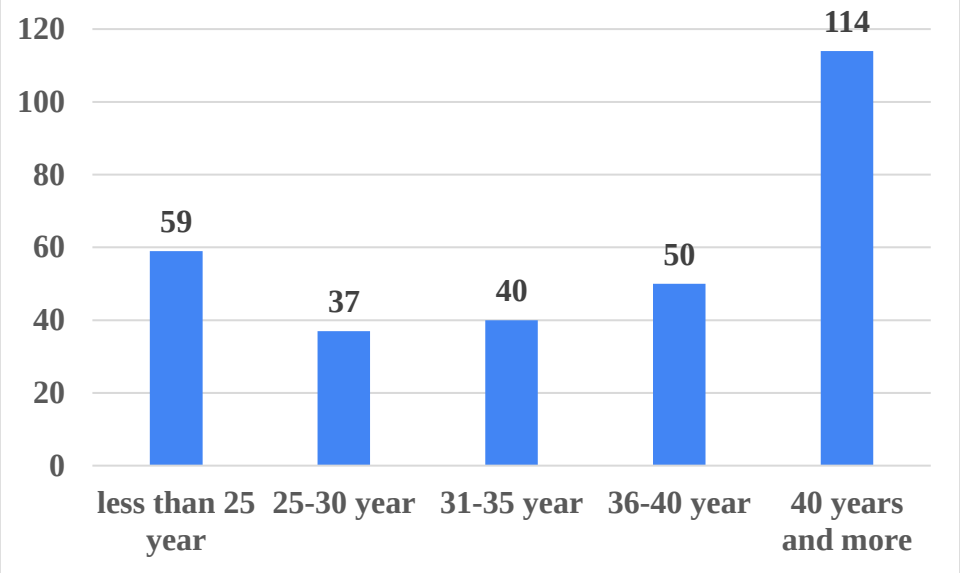

Figure 2: Age distribution among study participants

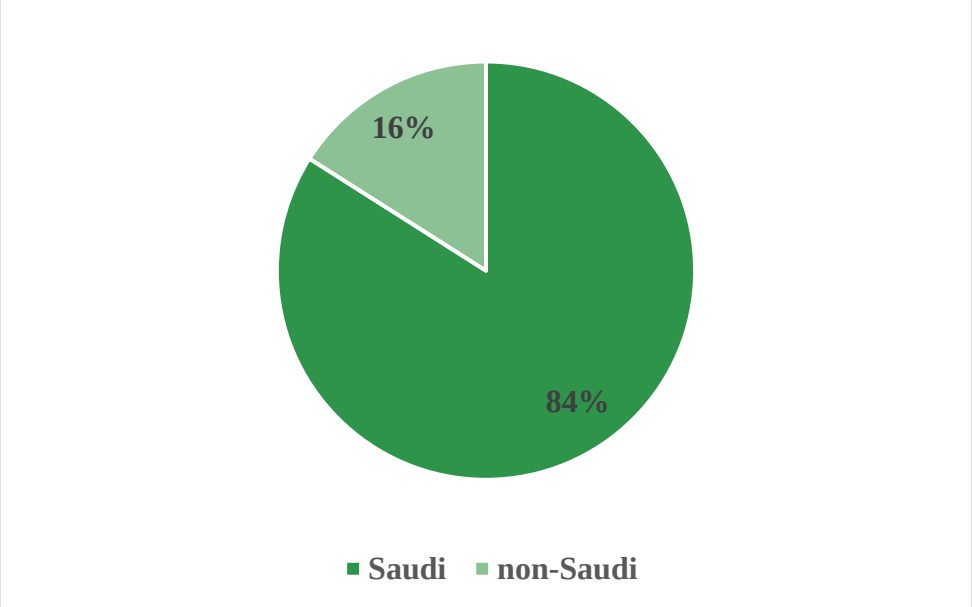

Figure 3: Nationality distribution among study participants

The most frequent educational level among them was university (n=204, 68%), followed by high school (n=48, 16%), and then others (n=28, 9.3%), intermediate school (n=15, 5%). Figure 4 shows the distribution of educational levels among study participants.

