



ISSN: 2230-9926

Available online at <http://www.journalijdr.com>

IJDR

International Journal of Development Research
Vol. 15, Issue, 09, pp. 68982-68987, September, 2025
<https://doi.org/10.37118/ijdr.29997.09.2025>



RESEARCH ARTICLE

OPEN ACCESS

MEDITERRANEAN DIET IN COMBATING HEPATIC ILLNESS: A REVIEW BASED ON GLOBAL PERSPECTIVES

*¹Deblina Chatterjee Basak and ²Titlee Majumder

¹Research Scholar, Swami Vivekananda University

²Assistant professor, Department of Medical Laboratory Technology, Techno India University

ARTICLE INFO

Article History:

Received 11th June, 2025
Received in revised form
27th July, 2025
Accepted 24th August, 2025
Published online 30th September, 2025

Key Words:

NAFLD*, NASH, Steatosis, Visceral fat content, Cirrhosis, Steatohepatitis, Mediterranean diet.

*Corresponding author:

Deblina Chatterjee Basak

ABSTRACT

Non-alcoholic fatty liver disease (NAFLD*) is the presentation of metabolic syndrome of liver issues or diseases. Apart from Alcoholic fatty liver syndrome NAFLD is expected to become the major cause of last-stage of hepatic illness globally. NAFLD is the primary culprit of different liver issues starting from Steatosis (deposition of fat in liver), steatohepatitis (NASH), and NASH Cirrhosis and cirrhosis complications. The load of disease connected to NAFLD is exceptionally high in the common population and the world-wide occurrence of liver steatosis is indeed around 25%. These figures are extremely vulnerable in the last few decades and also show a direct relationship with an increase in obesity and diabetes which establishes a strong correlation between them. Increased consumption of packaged and processed food has increased the prevalence of visceral fat which has clinically been proven to increase the hepatic fat content as well as overall lipid in the blood serum of the subject. Mediterranean diet is the dietary practice done by 16 plus countries surrounding the Mediterranean Sea having multiple aspects in managing health. It strongly supports restricting processed food and animal meat by growing tendencies of using grains, lentils, seeds, nuts, fish, dairy, eggs, vegetables, and fruits. The Mediterranean diet has been clinically proven to produce positive health outcomes in terms of cardiovascular health, Hb1Ac, and waist circumference in both genders. The following critical review aims to understand the positive correlation between Mediterranean diet and Non-alcoholic fatty liver disease in the population of West Bengal irrespective of gender in the middle-age group followed by improving quality of living in implementation of grain-based – low protein diet.

Copyright ©2025, Deblina Chatterjee Basak and Titlee Majumder. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Citation: Deblina Chatterjee Basak and Titlee Majumder. 2025. "Mediterranean diet in Combating Hepatic Illness: A Review based on Global Perspectives". *International Journal of Development Research*, 15, (09), 68982-68987.

INTRODUCTION

Fatty liver disease also referred as liver/hepatic steatosis and steatotic liver disease, is a condition where excess fat piles up in liver. Often there are no or few symptoms. Occasionally there will be pain in upper right side of the right abdomen. Complication can be liver steatosis to cirrhosis of liver-to-liver cancer. The main sub-division of fatty liver disease is ALD and NAFLD. For this above condition the primary cause is alcohol, sedentary lifestyle, obesity, type 2 diabetes. Other causes include certain medications like glucocorticoids. The occurrence of NAFLD has increased 10 times as per survey, taking a shape of epidemic in coming future. NAFLD covers the range of all kinds of fatty liver diseases starting from simple accumulation of fat that is called steatosis to non-alcoholic steatohepatitis (NASH), its major symptoms range from inflammation with markers of different intensity of fibrosis to cirrhosis and liver carcinoma. NAFLD is defined as an outcome of many chronic conditions in body and changing environmental conditions such as food habits and daily lifestyle, genetical factors, exercise. The gut flora has been seen to change with the above factors and create inflammation and other symptoms.

Additionally production of free radicals in the body leads to low grade inflammation in gut lining leading to several metabolic syndromes which gradually evolve to Non-alcoholic fatty liver disease (NAFLD). As per study done by EASL, EASD, EASO and their guidelines NAFLD can be managed to a greater extent with a lifestyle and dietary modification approaches.

A diet which is rich in polyphenols, antioxidants, Poly Unsaturated Fatty Acids (PUFA), both soluble and insoluble fibre limiting intake of refined flour and high sugar and sodium foods including processed foods which is the principle of Mediterranean diet can actually help in improving the condition. As per the study done and published in clinical nutrition eminent international journals, where it has been shown a positive relation between MD and NAFLD. A study was carried out among 73 people who were having their BMI in overweight to obese category, 34 out of them underwent biopsy study for liver, surprisingly a higher score of medi-diet has been seen. Again in 2015 a study was done to see the association between MD and liver histology among NAFLD patients. So the major aim of this study is to cross-check NAFLD and its outcome in subjects with Mediterranean diet as well as their insulin resistance, systolic diastolic pressure, BMI, waist circumference, lipid profile and body composition.

