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REVIEW ARTICLE

Ayurvedic Strategies for Managing Non-alcoholic Fatty Liver Disease: A Holistic Approach

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ABSTRACT

Metabolic disorders are now widespread even among seemingly healthy individuals. Non-alcoholic fatty liver disease (NAFLD) is one of them, NAFLD is a spectrum of liver disorders characterized by excessive fat accumulation in the liver, unrelated to alcohol consumption. It can progress from simple steatosis to non-alcoholic steatohepatitis, potentially leading to cirrhosis. NAFLD is closely linked to metabolic syndrome, obesity, and insulin resistance. NAFLD doesn't directly align with any single *Yakrit vikara* (liver disorder) described in Ayurvedic classical texts. However, it may share characteristics with the conditions of *Medoroga* (obesity) and *Yakrit Roga* (liver disorders), where improper diet and lifestyle lead to an imbalance in the Doshas. This imbalance results in impaired digestion and the accumulation of Ama, contributing to fat deposition in the liver. Ayurvedic Management of NAFLD offers a comprehensive strategy by focusing on improving liver functions, reducing oxidative stress, and boosting metabolism. Treatment of NAFLD involves a combination of dietary modifications, lifestyle changes, *Samshodhana karma,* and Ayurvedic formulations.

1. INTRODUCTION

The liver, the largest gland in the human body, performs a pivotal function in the biotransformation and elimination of toxic substances. It is the most common site for the accumulation of fat because it is a key organ involving in fat metabolism. Depending upon the cause and amount of accumulation, fatty change may be mild and reversible, or severe producing irreversible cell injury and cell death.[1] Disturbances of lipid metabolism in the liver due to various etiological factors lead to fatty liver. It is a reversible condition where in large amount of fat accumulates in liver cells through the process of steatosis. Fatty liver occurs when fat exceeds 5% of liver weight or is present in over 30% of liver cells in a lobule.[2]

The estimated global prevalence of non-alcoholic fatty liver disease (NAFLD) among adults is 32% and is higher among males (40%) compared to females (26%), making it the most widespread chronic liver condition.[3] Prevalence in the general population in India, as assessed by ultrasonography, varies from 9% to 53%, with lower rates in rural areas.[4] This prevalence increases significantly in high-risk groups, such as those with obesity or diabetes, reaching over 50%. Global prevalence varies, with rates highest in the Middle East and lowest in Africa. NAFLD can advance to non-alcoholic steatohepatitis (NASH), which may cause cirrhosis or liver cancer and is projected to become the leading cause of liver transplants by 2025.[5]

NAFLD corresponds to the presence of macro-vesicular changes without inflammation (steatosis) and lobular inflammation in the absence of significant alcohol use. It can be divided into two subgroups: Non-alcoholic fatty liver (NAFL) or simply steatosis and NASH. NAFL is defined as the presence of hepatic steatosis with no evidence of hepatocellular injury in the form of ballooning of the hepatocytes.[6] NASH is defined as the presence of hepatic steatosis and inflammation with hepatocyte injury (ballooning), Mallory hyaline, and mixed lymphocytic and neutrophilic inflammatory infiltrate in perivenular areas with or without fibrosis. It is important to note that NAFL is a spectrum, with NAFL being the mildest form and NASH and cirrhosis being at the other end of the spectrum.[7] In Ayurveda, there is no single condition or disease that exactly shows similarity with NAFLD, while observing the Nidana (etiology), *Samprapti* (pathogenesis) Lakshana (clinical features) puts this disease entity nearer to *Yakrita vikara*.[8]

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2. ETIOLOGY

The etiology of fatty liver mainly falls under two categories; the first category comprises the conditions with excess fat, which imparts increased workload to the liver for metabolizing fat (obesity, diabetes mellitus, and hyperlipidemia). The second category involves conditions of liver cell damage in which fat cannot be metabolized due to liver cell injury.[9,10] NAFLD is caused by metabolic syndrome (obesity, insulin resistance, type 2 diabetes, dyslipidemia), genetic predispositions (PNPLA3, TM6SF2), poor diet (high in fructose, saturated/trans fats), sedentary lifestyle, and gut microbiota changes. Hormonal factors, such as PCOS, hypothyroidism, and sleep apnea, and certain medications, such as corticosteroids and tamoxifen also contribute to its development.[11-13] The etiology of NAFLD is denoted in Figure 1.

