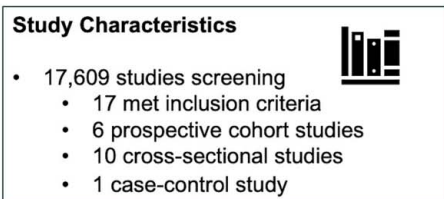
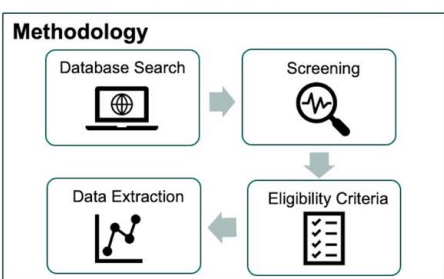


The impact of food insecurity on chronic liver disease: A systematic review of the literature

VISUAL ABSTRACT

The impact of food insecurity on chronic liver disease: A systematic review of the literature



Key Findings Associated with Patients Experiencing Food Insecurity:

Higher rates of hepatic steatosis and liver fibrosis OR: 1.40, 95% CI: 1.04–1.88	Higher risk of all-cause mortality in MASLD and advanced fibrosis HR: 1.46, 95% CI: 1.08–1.97	Increased outpatient healthcare utilization among MASLD patients OR: 1.31, 95% CI: 1.05–1.63
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Gaps in the Literature

- Other liver pathologies such as alcohol-associated liver disease, autoimmune liver disease, viral hepatitis, transplant
- Causal methodologies such as intervention studies, clinical trials

REVIEW

OPEN

The impact of food insecurity on chronic liver disease: A systematic review of the literature

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Abstract

Background: Chronic liver disease (CLD) poses a significant healthcare burden, with diet playing a crucial role in its management. Food insecurity, defined as limited or uncertain access to adequate food, may worsen liver disease outcomes due to reliance on nutrient-poor diets. While its association with chronic conditions is well-established, its impact on liver disease remains underexplored. This systematic review synthesizes evidence on the impact of food insecurity on liver disease development, progression, and outcomes, identifying gaps and informing future research and public health strategies.

Methods: Databases including Medline, CINAHL, Embase, and Web of Science were searched comprehensively through April 2025. Studies evaluating food insecurity and liver disease outcomes were included. Data on study design, population, definitions, and findings were extracted. Quality and risk of bias were assessed using the Mixed Methods Appraisal Tool.

Results: Of 17,609 studies identified, 17 met the inclusion criteria, predominantly from the United States. Most studies focused on metabolic dysfunction–associated steatotic liver disease (MASLD). Food insecurity was linked to increased odds of MASLD, advanced fibrosis, and mortality, with higher rates of hepatic steatosis, liver stiffness, and fibrosis progression in both pediatric and adult populations. Food insecurity was measured primarily using the USDA Household Food Security Survey Module, and liver outcomes via noninvasive techniques and biomarkers.

Conclusions: Food insecurity is a potentially modifiable risk factor for liver disease progression, emphasizing the need for targeted interventions. Further research should explore food assistance interventions, its impact on diet

Abbreviations: CLD, chronic liver disease; FIB-4, Fibrosis-4; MASLD, metabolic dysfunction–associated steatotic liver disease; MMAT, Mixed Methods Appraisal Tool; MRI-PDFF, MRI proton density fat fraction; NFS, NAFLD Fibrosis Score; NHANES, National Health and Nutrition Examination Survey; PCM, protein-calorie malnutrition; SES, socioeconomic status; VCTE, vibration-controlled transient elastography.

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and implement screening programs in hepatology clinics to inform tailored strategies addressing this critical determinant of liver health.

Keywords: diet and nutrition, food security, health disparities, liver fibrosis, metabolic dysfunction–associated steatotic liver disease

INTRODUCTION

Background

Chronic liver disease (CLD) is a substantial burden on health care systems, with annual costs in the United States surpassing \$29.9 billion.^[1] Among the various etiologies of CLD, nonalcoholic fatty liver disease (NAFLD)—recently reclassified as metabolic dysfunction–associated steatotic liver disease (MASLD)^[2]—is now the most common, driven by rising rates of obesity, insulin resistance, and other metabolic disorders. This shift highlights the critical role of a healthy diet in addressing metabolic risk factors and preventing progression of MASLD.^[3] Furthermore, the importance of dietary management extends beyond MASLD, as malnutrition is a well-recognized risk factor and poor prognostic indicator in patients with CLD.^[4–9] A healthy diet requires both affordability and consistent access to nutrient-rich foods that align with evidence-based dietary guidelines for CLD,^[3,9] which can be out of reach for many due to rising costs of food, among other factors. Understanding how food insecurity affects liver disease is critical for addressing the dual rising burdens of food insecurity and CLD in vulnerable populations.

Liver disease and diet

The liver is central to macronutrient metabolism, such that maintaining adequate liver function is essential to overall health. Metabolic disturbances in CLD include alterations in glucose metabolism, increased protein catabolism, and increased lipid oxidation, resulting in hepatic lipotoxicity and a deficiency in essential fatty acids.^[9] Protein-calorie malnutrition (PCM) is common in all stages of CLD and may be present in 65%–90% of patients with advanced disease.^[6] Severe PCM can undermine the capacity for liver regeneration and functional restoration and is associated with other complications such as esophageal varices, hepatic encephalopathy, and increased surgical morbidity and mortality.^[6,8] Consequently, diet is an important prognostic and therapeutic factor for patients with liver disease.