LITERATURE REVIEW

Circumstances claim a diet followed by olive growing countries that is Mediterranean diet is a therapy among Non-alcoholic fatty liver disease groups, as till date NAFLD is a malady without any determined treatment (1) Over the period outrages consumption of towering amount of processed and packaged food items and truncated intake of vegetable prioritising meals has led to degraded fatty acid plasma composition. (2) The MDP (Mediterranean diet pattern) has been received the honour of improving life expectancy with people having cardiovascular issues as per Ma-Martinez Gonzalez et.al in 2004 by improving the overall anthropometric markers (3). The Greece Government in 1948 took the first initiative to come up with an idea of dietary principle where the TEI (Total energy intake) of an individual adult is distributed as follows 61 percent from plant sources (cereals, pulses, nuts, vegetables and fruits), remaining 7 percent TEI from animal origin (meat, egg, fish and dairy products) and the cooking oil is olive oil (4). Gradually post this many scientists undertook research highlighting Mediterranean diet and role of the bioactive components presents in these food group and eventually in meals. NAFLD is a global epidemic leading to the array of related non communicable diseases to gulp the Asian population as per Ghevariya V Sandar N. Patel K, et. Al (2014) (5).

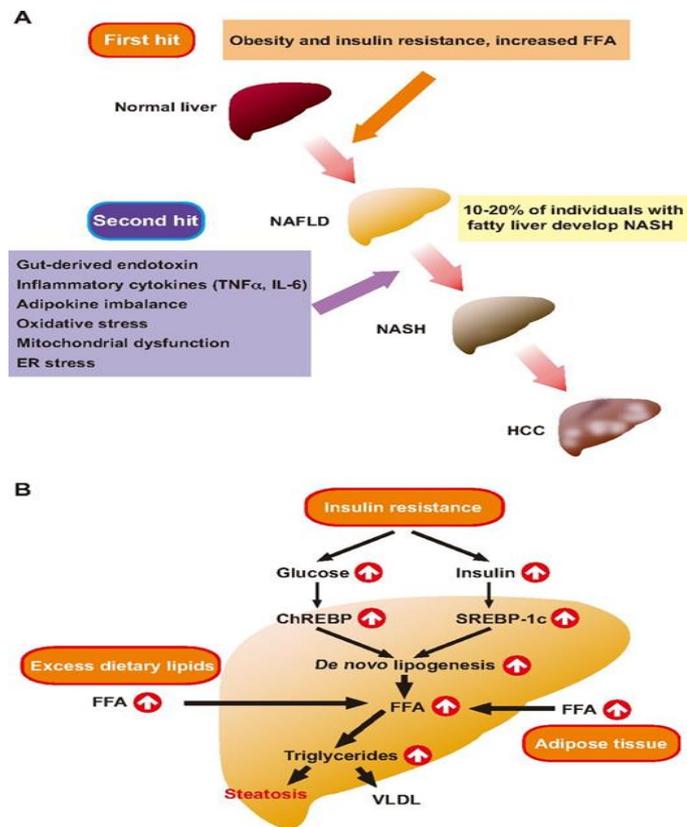


Fig. 1. Asaoka, Y., Terai, S., Sakaida, I., & Nishina, H. (2013). The expanding role of fish models in understanding non-alcoholic fatty liver disease. *Disease models & mechanisms*, 6(4), 905-914

The world wide prevalence of NAFLD is about twenty five percent ranging from thirteen percent in Africa to twenty three percent in Europe and thirty two percent in Middle East as per Younossi ZM, Koenig et.al. (2016) (6). However the overall number of patients with end stage liver disease caused by NAFLD is rapidly increasing, there was a one seventy percent increase in cases of NASH on the transplant waiting list in USA as per researches in last couple of years (7). NAFLD is most common liver disorder in United States as per Bambha K. Belt P.A Braham M et.al in his study of relationship between ethnicity and NAFLD. (8) In a prospective epidemiological study, seventy five percent of non-obese Bengali Indians with NAFLD were found to have a BMI above 25kg/m² as

per et.al in 2010 (9). It is therefore assumed a mass of South Asians may have undiagnosed early stages of NAFLD. (10) As per A. Arabet.al in 2019 it may be confirmed that, Non-alcoholic fatty liver disease by altering our routine lifestyle and eating or plating pattern in MED style. (11) Food groups and exchange list is one of the key factors in this aspect. In 2016 in an experiment K.Roy et.al have established role of phytochemicals present in MED food pyramid in relevance with improvement of biomarkers of steatohepatitis (12). Not only this in a study proved that this diet principle advocated more consumption of omega 3 fatty acid compared to saturated fatty acid in daily food plate leading to improving hypertension cases in subject (13). Non-alcoholic fatty liver disease referred as liver/hepatic steatosis and steatosis liver disease, is a condition where excess fat piles up in liver (14). Often there are no or few symptoms. Occasionally there will be pain in upper right side of the right abdomen. Complication can be liver steatosis to cirrhosis of liver-to-liver cancer (15). The main subdivision of fatty liver disease is ALD and NAFLD (16). For this above condition the primary cause is alcohol, sedentary lifestyle, obesity, type 2 diabetes. Other causes include certain medications like glucocorticoids (17). The occurrence of NAFLD has increased 10 times as per survey, taking a shape of epidemic in coming future (18).