3. PATHOLOGY

NAFLD is characterized by the accumulation of fat in the liver due to metabolic imbalances rather than alcohol consumption. The primary pathophysiological mechanism involves insulin resistance, which increases free fatty acid (FFA) flux to the liver, leading to fat accumulation. This hepatic steatosis triggers oxidative stress and inflammation, resulting in the production of reactive oxygen species (ROS) and pro-inflammatory cytokines. These processes cause hepatocyte injury and promote lipotoxicity, further exacerbating liver damage. In addition, genetic and environmental factors, gut-liver axis disturbances, and dysregulated lipid metabolism contribute to the progression of NAFLD, which can advance to NASH when inflammation and fibrosis occur.[14,15]

The hypothesis of *Medaja Yakrit Roga* suggests that people with *Kaphaja Prakriti* are more likely to eat fat-rich diet, which can result in obesity (*Sthaulya*), because of both hereditary and epigenetic reasons.[16] This condition, coupled with fatty dietary habits (Snigdha Ahara) and physical inactivity, increases blood lipids (*Abadha Meda*), initially disturbing the digestive fire (*Kayagni*) and subsequently altering fat metabolism (*Medagni Vaisyamya*). This dysfunction produces more FFAs and weakens *Medagni,* affecting tissue metabolism (*Dhatwagni*). The imbalance of all three Doshas localizes in the liver, making *Yakrit Vikara Tridoshaja*, with an increase in Snigdha Guna and a decrease in Ushna Guna, which enhances predominantly vitiated Kapha dosha within the liver.[17]

4. DIAGNOSTIC METHODS

NAFLD is often asymptomatic and commonly diagnosed incidentally when investigating other conditions. Mainly, there are three types of investigations as following.

4.1. Non-Invasive Imaging Techniques

Ultrasound is used to detect hepatic steatosis when the fat content is >30%, (magnetic resonance imaging), provides a more accurate quantification of liver fat, (computed tomography) and Transient Elastography (Fibro Scan) is used to assess liver stiffness and controlled attenuation parameter can be used to quantify steatosis.[18-20]

4.2. Blood Tests and Biomarkers

Liver function tests elevated may indicate liver damage, elevated lipid profile, fasting glucose, HbA1c, and insulin levels. NAFLD fibrosis score and fibrosis-4 (FIB-4) index can be used to assess liver fibrosis.[21]

4.3. Histology

Liver biopsy is considered as the gold standard for diagnosing NAFLD and differentiating NASH from simple steatosis. It assesses the degree of steatosis, inflammation, ballooning, and fibrosis.[22]

5. AYURVEDIC MANAGEMENT STRATEGIES

NAFLD is a multifactorial disease, so the management of NAFLD always remained a quest for physicians all over the world. The following are the different therapeutic modalities that can be used as in the management of NAFLD.