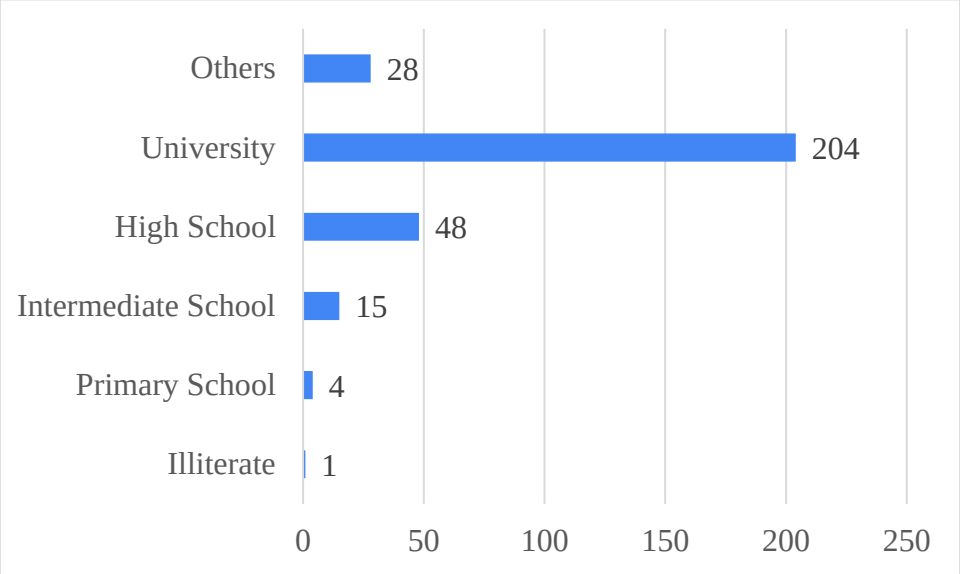

Figure 4: Educational level distribution among study participants

Participants were asked about their level of awareness of non-alcoholic fatty liver disease. Their responses and results are presented in Table 1.

Table 1: Awareness About NAFLD

what do you think of the following statement?	Agree	Disagree	I don't know
NAFLD is characterized by the accumulation of…	39 (13%)	163 (54.3%)	98 (32.7%)
Do you think NAFLD can only occur if it runs in the family?	241 (80.3%)	16 (5.3%)	43 (14.3%)
Do you think healthy eating habits can prevent NAFLD?	46 (15.3%)	86 (28.7%)	168 (56%)
People with low blood pressure are at higher risk of NAFLD.	101 (33.7%)	57 (19%)	142 (47.3%)
Diabetes is related to NAFLD	63 (21%)	106 (35.3%)	131 (43.7%)

Participants were asked about the diseases of fatty liver. The most frequent inflammation (n=224, 74.7%), followed by swelling (n=43, 14.3%), then injury (n=33, 11%). Figure 5 shows the fatty liver diseases of the participants.