NAFLD covers the range of all kinds of fatty liver diseases starting from simple accumulation of fat that is called steatosis to non-alcoholic steatohepatitis (NASH), its major symptoms range from inflammation with markers of different intensity of fibrosis to cirrhosis and liver carcinoma (19). NAFLD is defined as an outcome of many chronic conditions in body and changing environmental conditions such as food habits and daily lifestyle, genetical factors, exercise (20). The gut flora has been seen to change with the above factors and create inflammation and other symptoms (21). Additionally, production of free radicals in the body leads low grade inflammation in gut lining leading to several metabolic syndromes which gradually evolve to Non-alcoholic fatty liver disease (NAFLD) (22). As per study done by EASL EASD EASO and their guidelines NAFLD can be managed to a greater extent with a lifestyle and dietary modification approach (23).

Food Groups of Mediterranean diet and their phytochemical role in naflD: NAFLD is a blended outcome of vivid metabolic dysfunction majorly related to mal lifestyle and dietary practices in eastern population. As per the present situation a multitargeted strategy for therapeutic strategies as dietary intervention for NAFLD patients around the world is much needed (24). Till date many researches has advocated the positive correlation between Mediterranean diet pattern and the impact of different phytochemicals present in different food groups. Food groups are the classification of foods according to their role and function. Below the 8 food group classification has been discussed with phytochemicals we get from each group and their relevance in NAFLD (25).

Whole grains: The incidence of increase in body fat percentage eventually overall weight gain among population is growing worldwide. Obese condition is linked with increased rate of oxidation leading to oxidative stress and eventually activating inflammatory markers. (26) These leads to high concentration of lipids in blood leading to hyperlipidaemia, activation of proinflammatory cytokinin (TNF- α , IL-6 AND IL-BETA) and other transcriptional factor which in turn lead to the shower of metabolic diseases leading to Type 2 diabetes, Obesity, Cardiovascular disease, Asthama etc. Grains are the staple food food grown all over the country. These include rice, wheat, millets, kodo, maize, barley (27). When consumed in whole form with germ, endosperm and bran they serve as a one step solution for the presence of phytochemicals and meeting the daily requirement in our diet (28). Phenolic acids, vitamins, phytosterols, caretonoids, dietary fiber, lignans, ferulic acid are among some of them which comes with immense health benefits in metabolic dysfunction majorly NAFLD as established by Kategowdru Vijaykumar et. al in 2022 in the Journal of Food biochemistry (29).

Pulses: The cluster of extra glycerides called steatosis is known as the stamp mark for an imbalance between rates of hepatic fatty aciduptake, synthesis or export (30). Ethanol extracts of legumes are popular supplements due to their umbrella of phytochemical, especially talking about isoflavones and anthocyanins (31). In2020 Yen chu koh et.al established a positive corelation between pulses intake among high fat induced diet in the subjects. The not only come out improved weight management but also improved NAFLD markers (32).

Vegetables: Insulin resistance and inflammation are the most important hidden contributors in NAFLD progression (33). As per Zhang B et. Al dietary polyphenols help in glucose uptake by activating AMP activated protein kinase pathway eventually leading to improved energy outcome in insulin resistant subjects. Not only this but these molecules have a positive effect on obesity indices as well which in turn shapes the idea of healthy hepatic portal circulation. The presence of soluble and insoluble Fiber in vegetables helps in appetite management leading in the achievement of ideal BMI(34). Apart from this the presence of Alkaloids helps in preventing the adipose tissues to increase in size and managing liver steatosis in a better way (35).

effectively. The famous Spearman correlation analysis reveal strong links between intestinal flora, lipid metabolism and iron homeostasis mitigating that fruit extracts mitigated ALI via the gut microbiota liver-axis (38)

Fish: The growing manifestation of NAFLD worldwide with hyperlipidemia and increased cholesterol levels is getting an attention to segregate and analyze the animal sources of protein.Ina study of YouchiAshayoka et al he explained the benefits of small fish intake and improving liver health (40).

Egg: Source of amino acids and choline proves egg to be an essential part in NAFLD dietary management but due to its high cholesterol content the suggested daily intake needs to be titrated (42).In recent future the pharma cotreatment of NAFLD AND NASH from fish models utilising omega 3 fatty acid as per the experiment done in 2012 by Chalasani et.al (43)

Chicken/Meat: High consumption of red meat and processed meat is directly proportional to steato-hepatities.Consumption of meat cooked in unhealthy manner is related to insulin resistance as established by D Ivancovsky-wajcman et.al in 2022 (44).