1. *Nidana Parivarjana* (avoiding causative factor) is one of the strategies of prevention and cure for all diseases.[23] Sneha (Fatty diet) is responsible for fatty infiltration of the liver, therefore low fat diet is recommended which can prevent further progress of NAFLD.[24]
2. *Sanshaman Chikitsa* – Manda Agni is a significant factor in the accumulation of Meda (fat), so the *paachana* and *deepana* drugs should be used. The treatment for *Medaja Yakrit Vikara* involves utilizing Meda and *Kaphahara Dravyas*. In addition, employing *Srotoshodhaka* (cleansing agents) and *Pramathi Dravyas* (metabolic stimulants) can further support effective management and treatment.[16]

6. IMPORTANT AYURVEDIC DRUGS USED IN THE TREATMENT OF NAFLD

- *Kutki* (*Picrorhiza kurroa*), It contains bioactive compounds, such as *kutkin*, *picroside I,* and *picroside II,* which support liver health by promoting detoxification and antioxidant defenses.[25,26] *Kutkins* alters liver cell membranes to block toxin entry, stimulate nucleolar polymerase A, enhance ribosomal protein synthesis, and boost liver regeneration by promoting the formation of new hepatocytes.[27] Shetty *et al.* conducted an animal study using male Wistar rats, where a 30% high-fat butter-based diet was administered for 2 weeks to induce NAFLD, followed by treatment with hydroalcoholic extract of *Kutaki* to evaluate its effects on fatty liver changes. Lee *et al.* conducted an animal study where hyperlipidemia was induced in mice with a high-fat diet, followed by 12 weeks of oral *Kutaki* water extract at 50, 100, and 200 mg/kg, resulting in significant reductions in SGOT, SGPT, serum lipid levels, and liver weight, highlighting *Kutaki's* hypolipidemic effect.[28]
- *Bhumyamalaki* (*Phyllanthus urinaria*), rich in compounds, such as phyllanthin and hypophyllanthin, its extract metabolites alleviate oxidative stress and inflammatory responses, benefiting liver conditions such as fatty liver, viral hepatitis, and fibrosis.[25,26] Similarly, a 50% methanol extract of *Phyllanthus niruri* L. exhibited hepatoprotective effects in rats with NAFLD by reducing visceral fat, normalizing liver enzymes, and minimizing hepatic lipid peroxidation and fat accumulation.[29,30]
- *Punarnava* (*Boerhavia diffusa*), containing alkaloids, flavonoids, and glycosides, is valued for its hepatoprotective properties. It helps reduce serum liver enzyme levels, neutralizes free radicals, and lowers oxidative stress, supporting liver health and resilience against damage.[31] Devaki *et al.* investigated the ethanolic extract of Boerhavia diffusa (150 mg/kg/day, 30 days, oral) in rats with ethanol-induced liver injury. The extract reduced lipid peroxides and enhanced superoxide dismutase, catalase, glutathione

peroxidase, glutathione-S-transferase, and reduced glutathione levels.[32]

