



Prevention and Management of MASLD through Yogic Practices: A Clinical Review

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Abstract

Background: Metabolic dysfunction-associated steatotic liver disease (MASLD), formerly referred to as non-alcoholic fatty liver disease (NAFLD), is a common metabolic liver disorder strongly associated with obesity, insulin resistance, dyslipidemia, type 2 diabetes mellitus, and physical inactivity. Lifestyle modification, including diet, weight management, and regular physical activity, remains central to its management. Yoga and yogic practices may provide an additional mind-body approach by combining physical activity, breathing regulation, relaxation, and meditation.

Objective: To clinically review the potential role of yoga and specific yogic practices in the prevention and management of NAFLD/MASLD, with particular emphasis on hepatic, biochemical, anthropometric, metabolic, and cardiometabolic outcomes.

Methods: A systematic search of peer-reviewed literature was undertaken using PubMed, Scopus, Web of Science, and Google Scholar. Search terms included *yoga, yogic practices, NAFLD, MASLD, hepatic steatosis, insulin resistance,* and *lifestyle intervention*. Clinical trials and observational studies evaluating yoga-based interventions and hepatic, biochemical, or metabolic outcomes were considered. Relevant information regarding study characteristics, yoga interventions, duration, and outcomes was synthesized narratively.

Results: The reviewed evidence suggests that yoga may have beneficial effects on several risk factors associated with NAFLD/MASLD. Evidence includes improvements in liver enzymes, body weight, BMI, waist circumference, glucose regulation, insulin resistance, lipid profile, and blood pressure. An 8-week randomized clinical trial involving women with type 2 diabetes and ultrasound-confirmed NAFLD reported improvements in ALT, AST, fatty-liver grade, anthropometric measures, glycemic control, and lipid parameters following cyclic yoga. However, NAFLD-specific evidence remains limited, with small sample sizes, short intervention periods, heterogeneous yoga protocols, and limited objective imaging evidence.

Conclusion: Yoga and yogic practices may serve as a complementary lifestyle intervention in the prevention and management of NAFLD/MASLD by potentially improving metabolic health, body composition, cardiometabolic risk factors, and selected liver-related outcomes. Asanas, pranayama, Kapalbhata, meditation, and integrated yoga may act through interconnected pathways involving physical activity, insulin sensitivity, lipid metabolism, stress regulation, and cardiometabolic health. Nevertheless, yoga should not be considered a replacement for established medical, dietary, and exercise-based management. Larger, well-designed clinical trials using standardized yoga protocols and objective measures of hepatic fat and fibrosis are required to establish its clinical effectiveness.

Keywords: Metabolic dysfunction-associated steatotic liver disease (MASLD); Non-alcoholic fatty liver disease (NAFLD); Yoga Meditation; Metabolic health

1. Introduction

Non-alcoholic fatty liver disease (NAFLD) is one of the most prevalent chronic liver disorders worldwide and is closely associated with metabolic abnormalities such as obesity, insulin resistance, dyslipidemia, type 2 diabetes mellitus, and physical inactivity. The condition encompasses a spectrum ranging from simple hepatic steatosis to non-alcoholic steatohepatitis, progressive fibrosis, cirrhosis, and hepatocellular carcinoma. In addition to liver-related complications, NAFLD is strongly associated with cardiometabolic morbidity, thereby representing an important public-health concern (Rinella et al., 2023; Younossi et al., 2021).

Lifestyle modification remains a fundamental component of NAFLD management. Dietary modification, weight reduction, increased physical activity, and structured exercise have demonstrated beneficial effects on hepatic steatosis, liver enzymes, glucose metabolism, and other metabolic risk factors. Evidence from systematic reviews and meta-analyses indicates that exercise-based interventions can reduce intrahepatic lipid accumulation and serum alanine aminotransferase (ALT), with some evidence suggesting that improvements in hepatic outcomes may occur even in the absence of substantial weight loss (Keating et al., 2012; Katsagoni et al., 2017; Choi et al., 2023).

Although conventional aerobic and resistance exercise are well-established components of lifestyle management, adherence to structured exercise programs can be challenging for some individuals. Consequently, complementary mind–body approaches that combine physical activity with breathing, relaxation, and stress-management techniques have attracted increasing research interest. Yoga represents one such approach and generally incorporates physical postures (asanas), breathing practices (pranayama), relaxation, and, depending on the intervention, meditation and other mind–body techniques. These multidimensional components may provide potential benefits beyond those associated with physical activity alone, particularly through effects on body composition, cardiometabolic health, psychological well-being, and behavioral regulation (Cramer et al., 2016; Ghadge et al., 2020).