Fig. 2. Marra, A., Manousakis, V., Zervas, G. P., Koutis, N., Finos, M. A., Adamantidi, T., ... & Tsoupras, A. (2024). Avocado and its by-products as natural sources of valuable anti-inflammatory and antioxidant bioactive for functional foods and cosmetics with health-promoting properties. *Applied Sciences*, 14(14), 5978 (39)

Table 1: Asaoka, Y., Terai, S., Sakaida, I., & Nishina, H. (2013). The expanding role of fish models in understanding non-alcoholic fatty liver disease. *Disease models & mechanisms*, 6(4), 905-914 (41)

Table 1. List of mutant fish models of liver disease						
Species	Mutant	Gene	Function	Liver phenotypes	Knockout mice	Reference
Zebrafish	foie gras	Trafficking protein particle complex 11 (trappc11)	ER-to-Golgi trafficking	Hepatic steatosis; nuclear degeneration of hepatocytes	Not characterized yet	Sadler et al., 2005
Medaka	nmk	ATP-binding cassette sub-family B member 7 (abc7)	Lipid and iron metabolism	Hepatic steatosis	Knockout mice die early in gestation	Miyake et al., 2008
Zebrafish	ducttrip	S-adenosyl-homocysteine hydrolase (ahcy)	Methionine metabolism	Hepatic steatosis; mitochondrial dysfunction; liver degeneration	Not characterized yet	Matthews et al., 2009
Zebrafish	hi559	CDP-diacylglycerol-inositol 3-phosphatidyltransferase (cdipt)	Phospholipid synthesis	Hepatic steatosis	Not characterized yet	Thakur et al., 2011
Zebrafish	hu1960, hu1968	Serine/threonine kinase 11 (stk11)	Phosphorylation of the nutritional sensor AMP-kinase	Fasting hepatic steatosis; glycogen depletion	Homozygous deletion mutants die at midgestation	van der Velden et al., 2011
Zebrafish	red moon	Solute carrier family 16a member 6a (slc16a6a)	β-hydroxybutyrate transporter	Fasting hepatic steatosis	Not characterized yet	Hugo et al., 2012
Zebrafish	st67	Sec63	ER translocon machinery	Disrupted bile canaliculi; accumulation of large lysosomes; hepatic steatosis	Tissue-specific homozygous mutations result in kidney and liver cyst formation	Monk et al., 2013

Fruits: Liver is an important digestive gland in the body. In today's age of packaged and processed foods we have put an extra pressure over the system leading to the damage of the organ in turn leading to another array of metabolic diseases (37). NAFLD is one of them which is growing as a serious health concern worldwide. However, daily recommended consumption of whole fruits and the presence of functional components in them can help to manage the condition

Seeds/Nuts/Oil: Modulation of dietary fat and its impact on intestinal microbiome is well-known. Preferred and customized as per population or subject need can help in preventing NAFLD progression. Flaxseeds are well known for their fatty acid composition and healing mechanism of hepatic damage (45). Walnuts, Almonds, sesame seeds, sunflower seeds, and safflower seeds have their unique fatty acid composition profile which helps to counteract

the progression of steatosis (46). In 2013 in an research conducted by Betha Conlon et.al the role of pufa,mufa and saturated fats has been depicted in relevance with NAFLD (47).Many researches are being done in getting the fact that a diet rich in vegetable sources with high omega3 content and limiting excess saturated fat in meals can counteract NAFLD in population irrespective of gender age and place.Systemic reviews were done according to Cochrane, the centre for Reviews and Dissemination and PRISMA guidelines.

DISCUSSION

Amino alanine transferase levels were remarkably reduced in a quasi-model dietary intervention of Mediterranean diet experiment, along with HOMA cystine levels and improvement of overall health as per Fraser et al 2008 (48).In2012 a comparative dietaryintervention trial was run by L. Bozzetto et al. Two groups were divided and one was fed with foods rich in unsaturated fatty acids and whole grains whereas second was containing more of simple carbohydrates (49). The former group showed better liver function activity after aperiod of six months. In 2013 Rayan et.al did a comparative study again among dietary intervention of Mediterranean diet with diet rich in fats and lower percentage ofcarbohydrate groups. They came up with results which proved the suitability of Mediterranean diet among subjects (50). The effectiveness of Mediterranean diet was established among nonalcoholic fatty liver patients by bright liver score in just a 6-month trial period among people over 50 years of age with BMI above 30 by Trovato et.al in 2015.A combined effect of sylbin-Vitamin E and phospholipid complex along with Mediterranean diet showed improvement amongoverweight patients as per studied conducted by Abena Voli, 2015 (51).According to the article published in world journal of Gastroenterogy in 2016, traditional Mediterranean diet including meals from all 8 food group exchanges in definite serving is proved to be helpful in managing non alcoholic fatty liver disease among obese. Italian groups (52). The HOMA IR values got significantly reduced with gross reduction of body fat percentage.In Greece in 2014 a comparative trial experiment was conducted by Kontogiani among 73 overweight non alcoholic fatty liver patients and 58 non-alcoholic fatty liver patients irrespective of their body weight with dietary intervention of Mediterranean diet (53).