- *Haridra* (*Curcuma longa*), is rich in curcumin, and is beneficial for maintaining liver health and preventing oxidative stress-related damage Several studies suggest that curcumin exhibits cholesterol-lowering effects similar to statins like lovastatin by inhibiting HMG-CoA reductase, thereby reducing liver cholesterol biosynthesis.[33] It also enhances lipid clearance by upregulating LDL receptors (LDLr) in the liver and HepG2 cells, promoting cholesterol removal, bile production, and fecal excretion, contributing to its cholesterol-lowering and anti-atherosclerotic effects.[34] Another study on mice demonstrated that turmeric extract prevents triacylglycerol deposition in the liver by inhibiting membrane phospholipid peroxidation and enhancing liver lipid metabolism.[35]
- *Rohitaka* (*Tecoma undulate*), containing betulinic acid, semiglabrin, pongamole, and lanceolatins A and B, offers hepatoprotective, antioxidant, and anti-inflammatory effects. These compounds help support liver health, reduce inflammation, and protect against oxidative stress-related damage.
- *Sharapnkha* (*Tephrosia purpurea*) active compounds, such as flavonoids and glycosides show hepatoprotective effects, Flavonoids in Tephrosia purpurea possess potent antioxidant properties, effectively neutralizing ROSs (free radicals) responsible for oxidative stress in liver tissues. By scavenging these free radicals, flavonoids minimize lipid peroxidation, protect hepatocytes from damage, and preserve liver cell integrity.
- *Kalmegh* (Andrographis paniculata) contains potent compounds, including andrographolide, neo andrographolide, 14-deoxyandrographolide, and 14-deoxy-11,12-didehydroandrographolide, which demonstrate hepato stimulant and hepatoprotective effects. According to Lin *et al.* (2018), andrographolide alleviates liver inflammation and fibrosis in hepatic stellate cells by inhibiting the TLR4/nuclear factor kappa B and transforming growth factor-β/Smad2 signaling pathways.[36] Similarly, Liu *et al.* (2020) reported that 14-deoxy-11,12-didehydroandrographolide partially improves steatohepatitis, liver fibrosis, and liver injury in fatty liver disease induced by a high-fat, high-cholesterol diet.[37] Andrographis paniculata may help treat metabolic dysfunction-associated fatty liver disease (MAFLD) by regulating lipid metabolism, improving insulin resistance, reducing gluconeogenesis, and decreasing lipid peroxidation.[38,39]
- *Daruharidra* (*Berberis aristata*) with berberine offers antioxidant and anti-inflammatory benefits, potentially aiding fatty liver and obesity by reducing oxidative stress, improving liver function, in an high fat diet (HFD)-induced NAFLD rat model, Chang *et al.* found that increased DNA methylation in the microsomal triglyceride transfer protein (MTTP) promoter reduced MTTP expression. BBR treatment reversed this methylation, restoring MTTP expression, enhancing VLDL assembly, and alleviating fatty liver. Another study BBR has been shown to reduce liver necrosis both in nonalcoholic steatosis and in steatosis due to hepatitis C infection.[40]
- *Patola Katurohinyadi Kashaya* contains Patola (flavonoids, alkaloids) for liver detoxification, Katurohini (picroside-I, picroside-II) to enhance bile secretion and reduce fat accumulation, Guduchi (tinosporin, berberine) for anti-inflammatory and lipid-lowering effects, Neem (nimbin, azadirachtin) to prevent oxidative liver damage and Daruharidra (berberine) activates AMP-activated protein kinase (AMPK), reducing hepatic fat accumulation, improving lipid metabolism, and enhancing glucose regulation in liver cells.[41] Several studies have reported the hepatoprotective effects of Patola Katurohinyadi Kashaya, making it effective in the treatment of liver disorders.[42]
- *Phalatrikadi Kashaya* is an Ayurvedic formulation beneficial for hepatic steatosis due to its hepatoprotective, lipid-lowering, and detoxifying properties. *Triphala* protects hepatocytes from oxidative stress,[43] *Guduchi a*ids regeneration and reduces inflammation[44] and *Kutki* promotes bile secretion[45] Nimba regulates lipid metabolism[46] Vasa improves circulation[47] and *Kirata-Tikta* enhances detoxification while reducing fat accumulation[48] These herbs exhibit *Lekhaniya* (fat-scraping) and *Medohara* (fat-reducing) actions, improving lipid metabolism, reducing hepatic fat deposition, and supporting overall liver function, making it effective in managing fatty liver conditions.[49]
- *Panchakola Churna* It serves as a digestive aid, carminative, and appetite stimulant, commonly used to correct metabolic imbalances (*Agnidushti*).[50]
- *Arogyavardhani Vati,* a classical Ayurvedic formulation, is known for its hepatoprotective and lipid-lowering properties, with Katuki contributing to the reduction of liver lipid content.[51] A case study by Ashok Kumar Panda *et al*. highlighted significant reductions in BMI, liver fat, visceral fat accumulation, and adipocyte size. Ingredients, such as *Triphala, Shilajatu*, and *Tikta* help reduce *Kleda* (fluidity) and Meda (fat), while Guggulu clears lipid transportation pathways by removing the Avarana of Vata. Kajjali, *Lohabhasma, Tamrabhasma, Abhrakabhasma*, and *Shilajatu* act as *Rasayanas* with immunomodulatory and antioxidant properties.[52]
- *Gomutra* (cow urine) *Gomutra* is traditionally valued for its detoxifying and lipid-lowering effects. With its *katu* (pungent), *kashay*a (astringent) taste, and *kshara* (alkaline) properties, it supports *Medonashana* (fat reduction). Its *laghu* (light), *ruksha* (dry), *tikshna* (sharp), and *ushna* (hot) potency clears *srotas* (channel) obstructions, pacifies Kapha-Vata doshas, enhances Agni (metabolic fire), and helps alleviate NAFLD symptoms through *Medohara* (anti-obesity) and *Kamalahara* (anti-jaundice) properties.[53,54]