The potential relevance of yoga to NAFLD is supported indirectly by evidence demonstrating beneficial effects of yoga on several metabolic risk factors associated with hepatic steatosis. A systematic review and meta-analysis of randomized controlled trials found that yoga may improve certain metabolic-syndrome parameters, particularly waist circumference and systolic blood pressure, although the authors emphasized limitations related to methodological quality and potential bias (Cramer et al., 2016). Similarly, reviews of yoga-based interventions have reported potential improvements in glucose homeostasis, lipid metabolism, adiposity, and cardiovascular risk factors, all of which are clinically relevant to the metabolic pathophysiology underlying NAFLD (Ghadge et al., 2020).

Importantly, evidence specifically examining exercise-based interventions in NAFLD has demonstrated improvements in liver-related outcomes. A meta-analysis of randomized controlled trials reported that exercise was associated with significant reductions in intrahepatic lipid content and ALT concentrations among adults with NAFLD, with longer-duration interventions showing greater improvements in intrahepatic lipid content (Choi et al., 2023). More recent evidence continues to support the role of physical activity and exercise in reducing hepatic steatosis, including effects that may occur independently of weight loss (Ivancovsky-Wajcman et al., 2026).

Despite the growing evidence regarding exercise and the broader metabolic effects of yoga, the evidence base concerning yoga and yogic practices specifically in individuals with NAFLD remains comparatively fragmented. Existing studies differ substantially in terms of yoga modality, intervention components, frequency, session duration, intervention period, participant characteristics, comparator conditions, and outcome measures. Furthermore, studies may evaluate diverse outcomes, including liver enzymes, anthropometric characteristics, glucose metabolism, lipid profile, insulin resistance, blood pressure, and hepatic fat. Such methodological and clinical heterogeneity makes it difficult to establish a clear overall interpretation of the effectiveness of yoga for NAFLD.

Understanding the non-alcoholic fatty liver disease (NAFLD)

Non-alcoholic fatty liver disease (NAFLD), now increasingly termed metabolic dysfunction-associated steatotic liver disease (MASLD), refers to excessive hepatic fat accumulation in the absence of significant alcohol use, ranging from simple steatosis to non-alcoholic steatohepatitis (NASH), fibrosis, and cirrhosis (Rinella et al., 2023; EASL et al., 2024). It affects roughly 30% of the global population, with even higher rates—around 70–75%—among overweight and obese individuals, reflecting its close ties to obesity, insulin resistance, and metabolic syndrome (Younossi et al., 2024; Liu et al., 2022; Riazi et al., 2022; Quek et al., 2023). Its pathophysiology is multifactorial, involving insulin resistance, excess lipid delivery to the liver, adipose tissue dysfunction, oxidative stress, and gut–liver axis disturbances that together drive hepatic inflammation and injury (Rinella et al., 2023). Key risk factors include obesity, type 2 diabetes, dyslipidemia, hypertension, sedentary behaviour, genetic predisposition (e.g., PNPLA3, TM6SF2 variants), and age or sex differences, with disease also occurring in lean individuals due to visceral adiposity and metabolic dysfunction (EASL et al., 2024). Progression is variable—some remain at the steatosis stage, while others advance through steatohepatitis, fibrosis, and cirrhosis—making early lifestyle intervention, including physical activity and practices such as yoga, an important strategy for improving metabolic health and slowing disease progression (EASL et al., 2024).

2. Methodology

This review was conducted through a systematic search of peer-reviewed literature examining the role of yoga and yogic practices in the management of non-alcoholic fatty liver disease (NAFLD). Relevant studies were identified using electronic databases including PubMed, Scopus, Web of Science, and Google Scholar, employing combinations of keywords such as "yoga," "yogic practices," "non-alcoholic fatty liver disease," "NAFLD," "MASLD," "hepatic steatosis," "insulin resistance," and "lifestyle intervention." The search was limited to articles published in English, with particular emphasis on studies from the past decade to ensure inclusion of current terminology (MASLD) alongside the more established NAFLD literature. Both clinical trials and observational studies evaluating the effects of yoga on hepatic, biochemical, and metabolic parameters in individuals with NAFLD were considered for inclusion, while studies lacking direct relevance to yoga-based interventions or fatty liver outcomes were excluded. Selected articles were screened based on title and abstract relevance, followed by full-text review to assess methodological quality and applicability to the review's objectives. Data extracted from the included studies encompassed study design, sample characteristics, type and duration of yogic intervention, and outcome measures such as liver enzyme levels, hepatic fat content, insulin sensitivity, lipid profile, and anthropometric indices. Findings were then synthesized narratively to provide an integrated understanding of the

clinical, biochemical, and metabolic evidence supporting yoga as a complementary approach in the management of NAFLD, while also identifying gaps and limitations within the existing body of research.