Surprisingly both the groups showed less severity of the disease progression in both groups. In an Italian study conducted in 2016 by Trovato et.al has shown the improvement of non- alcoholic fatty liver disease markers and HOMA IR with an improvement in lifestyle and quality of diet that is by following diet rich in Mediterranean foods (54).In 2017 the study done by Baratta et.al has shown a positive relation among obese groups on consumption of Mediterranean diet by reducing risk of cardio vascular disorders and NAFLD (55). The strong bond between gut micro biota and NAFLD has been put forward byseveral studies, where the high fiber content of MD reduces Formicates andincreases Bacteriodetes,thus improving the microbial marking that enhances themuscle muss by lowering the fat content and different grades of obesity of differentgrade, inflammation and related metabolic alterations (56). Moreover, it's been wellproved in many researched papers the role of Bifidobacterium in reducing C reactiveproteins and plasma cholesterol (57). It has been researched and proved in manyjournals the clinical fat loss achieved by calorie restriction and leading to overallweight loss by restricting calories either including physical activity or not leading toimprovement in different and multiple NAFLD biomarkers including liver enzymes, NASH, liver fat and fibrosis (58). The subcategory NAFLD has two sub categories that isNAFL (Non Alcoholic Fatty Liver) and NASH (Non-alcoholic steatohepatitis). Halfwaythrough 2023, more than 200 experts in liver disease formalized their decision toreliable NAFLD to metabolic dysfunction associated steatotic liver disease. It isincreasing worldwide and expected to become number one cause of cirrhosis of liverand hepato-cellular carcinoma in coming 5 years (59). Presently there is no such provenpharmacologically treatment. Weight loss is the 1stline therapy in improving up to 10 percent hepatosteatois. To.

To achieve this wide clinically researched diet therapywith supplementation of super-food needs to be adapted with appropriate physicalactivity.

CONCLUSION

So far, we have come across that the various bioactive component of Mediterranean diet are useful in limiting the progression of the disease and healing process of liver but the findings are limited in supporting the fact that which food group needs to be consumed in how much amount and in what combination. Also, the data are limited in the cooking methodology of these food items and time of consumption.

Conflict of Authors: There is no conflict of interest to be declared by any of the authors.

REFERENCES

- Abenavoli, L., Greco, M., Milic, N., Accattato, F., Foti, D., Gulletta, E., & Luzzza, F. (2017). Effect of Mediterranean diet and antioxidant formulation in non-alcoholic fatty liver disease: a randomized study. *Nutrients*, 9(8), 870.
- Alami, F., Alizadeh, M., & Shateri, K. (2022). The effect of a fruit-rich diet on liver biomarkers, insulin resistance, and lipid profile in patients with non-alcoholic fatty liver disease: a randomized clinical trial. *Scandinavian journal of gastroenterology*, 57(10), 1238-1249.
- Aller, R., Izaola, O., de la Fuente, B., & de Luis, D. (2015). Mediterranean diet is associated with liver histology in patients with non alcoholic fatty liver disease. *Nutricionhospitalaria*, 32(6), 2518-2524.
- Anania, C., Perla, F. M., Olivero, F., Pacifico, L., & Chiesa, C. (2018). Mediterranean diet and nonalcoholic fatty liver disease. *World journal of gastroenterology*, 24(19), 2083.
- Angelico, F., Ferro, D., & Baratta, F. (2021). Is the mediterranean diet the best approach to NAFLD treatment today?. *Nutrients*, 13(3), 739.
- Arab, A., Hadi, A., Moosavian, S. P., Rafie, N., &Hajianfar, H. (2019). The effect of nutrition education program on overweight/obese patients with non-alcoholic fatty liver disease: a single-blind parallel randomized controlled trial. *Clinical nutrition research*, 8(3), 238.
- Asaoka, Y., Terai, S., Sakaida, I., & Nishina, H. (2013). The expanding role of fish models in understanding non-alcoholic fatty liver disease. *Disease models & mechanisms*, 6(4), 905-914.
- Asbaghi, O., Emamat, H., Kelishadi, M. R., &Hekmatdoost, A. (2020). The association between nuts intake and non-alcoholic fatty liver disease (NAFLD) risk: a case-control study. *Clinical nutrition research*, 9(3), 195.
- Bahrami, A., Teymooori, F., Eslamparast, T., Sohrab, G., Hejazi, E., Poustchi, H., &Hekmatdoost, A. (2019). Legume intake and risk of nonalcoholic fatty liver disease. *Indian Journal of Gastroenterology*, 38, 55-60.
- Bahrami, A., Teymooori, F., Eslamparast, T., Sohrab, G., Hejazi, E., Poustchi, H., &Hekmatdoost, A. (2019). Legume intake and risk of nonalcoholic fatty liver disease. *Indian Journal of Gastroenterology*, 38, 55-60.
- Bambha, K., Belt, P., Abraham, M., Wilson, L. A., Pabst, M., Ferrell, L., ... &Nonalcoholic Steatohepatitis Clinical Research Network Research Group. (2012). Ethnicity and nonalcoholic fatty liver disease. *Hepatology*, 55(3), 769-780.
- Baratta, F., Pastori, D., Polimeni, L., Bucci, T., Ceci, F., Calabrese, C., ... & Del Ben, M. (2017). Adherence to mediterranean diet and non-alcoholic fatty liver disease: effect on insulin resistance. *Official journal of the American College of Gastroenterology* | *ACG*, 112(12), 1832-1839.
- Baratta, F., Pastori, D., Polimeni, L., Bucci, T., Ceci, F., Calabrese, C., ... & Del Ben, M. (2017). Adherence to mediterranean diet and non-alcoholic fatty liver disease: effect on insulin