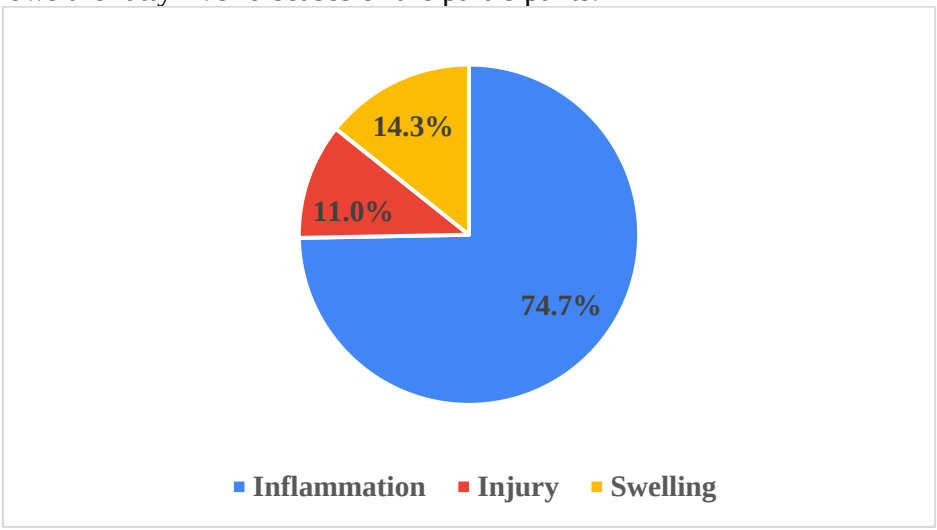

Figure 4: Educational level distribution among study participants

The source of information about the most common non-alcoholic fatty liver disease was never heard about it (n=117, 33.5%), health professional (n=71, (20.3%), social media (n=59,

16.9%), friend/relative (n=58, 16.6%), a previous study (n= 31(8.8%), and others (n=13, 3.7%). Figure 5 shows the source of information about non-alcoholic fatty liver disease distribution among study participants.

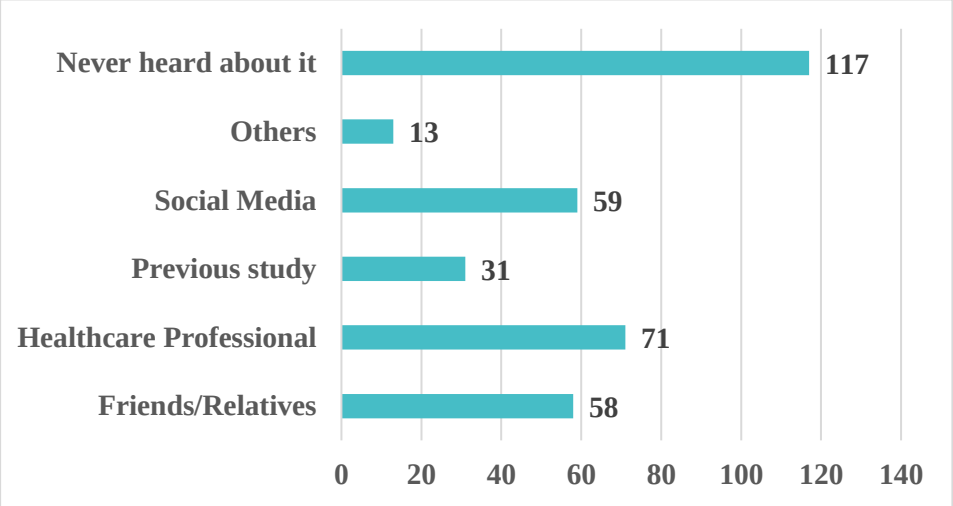

Figure 5: Source of information distribution among study participants

The participants asked about the causes of NAFLD. Their responses and results are presented in Table 2.

Table 2: NAFLD causes

item	Yes	No	I don't know
Do you think NAFLD can be prevented?	229 (76.3)	4 (1.3%)	67 (22.3%)
Do you think NAFLD can be cured?	216 (72%)	8 (2.7%)	76 (25.3%)
Can NAFLD be life-threatening?	181 (60.3%)	19 (6.3%)	100 (33.3%)

4. DISCUSSION

Microvesicular steatosis in at least 5% of liver cells is a characteristic of metabolic dysfunction-associated liver disease (MASLD), formerly known as non-alcoholic fatty liver disease (NAFLD), which occurs in cases when drugs or alcohol are not a factor. Among the diseases that fall under this umbrella are fibrosis, non-alcoholic fatty liver (NAFL), cirrhosis of the liver, and non-alcoholic steatohepatitis (NASH) [21]. Few details are known about NAFLD, despite the fact that it is a leading cause of chronic liver disease globally. Additionally, when people talk about the obesity epidemic in the United States, they often fail to include the consequences of cirrhosis [22]. No lobular inflammation, no steatosis—all individuals with steatosis are considered to have NAFL. Nevertheless, hepatocellular damage is another characteristic of NASH. Despite steatosis's reputation as a "benign" illness, the link it has with liver fibrosis increases the risk of cirrhosis and hepatic cell cancer. The several stages of NAFLD are shown in Figure 1 [23]. Worldwide, there are 47 new instances of NAFLD for every 1,000 people, with a greater frequency in men than in females. Males are more likely to have NAFLD (40%) than females (26%), contributing to the overall estimated incidence of 32% among adults worldwide [24].