3. Clinical Manifestations and Diagnosis of NAFLD

3.1 Symptoms

NAFLD is largely a clinically silent condition, especially in its early stages, with most cases identified incidentally through elevated liver enzymes or imaging rather than symptoms (Rinella et al., 2023). When symptoms do occur, they are typically nonspecific, such as fatigue or mild right upper quadrant discomfort, and cannot be considered diagnostic on their own. As the disease advances toward fibrosis or cirrhosis, more definitive features may appear, including jaundice, ascites, peripheral edema, and hepatic encephalopathy, though these generally reflect advanced rather than early-stage disease. Given this silent progression, current guidance recommends evaluating individuals with cardiometabolic risk factors or unexplained liver enzyme elevation rather than relying on symptoms alone (Rinella et al., 2023; EASL et al., 2024).

3.2 Anthropometric Indicators

Anthropometric measures such as BMI, waist circumference, and waist-to-hip ratio provide practical, low-cost tools for assessing metabolic risk associated with NAFLD. While BMI reflects general adiposity, it cannot distinguish visceral from subcutaneous fat, making waist circumference particularly relevant given the strong link between visceral adiposity and insulin resistance. These measurements are most informative when interpreted alongside other cardiometabolic factors such as blood pressure and lipid profile, and they are also useful for tracking changes during lifestyle interventions like yoga. However, anthropometric findings alone are not diagnostic, since NAFLD can occur without obesity and obesity does not guarantee hepatic steatosis, so they must be combined with clinical and biochemical evaluation (EASL et al., 2024).

3.3 Liver Function Tests and Biochemical Assessment

Biochemical assessment, particularly ALT and AST levels, is commonly used to detect hepatocellular injury, though these markers have limited sensitivity and normal values do not rule out significant disease (Rinella et al., 2023). Additional parameters—including GGT, ALP, bilirubin, albumin, and platelet count—along with metabolic indicators such as fasting glucose, HbA1c, insulin, and lipid profile, help characterize the broader metabolic context of NAFLD. These values also feed into composite tools like the FIB-4 index, which estimates fibrosis risk and guides a stepwise diagnostic approach alongside non-invasive imaging (EASL et al., 2024; Rinella et al., 2023). Such biochemical markers are especially useful for evaluating lifestyle interventions, though changes in ALT or AST alone should not be taken as definitive evidence of fibrosis improvement.

3.4 Imaging and Diagnostic Methods

Because early NAFLD often presents with normal enzymes and no symptoms, imaging plays a key diagnostic role. Abdominal ultrasonography is the standard first-line tool due to its accessibility and low cost, though it may miss mild steatosis. More advanced techniques—transient elastography (including VCTE), MRI, and MR elastography—offer greater sensitivity for quantifying hepatic fat and assessing fibrosis, particularly when initial findings are inconclusive (Sterling et al., 2025). Diagnosis is best approached as a stepwise process, beginning with risk-factor identification and blood-based scores like FIB-4, followed by imaging where indicated (EASL et al., 2024). Liver biopsy remains the histological reference standard but is reserved for cases of diagnostic uncertainty due to its invasiveness (Rinella et al., 2023). Overall, accurate diagnosis requires integrating clinical, anthropometric, biochemical, and imaging data, reflecting NAFLD's nature as a systemic metabolic condition.

4. Biochemical and Metabolic Parameters in NAFLD

Biochemical and metabolic parameters are important for understanding hepatic injury and the metabolic abnormalities associated with NAFLD. Since NAFLD is closely linked with obesity, insulin resistance, diabetes and dyslipidemia, assessment of liver enzymes, glucose regulation and lipid profile provides useful information about disease status and metabolic risk (Rinella et al., 2023; EASL et al., 2024).

4.1 Alanine Aminotransferase (ALT)

ALT is primarily found in liver cells and is commonly used to assess hepatocellular injury. Elevated ALT may occur in NAFLD; however, normal ALT does not exclude the presence of fatty liver or advanced disease. Therefore, ALT should be interpreted together with other clinical and biochemical findings (Rinella et al., 2023).

4.2 Aspartate Aminotransferase (AST)

AST is another enzyme used to assess liver injury, although it is less liver-specific than ALT because it is also present in skeletal muscle and other tissues. The AST/ALT relationship may provide additional clinical information, while both enzymes are incorporated into non-invasive fibrosis assessment tools such as FIB-4 (EASL et al., 2024).

4.3 Gamma-Glutamyl Transferase (GGT)

GGT is commonly included in liver-function testing. Elevated GGT may occur in NAFLD and is also associated with metabolic dysfunction. However, it is not specific to fatty liver and should be interpreted alongside other liver enzymes and clinical factors.