1. *Samshodhana Chikitsa* (purification therapy): Samshodhana, the Ayurvedic detoxification therapy, enhances gut health by modulating bacterial composition, influencing lipid metabolism, and bile acid synthesis. Studies highlight its effectiveness in NAFLD, with Samshodhana Chikitsa playing a key role. A case showed significant improvement with Kaphahara Basti and Rohitakadya Churna, leading to pathological remission, reinforcing Ayurveda's potential in NAFLD management.[55] This holistic cleansing process incorporates specialized treatments, such as Virechana (therapeutic purgation) and Vasti (medicated enema), both of which offer significant benefits for managing NAFLD. Virechana therapy, primarily targeting excess Pitta and Kapha doshas, systematically purges deep-seated toxins (Ama), alleviates liver inflammation, and enhances digestion. By expelling metabolic wastes and optimizing bile secretion, it

fosters improved liver function, promotes fat metabolism, and supports overall hepatic health. On the other hand, Vasti therapy, which is highly effective in balancing Vata dosha, plays a pivotal role in detoxifying the system through the colon. This treatment aids in the elimination of accumulated toxins and excessive fats (Meda), restoring metabolic balance and improving intestinal health. In addition, Vasti helps regulate lipid profiles and enhances the bioavailability of nutrients essential for liver regeneration.[56] Ahara acts as the Indhana (fuels) for the Jatharagni, ensuring proper digestion and health. Insufficient intake depletes Dhatus, aggravates Doshas, and causes disease. Acharya Charaka advises filling one-third of the stomach with solid food, one-third with liquids, and leaving one-third empty for Dosha movement and digestion.

2. Diet (*Ahara*) and lifestyle modification (*Vihara*)
   a. *Apathya* - Avoid reheated and untimely food, fatty diet, excessive spicy, oily, salty, sour food, pickles, fish, meat preparations, full-fat milk, curd, potato, junk food, aerated drinks, bakery items, and artificial sweeteners. Sedentary lifestyle, excessive and day time sleeping, smoking.[57]

3. *Pathya* - Ahara acts as the *Indhana* (fuels) for the *Jatharagni,* ensuring proper digestion and health. Insufficient intake depletes Dhatus, aggravates Doshas, and causes disease. Acharya Charaka advises filling one-third of the stomach with solid food, one-third with liquids, and leaving one-third empty for Dosha movement and digestion. Eat freshly prepared food, eat only when hungry and after the evacuation of Mala (waste products), Cereals and Pulses, Vegetables, Fruits, dry fruits, Luke warm water, buttermilk, Gruel prepared with *Panchakola or Trikatu.* Regular physical activity and exercise including yoga-like Kapalabhati Pranayama, Ardha *Matsyendrasana, Gomukhasana, Dhanurasana*, *Balasana,* and meditation along with Adequate sleep and rest.[58,59]