References

1. Ahmed A, Wong RJ, Harrison SA. Nonalcoholic fatty liver disease review: diagnosis, treatment, and outcomes. Clin Gastroenterol Hepatol. 2015;13:2062-70.
2. Machado MV, Diehl AM. Pathogenesis of nonalcoholic steatohepatitis. Gastroenterology. 2016;150:1769-77.

3. Chitturi S, Farrell GC. Etiopathogenesis of nonalcoholic steatohepatitis. Semin Liver Dis. 2001;21:27-41.
4. Fromenty B, Pessayre D. Impaired mitochondrial function in microvesicular steatosis. Effects of drugs, ethanol, hormones and cytokines. J Hepatol. 1997;26:43-53.
5. Pouwels S, Sakran N, Graham Y, et al. Non-alcoholic fatty liver disease (NAFLD): a review of pathophysiology, clinical management and effects of weight loss. BMC Endocr Disord. 2022;22:63.
6. Dixon JB, Bhathal PS, O'Brien PE. Nonalcoholic fatty liver disease: predictors of nonalcoholic steatohepatitis and liver fibrosis in the severely obese. Gastroenterology. 2001;121:91-100.
7. Younossi ZM, Golabi P, Paik JM, Henry A, Van Dongen C, Henry L. The global epidemiology of nonalcoholic fatty liver disease (NAFLD) and nonalcoholic steatohepatitis (NASH): a systematic review. Hepatology. 2023;77:1335-47.
8. Paik JM, Golabi P, Younossi Y, Mishra A, Younossi ZM. Changes in the global burden of chronic liver diseases from 2012 to 2017: the growing impact of NAFLD. Hepatology. 2020;72:1605-16.
9. Estes C, Razavi H, Loomba R, Younossi Z, Sanyal AJ. Modeling the epidemic of nonalcoholic fatty liver disease demonstrates an exponential increase in burden of disease. Hepatology. 2018;67:123-33.
10. Wong RJ, Cheung R, Ahmed A. Nonalcoholic steatohepatitis is the most rapidly growing indication for liver transplantation in patients with hepatocellular carcinoma in the U.S. Hepatology. 2014;59:2188-95.
11. Lin X, Xu Y, Pan X, et al. Global, regional, and national burden and trend of diabetes in 195 countries and territories: an analysis from 1990 to 2025. Sci Rep. 2020;10:14790.
12. Golabi P, Otgonsuren M, de Avila L, Sayiner M, Rafiq N, Younossi ZM. Components of metabolic syndrome increase the risk of mortality in nonalcoholic fatty liver disease (NAFLD). Medicine (Baltimore). 2018;97.
13. Salem V, AlHusseini N, Abdul Razack HI, Naoum A, Sims OT, Alqahtani SA. Prevalence, risk factors, and interventions for obesity in Saudi Arabia: a systematic review. Obes Rev. 2022;23.
14. Alenezi YM, Harris R, Morling J, Card T. Prevalence of non-alcoholic fatty liver disease (NAFLD) in Saudi Arabia: systematic review and meta-analysis. Cureus. 2023;15.
15. Alqahtani SA, Paik JM, Biswas R, Arshad T, Henry L, Younossi ZM. Poor awareness of liver disease among adults with NAFLD in the United States. Hepatol Commun. 2021;5:1833-47.
16. Lazarus JV, Ekstedt M, Marchesini G, et al. A cross-sectional study of the public health response to non-alcoholic fatty liver disease in Europe. J Hepatol. 2020;72:14-24.
17. Cleveland ER, Ning H, Vos MB, et al. Low awareness of nonalcoholic fatty liver disease in a population-based cohort sample: the CARDIA study. J Gen Intern Med. 2019;34:2772-8.
18. Younossi ZM, Henry L, Bush H, Mishra A. Clinical and economic burden of nonalcoholic fatty liver disease and nonalcoholic steatohepatitis. Clin Liver Dis. 2018;22:1-10.
19. Alsubaie A, Mohammad S, Alqarni A, et al. Awareness of adult population toward non-alcoholic fatty liver disease in Riyadh, Saudi Arabia. Int J Dev Ctries. 2020;1938:44.
20. Ghevariya V, Sandar N, Patel K, Ghevariya N, Shah R, Aron J, Anand S. Knowing what's out there: awareness of non-alcoholic fatty liver disease. Front Med (Lausanne). 2014;1:4.
21. Maurice J, Manousou P. Non-alcoholic fatty liver disease. Clin Med. 2018;18:245–250.
22. Neuschwander-Tetri BA. Non-alcoholic fatty liver disease. BMC Med. 2017;15:45.
23. Guo X, Yin X, Liu Z, Wang J. Non-alcoholic fatty liver disease (NAFLD) pathogenesis and natural products for prevention and treatment. Int J Mol Sci. 2022;23:15489.