4.4 Alkaline Phosphatase (ALP)

ALP is mainly associated with the liver, biliary system and bone. Although it is not a specific marker of NAFLD, its measurement can help assess overall hepatobiliary status and identify other possible causes of abnormal liver function.

4.5 Bilirubin

Bilirubin reflects the liver's ability to process and excrete the product of red blood-cell breakdown. It is generally normal in uncomplicated early-stage NAFLD and becomes more clinically relevant when significant liver dysfunction or advanced disease develops.

4.6 Glucose

Fasting blood glucose is an important metabolic indicator because insulin resistance and impaired glucose regulation are strongly associated with NAFLD. Elevated glucose levels may indicate impaired glucose metabolism or diabetes, both of which increase the risk of progressive liver disease (EASL et al., 2024).

4.7 HbA1c

HbA1c provides an estimate of average blood glucose over the preceding 2–3 months. It is useful for assessing longer-term glycemic control and is particularly relevant in NAFLD because of the close relationship between fatty liver, insulin resistance and type 2 diabetes.

4.8 Insulin Resistance/HOMA-IR

Insulin resistance is a central metabolic feature of NAFLD. HOMA-IR is commonly used in research as a surrogate measure of insulin resistance and is calculated from fasting glucose and fasting insulin. Higher HOMA-IR generally indicates greater insulin resistance.

4.9 Total Cholesterol

Total cholesterol provides an overall measure of circulating cholesterol. Abnormal cholesterol metabolism commonly accompanies NAFLD and contributes to the individual's broader cardiometabolic risk. It is best interpreted together with HDL-C, LDL-C and triglycerides.

4.10 Triglycerides

Elevated triglycerides are frequently associated with NAFLD, obesity and insulin resistance. Increased hepatic lipid accumulation is closely connected with disturbances in triglyceride metabolism, making triglycerides an important outcome in lifestyle and exercise research.

4.11 HDL-C

HDL-C is an important component of the lipid profile and is often lower in individuals with metabolic syndrome and insulin resistance. Although HDL-C is not a direct marker of liver fat, it contributes to assessment of overall cardiometabolic health.

4.12 LDL-C

LDL-C is an important atherogenic lipid and is relevant to NAFLD because cardiovascular disease represents a major health concern among individuals with metabolic dysfunction-associated steatotic liver disease. LDL-C should therefore be considered as part of the broader metabolic profile rather than as a direct indicator of hepatic steatosis (EASL et al., 2024).

5. Role of Lifestyle Modification in NAFLD

Lifestyle modification is considered a fundamental component of NAFLD management because the disease is strongly associated with obesity, insulin resistance, poor dietary patterns, and physical inactivity. Improvements in lifestyle can reduce hepatic fat and improve several cardiometabolic risk factors (Rinella et al., 2023; EASL et al., 2024).

5.1 Diet

Dietary modification aims to reduce excessive energy intake and improve overall diet quality. Diets emphasizing vegetables, fruits, whole grains, legumes, and unsaturated fats, while reducing refined carbohydrates, added sugars, saturated fats, and ultra-processed foods, may help reduce hepatic fat and improve metabolic health (EASL et al., 2024).

5.2 Weight Management

Weight reduction is strongly associated with improvement in hepatic steatosis and metabolic health. Even moderate weight loss can reduce liver fat, while greater sustained weight reduction may provide additional benefits for inflammation and fibrosis. Therefore, maintaining a healthy body weight is an important component of NAFLD management (Rinella et al., 2023).

5.3 Physical Activity

Regular physical activity can improve insulin sensitivity, cardiovascular fitness, body composition, and metabolic health. Importantly, physical activity may reduce hepatic fat even when substantial weight loss does not occur, making it valuable for individuals who have difficulty achieving significant weight reduction (Katsagoni et al., 2017).

5.4 Exercise

Both aerobic and resistance exercise have demonstrated beneficial effects on hepatic steatosis and metabolic risk factors. Exercise may improve liver enzymes, insulin sensitivity, lipid metabolism, and cardiovascular fitness. Consequently, structured exercise is an important lifestyle strategy for managing NAFLD and provides a basis for exploring complementary approaches such as yoga and yogic practices (Keating et al., 2012; Rinella et al., 2023).

6. Yoga and Yogic Practices

Yoga is a holistic traditional practice that integrates physical postures, breathing regulation, mental concentration, meditation, and relaxation. In the context of metabolic health, these practices may contribute to improved physical

activity, stress regulation, respiratory function, body composition, and overall well-being. The major components relevant to the present paper are asanas, pranayama, Kapalbhathi, meditation, and relaxation practices.