- resistance. *Official journal of the American College of Gastroenterology* | *ACG*, 112(12), 1832-1839.
- Barrea, L., Verde, L., Savastano, S., Colao, A., & Muscogiuri, G. (2023). Adherence to Mediterranean diet: any association with NAFLD?. *Antioxidants*, 12(7), 1318.
- Barrea, L., Verde, L., Savastano, S., Colao, A., & Muscogiuri, G. (2023). Adherence to Mediterranean diet: any association with NAFLD?. *Antioxidants*, 12(7), 1318.
- Bozzetto, L., Prinster, A., Annuzzi, G., Costagliola, L., Mangione, A., Vitelli, A., ... & Rivellese, A. A. (2012). Liver fat is reduced by an isoenergetic MUFA diet in a controlled randomized study in type 2 diabetic patients. *Diabetes care*, 35(7), 1429-1435.
- Brunt, E. M., Kleiner, D. E., Wilson, L. A., Unalp, A., Behling, C. E., Lavine, J. E., ... & NASH Clinical Research Network. (2009). Portal chronic inflammation in nonalcoholic fatty liver disease (NAFLD): a histologic marker of advanced NAFLD—clinicopathologic correlations from the nonalcoholic steatohepatitis clinical research network. *Hepatology*, 49(3), 809-820.
- Cardoso, B. R., Tan, S. Y., Daly, R. M., Dalla Via, J., Georgousopoulou, E. N., & George, E. S. (2021). Intake of nuts and seeds is associated with a lower prevalence of nonalcoholic fatty liver disease in US adults: findings from 2005–2018 NHANES. *The Journal of Nutrition*, 151(11), 3507-3515.
- Chan, R., Wong, V. W. S., Chu, W. C. W., Wong, G. L. H., Li, L. S., Leung, J., ... & Chan, H. L. Y. (2015). Diet-quality scores and prevalence of nonalcoholic fatty liver disease: a population study using proton-magnetic resonance spectroscopy. *PLoS one*, 10(9), e0139310.
- Chaturvedi, S., Tripathi, D., Vikram, N. K., Madhusudhan, K. S., Pandey, R. M., & Bhatia, N. (2024). Dietary pattern associated with non-alcoholic fatty liver disease (NAFLD) in non-diabetic adult patients: A case control study. *Clinical Nutrition ESPEN*, 60, 247-253.
- Chen, Q., Wang, T., Li, J., Wang, S., Qiu, F., Yu, H., ... & Wang, T. (2017). Effects of natural products on fructose-induced nonalcoholic fatty liver disease (NAFLD). *Nutrients*, 9(2), 96.
- Cicero, A. F., Ertek, S., & Borghi, C. (2009). Omega-3 polyunsaturated fatty acids: their potential role in blood pressure prevention and management. *Current vascular pharmacology*, 7(3), 330-337.
- Das, M., Biswas, A., Goswami, S., Deb, R., Das, S., & Ray, D. (2024). Association of the rs738409 polymorphism in PNPLA3 with development and severity of non-alcoholic fatty liver disease in ethnic Bengali population of West Bengal. *medRxiv*, 2024-09.
- Dorosti, M., Heidarloo, A. J., Bakhshimoghaddam, F., & Alizadeh, M. (2020). Whole-grain consumption and its effects on hepatic steatosis and liver enzymes in patients with non-alcoholic fatty liver disease: a randomised controlled clinical trial. *British Journal of Nutrition*, 123(3), 328-336.
- Emamat, H., Farhadnejad, H., Tangestani, H., SanceiTotmaj, A., Poustchi, H., & Hekmatdoost, A. (2020). Association of allium vegetables intake and non-alcoholic fatty liver disease risk: a case-control study. *Nutrition & Food Science*, 50(6), 1075-1083.
- Fraser, D., Bilenko, N., Vardy, H., Abu-Saad, K., Shai, I., Abu-Shareb, H., & Shahar, D. R. (2008). Differences in food intake and disparity in obesity rates between adult Jews and Bedouins in southern Israel. *Ethnicity & disease*, 18(1), 13-18.
- Friedman, S. L., Neuschwander-Tetri, B. A., Rinella, M., & Sanyal, A. J. (2018). Mechanisms of NAFLD development and therapeutic strategies. *Nature medicine*, 24(7), 908-922.
- Gelli, C., Tarocchi, M., Abenavoli, L., Di Renzo, L., Galli, A., & De Lorenzo, A. (2017). Effect of a counseling-supported treatment with the Mediterranean diet and physical activity on the severity of the non-alcoholic fatty liver disease. *World journal of gastroenterology*, 23(17), 3150.
- George, J., Anstee, Q., Ratziu, V., & Sanyal, A. (2018). NAFLD: The evolving landscape. *Journal of Hepatology*, 68(2), 227-229.
- Georgoulis, M., Kontogianni, M. D., Tileli, N., Margariti, A., Fragopoulou, E., Tiniakos, D., ... & Papatheodoridis, G. (2014). The impact of cereal grain consumption on the development and severity of non-alcoholic fatty liver disease. *European journal of nutrition*, 53, 1727-1735.