24. Teng ML, Ng CH, Huang DQ, et al. Global incidence and prevalence of nonalcoholic fatty liver disease. Clin Mol Hepatol. 2023;29:0–42.
25. Powell EE, Wong VW-S, Rinella M. Non-alcoholic fatty liver disease. Lancet. 2021;397:2212–2224.
26. Bambha K, Belt P, Abraham M, et al. Ethnicity and nonalcoholic fatty liver disease. Hepatology. 2012;55:769–780.
27. Younossi ZM, Koenig AB, Abdelatif D, Fazel Y, Henry L, Wymer M. Global epidemiology of nonalcoholic fatty liver disease - meta-analytic assessment of prevalence, incidence, and outcomes. Hepatology. 2016;64:73–84.
28. Sinn DH, Kang D, Chang Y, et al. Non-alcoholic fatty liver disease and progression of coronary artery calcium score: a retrospective cohort study. Gut. 2017;66:323–329.
29. Takaki A, Kawai D, Yamamoto K. Multiple hits, including oxidative stress, as pathogenesis and treatment target in non-alcoholic steatohepatitis (NASH). Int J Mol Sci. 2013;14:20704–20728.
30. Karkucinska-Wieckowska A, Simoes IC, Kalinowski P, et al. Mitochondria, oxidative stress and nonalcoholic fatty liver disease: a complex relationship. Eur J Clin Invest. 2022;52:0.
31. Nassir F. NAFLD: mechanisms, treatments, and biomarkers. Biomolecules. 2022;12:824.
32. Liu Q, Bengmark S, Qu S. The role of hepatic fat accumulation in pathogenesis of non-alcoholic fatty liver disease (NAFLD). Lipids Health Dis. 2010;9:42.
33. Tanase DM, Gosav EM, Costea CF, et al. The intricate relationship between type 2 diabetes mellitus (T2DM), insulin resistance (IR), and nonalcoholic fatty liver disease (NAFLD). J Diabetes Res. 2020;2020:3920196.
34. Basaranoglu M, Basaranoglu G, Sabuncu T, Sentürk H. Fructose as a key player in the development of fatty liver disease. World J Gastroenterol. 2013;19:1166–1172.
35. Chen Z, Tian R, She Z, Cai J, Li H. Role of oxidative stress in the pathogenesis of nonalcoholic fatty liver disease. Free Radic Biol Med. 2020;152:116–141.
36. Robertson G, Leclercq I, Farrell GC. Nonalcoholic steatosis and steatohepatitis. II. Cytochrome P-450 enzymes and oxidative stress. Am J Physiol Gastrointest Liver Physiol. 2001;281:0–9.
37. Pessayre D, Mansouri A, Fromenty B. Nonalcoholic steatosis and steatohepatitis. V. Mitochondrial dysfunction in steatohepatitis. Am J Physiol Gastrointest Liver Physiol. 2002;282:0–9.
38. Flamment M, Kammoun HL, Hainault I, Ferré P, Foufelle F. Endoplasmic reticulum stress: a new actor in the development of hepatic steatosis. Curr Opin Lipidol. 2010;21:239–246.
39. Gentile CL, Frye M, Pagliassotti MJ. Endoplasmic reticulum stress and the unfolded protein response in nonalcoholic fatty liver disease. Antioxid Redox Signal. 2011;15:505–521.
40. Hetz C, Chevet E, Harding HP. Targeting the unfolded protein response in disease. Nat Rev Drug Discov. 2013;12:703–719.
41. Engin AB. Obesity and lipotoxicity. Cham: Springer; 2017. What is lipotoxicity? pp. 197–220.
42. Branković M, Jovanović I, Dukić M, et al. Lipotoxicity as the leading cause of non-alcoholic steatohepatitis. Int J Mol Sci. 2022;23:5146.
43. Svegliati-Baroni G, Pierantonelli I, Torquato P, et al. Lipidomic biomarkers and mechanisms of lipotoxicity in non-alcoholic fatty liver disease. Free Radic Biol Med. 2019;144:293–309.
44. Ricchi M, Odoardi MR, Carulli L, et al. Differential effect of oleic and palmitic acid on lipid accumulation and apoptosis in cultured hepatocytes. J Gastroenterol Hepatol. 2009;24:830–840.
45. Musso G, Cassader M, Paschetta E, Gambino R. Bioactive lipid species and metabolic pathways in progression and resolution of nonalcoholic steatohepatitis. Gastroenterology. 2018;155:282–302.