Figure 1. Yoga and Yogic Practices and Their Major Components

7. Potential Mechanisms Through Which Yoga May Influence NAFLD

Yoga may influence NAFLD through multiple interconnected pathways involving body composition, metabolic regulation, oxidative balance, inflammation, stress response, and cardiovascular health. Although the mechanisms are not fully established, existing evidence suggests several plausible pathways.

7.1 Weight and Body Composition

Regular yoga practice may increase physical activity and energy expenditure while supporting weight management. Improvements in body weight, BMI, waist circumference, and body composition may contribute to reduced hepatic fat accumulation (Cramer et al., 2016).

7.2 Insulin Sensitivity

Yoga may improve insulin sensitivity through increased physical activity, improved muscle glucose utilization, and reduced stress-related metabolic disturbances. Better insulin sensitivity may subsequently reduce excessive glucose and fatty-acid availability to the liver.

7.3 Lipid Metabolism

Yoga may positively influence lipid metabolism by improving triglycerides, total cholesterol, LDL-C, and HDL-C. Such changes may reduce the metabolic conditions associated with hepatic fat accumulation (Cramer et al., 2016).

7.4 Oxidative Stress

Oxidative stress contributes to hepatocellular injury and disease progression in NAFLD. Breathing, relaxation, and mind-body practices may help improve antioxidant defenses and reduce oxidative stress, although direct evidence in NAFLD remains limited.

7.5 Inflammation

Chronic low-grade inflammation is involved in the progression of metabolic dysfunction and fatty liver disease. Yoga may influence inflammatory pathways indirectly through improvements in obesity, insulin resistance, stress, and physical activity.

7.6 Stress and Autonomic Regulation

Yoga, particularly pranayama and meditation, may promote relaxation and influence autonomic nervous-system balance. Reduced psychological stress and improved autonomic regulation may support healthier metabolic and behavioral responses.

7.7 Cardiometabolic Health

Yoga may contribute to improved blood pressure, glucose regulation, lipid profile, physical fitness, and psychological well-being. These effects are relevant because cardiovascular and metabolic disorders are closely associated with NAFLD/MASLD (EASL et al., 2024).



Importantly, these mechanisms are plausible rather than definitively established as direct effects of yoga on NAFLD, and further clinical research is needed to determine the specific contribution of individual yogic practices.

8. Evidence for Yoga in NAFLD

Outcome	Evidence from available literature	Overall interpretation
Liver enzymes (ALT & AST)	A 2026 randomized clinical trial in 40 overweight women with T2DM and ultrasound-confirmed NAFLD reported significant reductions in ALT and AST after 8 weeks of cyclic yoga compared with usual activity. (PubMed Central (PMC))	Promising NAFLD-specific evidence , but evidence is still limited by small sample size and short duration.
Hepatic fat / steatosis	The same 2026 trial reported an average improvement of approximately one fatty-liver grade following cyclic yoga. A separate 2026 MASLD trial protocol is evaluating liver fat by ultrasound, while an earlier clinical trial was designed to measure liver fat by MRI. (ScienceDirect)	Potential benefit , but objective imaging evidence remains limited and further trials are needed.
BMI and body weight	In the NAFLD-specific 2026 trial, cyclic yoga significantly reduced body weight, BMI, waist circumference and hip circumference . Broader meta-analysis of 32 RCTs also found reductions in BMI and body weight with yoga compared with non-exercise controls. (PubMed Central (PMC))	Moderate supportive evidence , particularly for improving anthropometric risk factors.
Glucose metabolism	The 2026 NAFLD trial reported significant improvements in fasting blood glucose, HbA1c and insulin resistance following cyclic yoga. However, broader evidence is mixed: an earlier meta-analysis found no significant overall effect of yoga on fasting glucose or HbA1c. (PubMed Central (PMC))	Promising but inconsistent evidence ; effects may depend on population, intervention and baseline metabolic status.
Lipid profile	In the NAFLD-specific trial, cyclic yoga significantly reduced triglycerides and LDL-C and increased HDL-C . A meta-analysis of 53 RCTs also reported improvements in total cholesterol, LDL-C, HDL-C and triglycerides following yoga. (PubMed Central (PMC))	Relatively strong supportive metabolic evidence , although most evidence is not specifically from NAFLD populations.
Blood pressure	Direct NAFLD-specific evidence is still limited. However, meta-analyses of yoga interventions in metabolic and cardiovascular populations have reported reductions in systolic and diastolic blood pressure. (PubMed)	Supportive indirect evidence ; potential benefit for the cardiometabolic risk associated with NAFLD.
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Taken together, current evidence points to yoga as a promising adjunct in NAFLD management, with the most compelling support coming from an 8-week randomized trial in women with type 2 diabetes and NAFLD, where participants showed improvements in liver enzymes, fatty-liver grade, body measurements, glycemic control, and lipid profile. Still, this evidence falls short of proving that yoga alone can treat or reverse the condition. Research specific to NAFLD remains limited, intervention protocols differ widely across studies, and much of the supporting data comes from populations with metabolic syndrome, diabetes, or cardiovascular risk rather than confirmed fatty liver disease. Even the Indian National Association for the Study of the Liver acknowledges that yoga's specific role in NAFLD has not been adequately studied. Given these gaps, yoga is best understood not as a standalone cure but as a complementary practice one that works alongside conventional medical care, dietary changes, weight management, and regular physical activity to support better outcomes in NAFLD.