- Guo, F., Chen, D., Tsao, R., Shahidi, F., Xiong, H., Zhang, H., ... & Sun, Y. (2024). Effects of dietary supplementation with green lentil (*Lens culinaris*) hulls on NAFLD: Focus on intestinal and hepatic metabolism. *Food Bioscience*, 59, 103851.
- Haigh, L., Kirk, C., El Gendy, K., Gallacher, J., Errington, L., Mathers, J. C., & Anstee, Q. M. (2022). The effectiveness and acceptability of Mediterranean diet and calorie restriction in non-alcoholic fatty liver disease (NAFLD): A systematic review and meta-analysis. *Clinical Nutrition*, 41(9), 1913-1931.
- Hassapidou, M., Fotiadou, E., Maglara, E., & Papadopoulou, S. K. (2006). Energy intake, diet composition, energy expenditure, and body fatness of adolescents in northern Greece. *Obesity*, 14(5), 855-862.
- He, K., Guo, L. L., Tang, H., Peng, X., Li, J., Feng, S., ... & Tang, S. (2022). A freshwater fish-based diet alleviates liver steatosis by modulating gut microbiota and metabolites: a clinical randomized controlled trial in Chinese participants with nonalcoholic fatty liver disease. *Official journal of the American College of Gastroenterology* | *ACG*, 117(10), 1621-1631.
- Kontogianni, M. D., Tileli, N., Margariti, A., Georgoulis, M., Deutsch, M., Tiniakos, D., ... & Papatheodoridis, G. (2014). Adherence to the Mediterranean diet is associated with the severity of non-alcoholic fatty liver disease. *Clinical Nutrition*, 33(4), 678-683.
- Li, H., Wang, X., Ye, M., Zhang, S., Zhang, Q., Meng, G., ... & Niu, K. (2021). Does a high intake of green leafy vegetables protect from NAFLD? Evidence from a large population study. *Nutrition, Metabolism and Cardiovascular Diseases*, 31(6), 1691-1701.
- Liu, C., Liu, Y., Liu, J., Liu, J., Lu, T., Yu, J., ... & Xu, K. (2025). Liu, C., Liu, Y., Liu, J., Liu, J., Lu, T., Yu, J., ... & Xu, K. (2025). Associations between intake of different types of vegetables and metabolic dysfunction-associated fatty liver disease: a population-based study. *BMC Public Health*, 25(1), 315. *BMC Public Health*, 25(1), 315.
- Makovicky, P., Dudova, M., Tumova, E., Rajmon, R., & Vodkova, Z. (2011). Experimental study of non-alcoholic fatty liver disease (NAFLD) on a model of starving chickens: is generalization of steatosis accompanied by fibrosis of the liver tissue?. *Pathology-Research and Practice*, 207(3), 151-155.
- Martínez-González, M. A., & Bastarrika, G. (2020). Mediterranean diet as the ideal model for preventing non-alcoholic fatty liver disease (NAFLD). *Hepatobiliary Surgery and Nutrition*, 9(3), 379.
- Martínez-González, M. A., Corella, D., Salas-Salvadó, J., Ros, E., Covas, M. I., Fiol, M., & Estruch, R. (2012). Cohort profile: design and methods of the PREDIMED study. *International journal of epidemiology*, 41(2), 377-385.
- Mazidi, M., Mikhailidis, D. P., & Banach, M. (2020). Adverse impact of egg consumption on fatty liver is partially explained by cardiometabolic risk factors: A population-based study. *Clinical Nutrition*, 39(12), 3730-3735.
- Misciagna, G., Del Pilar Díaz, M., Caramia, D. V., Bonfiglio, C., Franco, I., Noviello, M. R., ... & Osella, A. R. (2017). Effect of a low glycemic index Mediterranean diet on non-alcoholic fatty liver disease. A randomized controlled clinical trial. *The Journal of nutrition, health and aging*, 21(4), 404-412.
- Montemayor, S., Mascaró, C. M., Ugarriza, L., Casares, M., Llompart, I., Abete, I., ... & Bouzas, C. (2022). Adherence to mediterranean diet and NAFLD in patients with metabolic syndrome: the FLIPAN study. *Nutrients*, 14(15), 3186.
- Pais, R., Barritt 4th, A. S., Calmus, Y., Scatton, O., Runge, T., Lebray, P., ... & Conti, F. (2016). NAFLD and liver transplantation: current burden and expected challenges. *Journal of hepatology*, 65(6), 1245-1257.
- Plaz Torres, M. C., Aghemo, A., Lleo, A., Bodini, G., Furnari, M., Marabotto, E., ... & Giannini, E. G. (2019). Mediterranean diet and NAFLD: what we know and questions that still need to be answered. *Nutrients*, 11(12), 2971.
- Plaz Torres, M. C., Aghemo, A., Lleo, A., Bodini, G., Furnari, M., Marabotto, E., ... & Giannini, E. G. (2019). Mediterranean diet