46. Younossi ZM, Gramlich T, Liu YC, et al. Nonalcoholic fatty liver disease: assessment of variability in pathologic interpretations. Mod Pathol. 1998;11:560–565.
47. Mofrad P, Contos MJ, Haque M, et al. Clinical and histologic spectrum of nonalcoholic fatty liver disease associated with normal ALT values. Hepatology. 2003;37:1286–1292.
48. Wieckowska A, Feldstein AE. Diagnosis of nonalcoholic fatty liver disease: invasive versus noninvasive. Semin Liver Dis. 2008;28:386–395.
49. Ratziu V, Charlotte F, Heurtier A, et al. Sampling variability of liver biopsy in nonalcoholic fatty liver disease. Gastroenterology. 2005;128:1898–1906.
50. Cobbina E, Akhlaghi F. Non-alcoholic fatty liver disease (NAFLD) - pathogenesis, classification, and effect on drug metabolizing enzymes and transporters. Drug Metab Rev. 2017;49:197–211.
51. Matteoni C, Younossi Z, Gramlich T, Boparai N, Liu Y, Mccullough A. Nonalcoholic fatty liver disease: a spectrum of clinical and pathological severity. Gastroenterology. 1999;116:1413–1419.
52. Angulo P, Keach JC, Batts KP, Lindor KD. Independent predictors of liver fibrosis in patients with nonalcoholic steatohepatitis. Hepatology. 1999;30:1356–1362.
53. Brunt EM, Janney CG, Di Bisceglie AM, Neuschwander-Tetri BA, Bacon BR. Nonalcoholic steatohepatitis: a proposal for grading and staging the histological lesions. Am J Gastroenterol. 1999;94:2467–2474.
57. Kleiner DE, Brunt EM, Van Natta M, et al. Design and validation of a histological scoring system for nonalcoholic fatty liver disease. Hepatology. 2005;41:1313–1321.
55. Bedossa P, Poitou C, Veyrie N, et al. Histopathological algorithm and scoring system for evaluation of liver lesions in morbidly obese patients. Hepatology. 2012;56:1751–1759.
56. Harrison SA, Torgerson S, Hayashi PH. The natural history of nonalcoholic fatty liver disease: a clinical histopathological study. Am J Gastroenterol. 2003;98:2042–2047.
57. Chalasani N, Younossi Z, Lavine JE, et al. The diagnosis and management of nonalcoholic fatty liver disease: practice guidance from the American Association for the Study of Liver Diseases. Hepatology. 2018;67:328–357.
58. European Association for the Study of the Liver. EASL-EASD-EASO Clinical Practice Guidelines for the management of non-alcoholic fatty liver disease. J Hepatol. 2016;64:1388–1402.
59. Simon TG, Roelstraete B, Sharma R, Khalili H, Hagström H, Ludvigsson JF. Cancer risk in patients with biopsy-confirmed nonalcoholic fatty liver disease: a population-based cohort study. Hepatology. 2021;74:2410–2423.
60. Hagström H, Nasr P, Ekstedt M, et al. Fibrosis stage but not NASH predicts mortality and time to development of severe liver disease in biopsy-proven NAFLD. J Hepatol. 2017;67:1265–1273.
61. Dulai PS, Singh S, Patel J, et al. Increased risk of mortality by fibrosis stage in nonalcoholic fatty liver disease: systematic review and meta-analysis. Hepatology. 2017;65:1557–1565.
62. Sanyal AJ, Banas C, Sargeant C, et al. Similarities and differences in outcomes of cirrhosis due to nonalcoholic steatohepatitis and hepatitis C. Hepatology. 2006;43:682–689.
63. Lazo M, Hernaez R, Bonekamp S, et al. Non-alcoholic fatty liver disease and mortality among US adults: prospective cohort study. BMJ. 2011;343.
64. Mantovani A, Scorletti E, Mosca A, Alisi A, Byrne CD. Nonalcoholic fatty liver disease (NAFLD) and risk of incident extra-hepatic cancers: a systematic review and meta-analysis. Metabolism. 2020;111:154315.
65. Pais R, Giral P, Khan JF, et al. Fatty liver is an independent predictor of early carotid atherosclerosis. J Hepatol. 2016;65:95–102.
66. Spengler EK, Loomba R. Recommendations for diagnosis, referral for liver biopsy, and treatment of NAFLD and NASH. Mayo Clin Proc. 2015;90:1233–1246.