9. Role of specific yoga practices



Asana Postures Asanas are physical postures aimed at building strength, flexibility, balance, and body awareness. Beyond the obvious physical benefits, regular practice raises energy expenditure and appears to nudge body composition and insulin sensitivity in a favourable direction — effects that matter for NAFLD given how closely the disease tracks with obesity and insulin resistance. This isn't just theoretical: in a 2026 randomized trial, an eight-week structured asana sequence (cyclic yoga) improved liver enzymes, fatty-liver grade, body weight, and glycemic and lipid markers in women with type 2 diabetes and NAFLD (Bayat et al., 2026).

Pranayama (Breath Regulation) Pranayama refers to the deliberate control of breathing — through paced inhalation, exhalation, and sometimes breath retention. A comprehensive review of the pranayama literature found consistent benefits for autonomic balance, stress reduction, and a range of neurocognitive, respiratory, and metabolic functions (Saoji, Raghavendra, & Manjunath, 2018). These autonomic and stress-related shifts are plausible indirect routes by which pranayama could support cardiometabolic health, even without acting on the liver directly.

Kapalbhati Kapalbhati is a fast-paced yogic breathing technique built around forceful, active exhalations followed by passive inhalation, often used in cleansing and energizing routines. Research specifically on Kapalbhati has linked the practice to increases in basal metabolic rate and reductions in body fat and waist circumference (Bal, 2015). That said, evidence tying Kapalbhati specifically to liver outcomes in NAFLD is still thin, and its relevance here is best understood as indirect — through respiratory engagement, metabolic stimulation, and stress modulation — rather than established through direct clinical trials in fatty liver patients.

Meditation (Dhyan) Meditation trains sustained attention and awareness, and its physiological effects run largely through the endocrine and stress-response systems — particularly the hypothalamic-pituitary-adrenal axis (Pascoe, Thompson, & Ski, 2020). Because chronic stress can disrupt eating behaviour, sleep, and hormonal regulation — all of which feed into metabolic dysfunction — meditation's role in NAFLD management is best framed as supportive rather than direct, working on the psychological and behavioural conditions that allow other interventions to succeed.

Integrated Yoga Integrated yoga brings asanas, pranayama, meditation, and sometimes cleansing practices together into a single protocol, and this combined approach is where the NAFLD-specific evidence is strongest. A dedicated yoga module developed and piloted for adults with NAFLD — combining joint-loosening exercises, Surya Namaskar, seated postures, and breathing techniques — was found feasible, well accepted by patients, and associated with measurable improvement in liver fat on imaging after three months (Mishra et al., 2025). This kind of multi-component design makes sense given how many pathways (physical, respiratory, psychological) feed into hepatic and metabolic health simultaneously.

Overall Perspective These five practices aren't interchangeable, and lumping them together risks overstating what any one of them does on its own. Asanas carry the physical load, pranayama and Kapalbhati work through breath and autonomic regulation, meditation addresses the psychological and stress side of things, and integrated yoga is where these threads come together into something closer to a genuine lifestyle intervention. The current

evidence — strongest for cyclic yoga and integrated protocols (Bayat et al., 2026; Mishra et al., 2025), more mechanistic for pranayama, Kapalbhathi, and meditation individually suggests any benefit to the liver in NAFLD is likely to come from several pathways acting together, not from a single practice acting on the liver in isolation.

Conclusion

NAFLD is a complex metabolic liver disorder closely associated with obesity, insulin resistance, dyslipidemia, physical inactivity, and other cardiometabolic risk factors. Effective management therefore requires a comprehensive lifestyle approach involving healthy dietary practices, weight management, regular physical activity, and appropriate medical care. Current evidence indicates that lifestyle modification can reduce hepatic fat and improve metabolic health, making it an important foundation of NAFLD management (Rinella et al., 2023; EASL et al., 2024).

Yoga and yogic practices may offer an additional, holistic approach because they combine physical activity, breathing regulation, meditation, and relaxation. Asanas may support body composition and physical fitness, while pranayama and meditation may contribute to stress and autonomic regulation. Kapalbhathi may have potential metabolic and respiratory benefits, although direct evidence in NAFLD remains limited. Integrated yoga may provide complementary effects by combining these practices within a structured mind–body approach.