7. DISCUSSION

NAFLD is a prevalent condition with the potential to progress to advanced liver disease, including cirrhosis and liver failure. NAFLD cases are rising steadily due to factors, such as poor diet, sedentary lifestyles, and metabolic disorders, impacting global liver health significantly. At present, modern medicine utilizes thiazolidinediones (TZDs) to help manage NAFLD and type 2 diabetes by enhancing liver function, reducing fat, lowering glucose, and improving insulin sensitivity. However, TZDs may also lead to side effects such as weight gain, fluid retention, increased heart failure risk, and potential long-term risks of fractures and bladder cancer.[60] Despite these pharmacological options, NAFLD lacks a definitive treatment with lifestyle modifications such as dietary management, regular physical activity, and weight reduction serving as the primary interventions due to its widespread prevalence. In Ayurveda, there is no single condition or disease that exactly shows similarity with NAFLD, yet observing Nidana (etiology), *Samprapti* (pathogenesis) and Lakshana (clinical features) closely link it to *medoroga* and *yakrita roga*. Pathology begins with Agnivikruti (digestive disruption), producing *Apakvaannarasa* (improper digestive byproduct), which vitiates Kaphadosha and leads to uneven Meda (fat) deposits in the liver (Yakrit), resembling fatty liver condition. Ayurveda offers promising management, focusing on restoring liver health by balancing the doshas, particularly (Kapha and Pitta), Agni, *Srotoshodhana* through diet, Ayurvedic *Aushadha, Samshodhana* karma, and lifestyle modifications.[61] *Nidana Parivarjana* is a primary strategy for preventing and curing diseases.

In *Sanshaman chikitsa* (palliative care) various single Ayurvedic drugs, such as *Punarnava, Guduchi, Kalmegh, and Kutki* aid in liver detoxification, reducing inflammation, and boosting liver function. Like that *Katuki, a Tikta* Rasa herb, alleviates Ama through *Deepan-Pachana* karma. It supports liver health by modifying cell membranes to block toxins, stimulating nucleolar polymerase A, enhancing protein synthesis, and promoting hepatocyte regeneration. Bhumyamalaki supports liver health with antioxidant and anti-inflammatory properties, preventing fibrosis and aiding in hepatitis management. A 50% methanolic extract of Phyllanthus niruri exhibited hepatoprotective effects in NAFLD rats by reducing visceral fat, normalizing liver enzymes, and minimizing hepatic lipid peroxidation and fat accumulation. Punarnava (*Boerhavia diffusa*) enhances liver function by lowering enzymes, combating oxidative stress, and preventing damage. Haridra, (*Curcuma longa*) rich in curcumin, lowers cholesterol like lovastatin by inhibiting HMG-CoA reductase, thereby reducing liver cholesterol biosynthesis. *Panchkola churna* is commonly used as a digestive aid, carminative, and appetizer, helping to correct metabolic imbalances (*Agnidushti*). Drugs, such as *Rohitaka and Sharapunkha* specifically support liver function as *Yakrita uttejaka* (liver stimulants) and Pittasaraka (Pitta-regulating agents). *Kalmegh c*ontains bioactive compounds, such as andrographolide and 14-deoxy-11,12-didehydroandrographolide, which exhibit hepatoprotective effects by reducing inflammation, fibrosis, and lipid peroxidation, regulating lipid metabolism, improving insulin resistance, and inhibiting gluconeogenesis, aiding in MAFLD treatment. Patola Katurohinyadi Kashaya supports liver health with Patola for detoxification, Katurohini for bile secretion, Guduchi for anti-inflammatory effects, Neem for oxidative protection, and Daruharidra (*berberine*) activates AMPK, reducing hepatic fat accumulation, improving lipid metabolism, and enhancing glucose regulation in liver cells. *Phalatrikadi* Kashaya supports liver health with *Triphala, Guduchi, Kutki*, *Nimba, Vasa, and Kirata-Tikta***,** aiding bile secretion, lipid regulation, circulation, and reducing hepatic fat while improving lipid metabolism. *Arogyavardhani Vati* supports *Srotoshodhana and Lekhana*, reducing BMI, liver fat, and visceral fat, while *Triphala, Shilajatu, and Tikta balance Kleda* and Meda, and Guggulu clears lipid transportation pathways by removing the *Avarana of Vata*. *Gomutra,* rich in nutrients, supports digestion, immunity, and liver function, enhancing blood purity and boosting the body's disease resistance, its *Lekhaniya* (scraping) and Sara (cleansing) properties, act as *Agnideepan* (digestive stimulant) and *Medhya* (cognitive enhancer), also balancing *Tridosha* (*Vata, Pitta, Kapha*) and boosting immunity to protect against diseases. These drugs play a vital role in liver health by promoting detoxification, combating oxidative stress, and maintaining lipid balance. Dietary modifications as avoiding Kapha-aggravating foods (fried, oily, and sugary) while promoting fresh vegetables, whole grains, and digestive spices, such as turmeric and ginger[62] because *ahara* serves as the I*ndhana* (fuel) for *Jatharagni,* supporting digestion and overall health, while inadequate intake depletes Dhatus, disturbs Doshas, and leads to disease.