- and NAFLD: what we know and questions that still need to be answered. *Nutrients*, 11(12), 2971.
- Ross, A. B., Godin, J. P., Minehira, K., & Kirwan, J. P. (2013). Increasing whole grain intake as part of prevention and treatment of nonalcoholic Fatty liver disease. *International journal of endocrinology*, 2013(1), 585876.
- Roy, K. (2016). *Prevalence of Non-alcoholic Fatty Liver Disease (NAFLD) in Association with Cardio-metabolic Risk Factors in Patients with Type 2 Diabetes Mellitus and the Impact of Lifestyle Modification Therapy in the Management of NAFLD and the Role of Tinospora cordifolia in the Management of Diabetic Dyslipide* (Doctoral dissertation, Maharaja Sayajirao University of Baroda (India)).
- Roy, K. (2016). *Prevalence of Non-alcoholic Fatty Liver Disease (NAFLD) in Association with Cardio-metabolic Risk Factors in Patients with Type 2 Diabetes Mellitus and the Impact of Lifestyle Modification Therapy in the Management of NAFLD and the Role of Tinospora cordifolia in the Management of Diabetic Dyslipide* (Doctoral dissertation, Maharaja Sayajirao University of Baroda (India)).
- Ryan, M. C., Itsiopoulos, C., Thodis, T., Ward, G., Trost, N., Hofferberth, S., ... & Wilson, A. M. (2013). The Mediterranean diet improves hepatic steatosis and insulin sensitivity in individuals with non-alcoholic fatty liver disease. *Journal of hepatology*, 59(1), 138-143.
- Shi, X., Xiong, X., Li, S., Zhao, H., Song, H., Wang, J., ... & Wu, N. (2024). A systematic review and meta-analysis of randomized controlled trials: effects of mediterranean diet and low-fat diet on liver enzymes and liver fat content of NAFLD. *Food & Function*.
- Trovato, F. M., Martines, G. F., Brischetto, D., Trovato, G., & Catalano, D. (2016). Neglected features of lifestyle: Their relevance in non-alcoholic fatty liver disease. *World journal of hepatology*, 8(33), 1459.
- Trovato, F. M., Martines, G. F., Brischetto, D., Trovato, G., & Catalano, D. (2016). Neglected features of lifestyle: Their relevance in non-alcoholic fatty liver disease. *World journal of hepatology*, 8(33), 1459.
- Vancells Lujan, P., Vinas Esmel, E., & Sacanella Meseguer, E. (2021). Overview of non-alcoholic fatty liver disease (NAFLD) and the role of sugary food consumption and other dietary components in its development. *Nutrients*, 13(5), 1442.
- Wang, R., Yan, R., Jiao, J., Li, F., Zhang, H., Chang, Z., ... & Li, J. (2024). Fruit and vegetable intake and the risk of non-alcoholic fatty liver disease: a meta-analysis of observational studies. *Frontiers in Nutrition*, 11, 1398184.
- Wu, Q., Tang, H., & Wang, H. (2019). The anti-oxidation and mechanism of essential oil of *Paederia scandens* in the NAFLD model of chicken. *Animals*, 9(10), 850.
- Yin, M., Chen, S., Sun, Y., Feng, B., Lan, Y., Wu, S., & Wang, L. (2023). Egg consumption and non-alcoholic fatty liver disease: a prospective cohort study. *Wei Sheng yan jiu= Journal of Hygiene Research*, 52(3), 362-368.
- Younossi, Z., Anstee, Q. M., Marietti, M., Hardy, T., Henry, L., Eslam, M., ... & Bugianesi, E. (2018). Global burden of NAFLD and NASH: trends, predictions, risk factors and prevention. *Nature reviews Gastroenterology & hepatology*, 15(1), 11-20.
- Zhang, Y., Sui, J., Xu, Y., Pan, L., Xia, H., & Sun, G. (2024). Effect of whole grain and fiber consumption on chronic liver diseases: a systematic review and meta-analysis. *Food & Function*.