Available evidence suggests potential improvements in liver enzymes, body weight, BMI, glucose regulation, insulin resistance, lipid profile, and blood pressure among individuals practicing yoga. However, NAFLD-specific evidence remains relatively limited, and differences in yoga protocols, duration, intensity, participant characteristics, and outcome measures make definitive conclusions difficult. Therefore, yoga should currently be regarded as a complementary lifestyle intervention rather than a replacement for established medical and dietary management.

Future research should focus on well-designed clinical trials with clearly standardized yoga protocols, adequate sample sizes, longer intervention periods, and objective measures of hepatic fat and fibrosis. Greater attention should also be given to identifying which individual practices or combinations particularly asanas, pranayama, Kapalbhathi, meditation, and integrated yoga provide the greatest benefit. Such evidence may help establish the appropriate role of yoga as a sustainable and culturally relevant component of comprehensive NAFLD management.

References

1. Bayat, Z., Mahdioun, S. S., Nemati, H., Rezvan Madani, F., Rahimi, M., Dehghan, H., Naseri, R., & Goosheh, S. M. (2026). Effects of cyclic yoga on selected metabolic and hepatic parameters in diabetic women with fatty liver diseases: A clinical trial. *Journal of Clinical & Translational Endocrinology*, 43, 100431. doi:10.1016/j.jcte.2026.100431
2. Sterling, R. K., Duarte-Rojo, A., Patel, K., Asrani, S. K., Alsawas, M., Dranoff, J. A., Fiel, M. I., Murad, M. H., Leung, D. H., Levine, D., Taddei, T. H., Taouli, B., & Rockey, D. C. (2025). AASLD practice guideline on imaging-based noninvasive liver disease assessment of hepatic fibrosis and steatosis. *Hepatology*, 81(2), 672–724. doi:10.1097/HEP.0000000000000843
3. Sterling, R. K., Patel, K., Duarte-Rojo, A., Asrani, S. K., Alsawas, M., Dranoff, J. A., Fiel, M. I., Murad, M. H., Leung, D. H., Levine, D., Taddei, T. H., Taouli, B., & Rockey, D. C. (2025). AASLD practice guideline on blood-based noninvasive liver disease assessment of hepatic fibrosis and steatosis. *Hepatology*, 81(1), 321–357. doi:10.1097/HEP.0000000000000845
4. Amini-Salehi, E., Letafatkar, N., Norouzi, N., Joukar, F., Habibi, A., Javid, M., Sattari, N., Khorasani, M., Farahmand, A., Tavakoli, S., Masoumzadeh-Kiaee, B., Abbaspour, E., Karimzadghagh, S., Ghadiri, A., Maddineni, G., Khosousi, M. J., Faraji, N., Keivanlou, M. H., Mahapatro, A., ... Nayak, S. S. (2024). Global prevalence of nonalcoholic fatty liver disease: An updated review meta-analysis comprising a population of 78 million from 38 countries. *Archives of Medical Research*, 55(6), 103043. doi:10.1016/j.arcmed.2024.103043
5. European Association for the Study of the Liver, European Association for the Study of Diabetes, & European Association for the Study of Obesity. (2024). EASL-EASD-EASO clinical practice guidelines on the management of metabolic dysfunction-associated steatotic liver disease (MASLD). *Journal of Hepatology*, 81(3), 492–542. doi:10.1016/j.jhep.2024.04.031
6. Rinella, M. E., Neuschwander-Tetri, B. A., Siddiqui, M. S., Abdelmalek, M. F., Caldwell, S., Barb, D., Kleiner, D. E., Loomba, R., & others. (2023). AASLD practice guidance on the clinical assessment and management of nonalcoholic fatty liver disease. *Hepatology*, 77(5), 1797–1835. doi:10.1097/HEP.0000000000000323
7. Nam, H., Yoo, J.-J., Cho, Y., Kang, S. H., Ahn, S. B., Lee, H.-W., Jun, D. W., Song, D. S., & Choi, M. (2023). Effect of exercise-based interventions in nonalcoholic fatty liver disease: A systematic review with meta-analysis. *Digestive and Liver Disease*, 55(9), 1178–1186. doi:10.1016/j.dld.2022.12.013
8. Quek, J., Chan, K. E., Wong, Z. Y., Tan, C., Tan, B., Lim, W. H., Tan, D. J. H., Tang, A. S. P., Tay, P., Xiao, J., Yong, J. N., Zeng, R. W., Chew, N. W. S., Nah, B., Kulkarni, A., Siddiqui, M. S., Dan, Y. Y., Wong, V. W. S., Sanyal, A. J., Nouredin, M., Muthiah, M., & Ng, C. H. (2023). Global prevalence of non-alcoholic fatty liver disease and non-alcoholic steatohepatitis in the overweight and obese population: A systematic review and meta-analysis. *The Lancet Gastroenterology & Hepatology*, 8(1), 20–30. doi:10.1016/S2468-1253(22)00317-X
9. Duseja, A., Singh, S. P., De, A., Madan, K., Rao, P. N., Shukla, A., Choudhuri, G., Saigal, S., Shalimar, Arora, A., Anand, A. C., Das, A., Kumar, A., Eapen, C. E., Devadas, K., Shenoy, K. T., Panigrahi, M., Wadhawan, M.,