67. Hallsworth K, Adams LA. Lifestyle modification in NAFLD/NASH: facts and figures. JHEP Rep. 2019;1:468–479.
68. Koutoukidis DA, Astbury NM, Tudor KE, et al. Association of weight loss interventions with changes in biomarkers of nonalcoholic fatty liver disease: a systematic review and meta-analysis. JAMA Intern Med. 2019;179:1262–1271.
69. Alam S, Mustafa G, Alam M, Ahmad N. Effect of different therapeutic regimens on biochemical improvement of nonalcoholic fatty liver disease. J Clin Exp Hepatol. 2012;2:304–311.
70. Armstrong MJ, Gaunt P, Aithal GP, et al. Liraglutide safety and efficacy in patients with non-alcoholic steatohepatitis (LEAN): a multicentre, double-blind, randomised, placebo-controlled phase 2 study. Lancet. 2016;387:679–690.
71. Marchesini G, Brizi M, Morselli-Labate AM, et al. Association of nonalcoholic fatty liver disease with insulin resistance. Am J Med. 1999;107:450–455.
72. Promrat K, Longato L, Wands JR, de la Monte SM. Weight loss amelioration of non-alcoholic steatohepatitis (NASH) is associated with altered hepatic histological and molecular markers. Hepatol Int. 2011;5:673–679.
73. Dickins DS, Sacks D, Sacks GS, et al. Nutrition management in nonalcoholic fatty liver disease: an evidenced-based review. Nutr Clin Pract. 2021;36:737–751.
74. Abdulfattah AA, Elmakki EE, Maashi BI, Alfaifi BA, Almalki AS, Alhadi NA, Majrabi H, Kulaybi A, Salami A, Hakami FI. Awareness of Non-alcoholic Fatty Liver Disease and Its Determinants in Jazan, Saudi Arabia: A Cross-Sectional Study. Cureus. 2024 Jan;16(1).