Samshodhana karma, including *Virechana* (purgation) therapy in NAFLD removes excess Pitta and Kapha, eliminates toxins, reduces liver inflammation, and enhances digestion, supporting liver function and balanced fat metabolism and Vasti (medicated enema) therapy is effective for managing NAFLD by detoxifying the body and balancing Vata dosha and enhancing the elimination of accumulated toxins

(Ama) and excess fats (Meda).[63] Regular exercise and yoga postures, such as *Bhujangasana and Dhanurasana*, along with pranayama and meditation, support weight management and enhance liver metabolism. The review found that Ayurvedic liver medications function as *Yakrit uttejaka, Pitta saraka, Sothagna, and Pittghna* drugs, supporting liver functions.

8. CONCLUSION

NAFLD, a growing clinicopathological condition, can progress to end-stage liver disease, often lacking effective management in conventional medicine. A comprehensive Ayurvedic approach emphasizes Nidana Parivarjana (avoiding causes) and *Samprapti Vighatana* (interrupting progression), focusing on *Agnideepana* (digestive fire enhancement), *Amapachana* (toxin digestion), *Srotoshodhana* (channel cleansing), Lekhana (fat reduction), and *Vatanulomana* (Vata balancing) for effective management.

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10. AUTHORS' CONTRIBUTIONS

The specific contribution of each author to this manuscript is as mentioned below:

- Dr. Rohit Kumar Mishra: Conceptualization, Writing, Reviewing and Editing, Analysis and Interpretation of Data
- Dr. Sneha Gupta: Writing, Reviewing and Editing
- Dr. Meera Antiwal: Visualization, Investigation, Reviewing and Editing.

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12. ETHICAL APPROVALS

This study not require ethical approval as it is a review study.

13. CONFLICTS OF INTEREST

Nil.

14. DATA AVAILABILITY

This is an original manuscript and all data are available for only review purposes from principal investigators.

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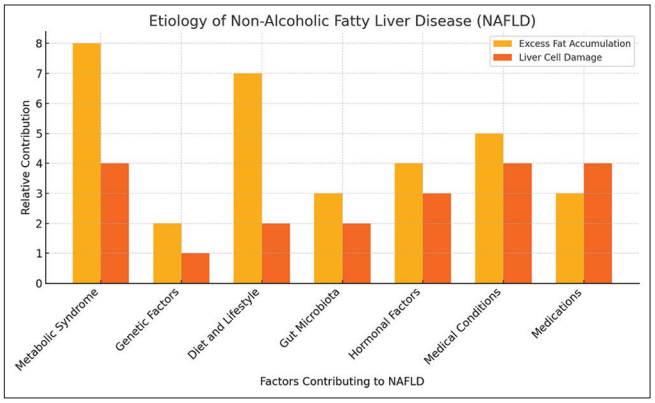

Figure 1: Denotes the etiological factors of non-alcoholic fatty liver disease