- Rathi, M., ... Chawla, Y. K. (2023). Indian National Association for Study of the Liver (INASL) guidance paper on nomenclature, diagnosis and treatment of nonalcoholic fatty liver disease (NAFLD). *Journal of Clinical and Experimental Hepatology*, 13(2), 273–302. doi:10.1016/j.jceh.2022.11.014
10. Cusi, K., Isaacs, S., Barb, D., Basu, R., Caprio, S., Garvey, W. T., Kashyap, S., Mechanick, J. I., Mouzaki, M., Nadolsky, K., Rinella, M. E., Vos, M. B., & Younossi, Z. (2022). American Association of Clinical Endocrinology clinical practice guideline for the diagnosis and management of nonalcoholic fatty liver disease in primary care and endocrinology clinical settings. *Endocrine Practice*, 28(5), 528–562. doi:10.1016/j.eprac.2022.03.010
 11. Ghazvineh, D., Daneshvar, M., Basirat, V., & Daneshzad, E. (2022). The effect of yoga on the lipid profile: A systematic review and meta-analysis of randomized clinical trials. *Frontiers in Nutrition*, 9, 942702. doi:10.3389/fnut.2022.942702
 12. Riazi, K., Azhari, H., Charette, J. H., Underwood, F. E., King, J. A., Ehteshami Afshar, E., Swain, M. G., Congly, S. E., Kaplan, G. G., & Shaheen, A.-A. (2022). The prevalence and incidence of NAFLD worldwide: A systematic review and meta-analysis. *The Lancet Gastroenterology & Hepatology*, 7(9), 851–861. doi:10.1016/S2468-1253(22)00165-0
 13. Liu, J., Tian, Y., Fu, X., Mu, C., Yao, M., Ni, Y., Liu, Y., & Li, Z. (2022). Estimating global prevalence, incidence, and outcomes of non-alcoholic fatty liver disease from 2000 to 2021: Systematic review and meta-analysis. *Chinese Medical Journal*, 135(14), 1682–1691. doi:10.1097/CM9.0000000000002277
 14. Khoshnaw, D. M., & Ghadge, A. A. (2021). Yoga as a complementary therapy for metabolic syndrome: A narrative review. *Journal of Integrative Medicine*, 19(1), 6–12. doi:10.1016/j.joim.2020.09.002
 15. Younossi, Z. M., Corey, K. E., & Lim, J. K. (2021). AGA clinical practice update on lifestyle modification using diet and exercise to achieve weight loss in the management of nonalcoholic fatty liver disease: Expert review. *Gastroenterology*, 160(3), 912–918. doi:10.1053/j.gastro.2020.11.051
 16. Katsagoni, C. N., Georgoulis, M., Papatheodoridis, G. V., Panagiotakos, D. B., & Kontogianni, M. D. (2017). Effects of lifestyle interventions on clinical characteristics of patients with non-alcoholic fatty liver disease: A meta-analysis. *Metabolism*, 68, 119–132. doi:10.1016/j.metabol.2016.12.006
 17. Cramer, H., Langhorst, J., Dobos, G., & Lauche, R. (2016). Yoga for metabolic syndrome: A systematic review and meta-analysis. *European Journal of Preventive Cardiology*, 23(18), 1982–1993. doi:10.1177/2047487316665729
 18. Chu, P., Gotink, R. A., Yeh, G. Y., Goldie, S. J., & Hunink, M. G. M. (2016). The effectiveness of yoga in modifying risk factors for cardiovascular disease and metabolic syndrome: A systematic review and meta-analysis of randomized controlled trials. *European Journal of Preventive Cardiology*, 23(3), 291–307. doi:10.1177/2047487314562741
 19. Keating, S. E., Hackett, D. A., George, J., & Johnson, N. A. (2012). Exercise and non-alcoholic fatty liver disease: A systematic review and meta-analysis. *Journal of Hepatology*, 57(1), 157–166. doi:10.1016/j.jhep.2012.02.023