The unique pathophysiology of liver disease requires dietary patterns distinct from those recommended for other chronic conditions, creating additional barriers to food access. For instance, patients with cirrhosis are

typically advised to follow high-protein, high-calorie diets with small, frequent meals to combat malnutrition and prevent muscle wasting.^[8] Sodium intake is often restricted in patients with ascites to reduce fluid retention. Moreover, deficiencies in fat-soluble vitamins (A, D, E, and K) and trace elements such as zinc and selenium are common, further complicating disease management.^[6,8,10] These dietary needs present additional barriers for food-insecure individuals, who frequently rely on inexpensive, nutrient-poor foods that exacerbate metabolic dysfunction.^[11] Despite this, there is very limited data on how food insecurity impacts the development and outcome of liver diseases. Recent op-eds and commentaries have underscored the need for more research into how socioeconomic factors, particularly food insecurity, contribute to liver disease.^[12–14]

Food insecurity and socioeconomic status

Food insecurity, defined as limited or uncertain access to adequate food, is both a marker of poverty and a reflection of broader structural inequities.^[15] In 2023, more than 47 million Americans lived in food-insecure households, with disproportionately higher rates among non-Hispanic Black and Hispanic communities.^[16–18] The COVID-19 pandemic has exacerbated these disparities.^[19] In high-income nations, food insecurity is paradoxically linked to obesity, largely due to lower cost, energy-dense, high-fat, and ultra-processed foods.^[20] Food insecurity has a well-established relationship with an increased risk of chronic conditions such as diabetes, obesity, hypertension, and cardiovascular disease,^[20–22] but data on its impact on liver disease remains sparse.

Limited access to health care, chronic stress, lack of safe and accessible spaces for physical activity, lower education and health literacy, and lack of access to healthy foods all contribute to higher risks for developing cardiometabolic diseases.^[23] MASLD shares many of the same risk factors as cardiometabolic diseases, such as insulin resistance and dyslipidemia. Understanding how food insecurity impacts not only MASLD but also other forms of liver disease is crucial for improving disease outcomes, especially in underserved populations. Addressing food insecurity in these communities is not only vital for managing liver disease but also for reducing the burden of chronic conditions and improving overall health outcomes.

Purpose of review

Despite the clear link between diet, socioeconomic status (SES), and liver disease, the relationship between food insecurity and liver disease remains poorly understood. We have conducted the first systematic review to date to fill this gap by examining the available evidence on how food insecurity impacts the development, progression, and outcomes of liver diseases. By reviewing the current evidence on this critical issue, we hope to identify data gaps and inform future research opportunities and public health policies aimed at addressing food insecurity and improving health outcomes for vulnerable populations with liver disease. The full review question is as follows: What is the current evidence on the relationship between food insecurity and the prevalence, development, morbidity, and mortality associated with liver disease?

METHODS

Literature search

We searched Medline (PubMed), CINAHL, Embase, and the Web of Science databases with no temporal or language restrictions for relevant publications. The search terms and strategy were designed after consultation with a librarian and are reported in Supplemental Table S1, <http://links.lww.com/HC9/C103>. All publications were uploaded into Covidence, and 2 reviewers (Laila M. Elias and Jordy E. Agins) used this software to independently evaluate each record. The initial screening is based on the title and abstract of studies identified for inclusion. Then, the full texts of potentially eligible studies were examined to determine whether they met the inclusion criteria. The selection process is further described in the Prisma flowchart, as shown in [Figure 1](#). Any conflicting decisions were adjudicated by the entire research team.

Inclusion and exclusion criteria

The inclusion criteria were as follows: (1) studies that assessed the link between food insecurity and the presence or development of liver disease; (2) studies that evaluate the association between food insecurity and liver disease morbidity, and/or mortality; and (3) papers published in the English language, or with a qualified reader available. We excluded (1) animal studies, (2) editorials, (3) personal opinions, (4) abstracts/posters, and (5) review articles. Papers were also excluded if they focused on nutritional content/quality or famine/starvation rather than food insecurity. All papers included were conducted in accordance with both the Declaration of Helsinki and Istanbul.

Information extraction

After reading the full articles, the following information was extracted from the retained final studies: authors, year of publication, country where the study was carried out, study design, study population and characteristics, definition and measurement of food insecurity, definition and measurement of liver disease, and main findings. In addition, the full-text articles were examined to exclude duplicate entries by the same first or corresponding author, and they were also judged as to whether there were overlaps in content. Then, full-text versions of the included articles were evaluated by the authors to compile several tables to summarize the findings between food insecurity and liver disease.

Evaluation of the quality of selected studies and the assessment of the risk of bias

The evaluation of the quality of selected studies and the assessment of the risk of bias were carried out using the Mixed Methods Appraisal Tool (MMAT). The MMAT is a critical appraisal tool that is designed for the appraisal stage of systematic mixed studies reviews, that is, reviews that include qualitative, quantitative, and mixed methods studies.

RESULTS

Overall

The search was performed in May 2024 and updated in April 2025. The search strategy is reported in [Figure 1](#). A total of 17,609 studies were identified, and 4875 duplicates were excluded. During the screening phase, 12,734 studies were excluded based on the title and abstract, and 88 full-text papers were retrieved and read. Subsequently, 71 manuscripts were excluded: 11 for not focusing on liver disease outcomes, 21 for not focusing on food insecurity (rather nutritional content or starvation/famine), 37 for publication type (review, abstract, poster), and 2 for not being written in English with no translation. After review, 17 articles^[24–40] met the inclusion criteria. Out of the 17 identified studies, the oldest was published in 2020 and the newest in 2025. Fifteen (88%) studies were conducted in the United States, and 2 (12%) were conducted in Iran. There was 1 case–control study (6%), 10 cross-sectional studies (59%), 2 retrospective cohort studies (12%), 2 prospective cohort studies (12%), and 2 population-based cohort studies (12%). Thirteen (76%) studies looked at adult populations, and the remaining 4 (24%) looked at pediatric populations. The characteristics of each study are outlined in [Table 1](#).

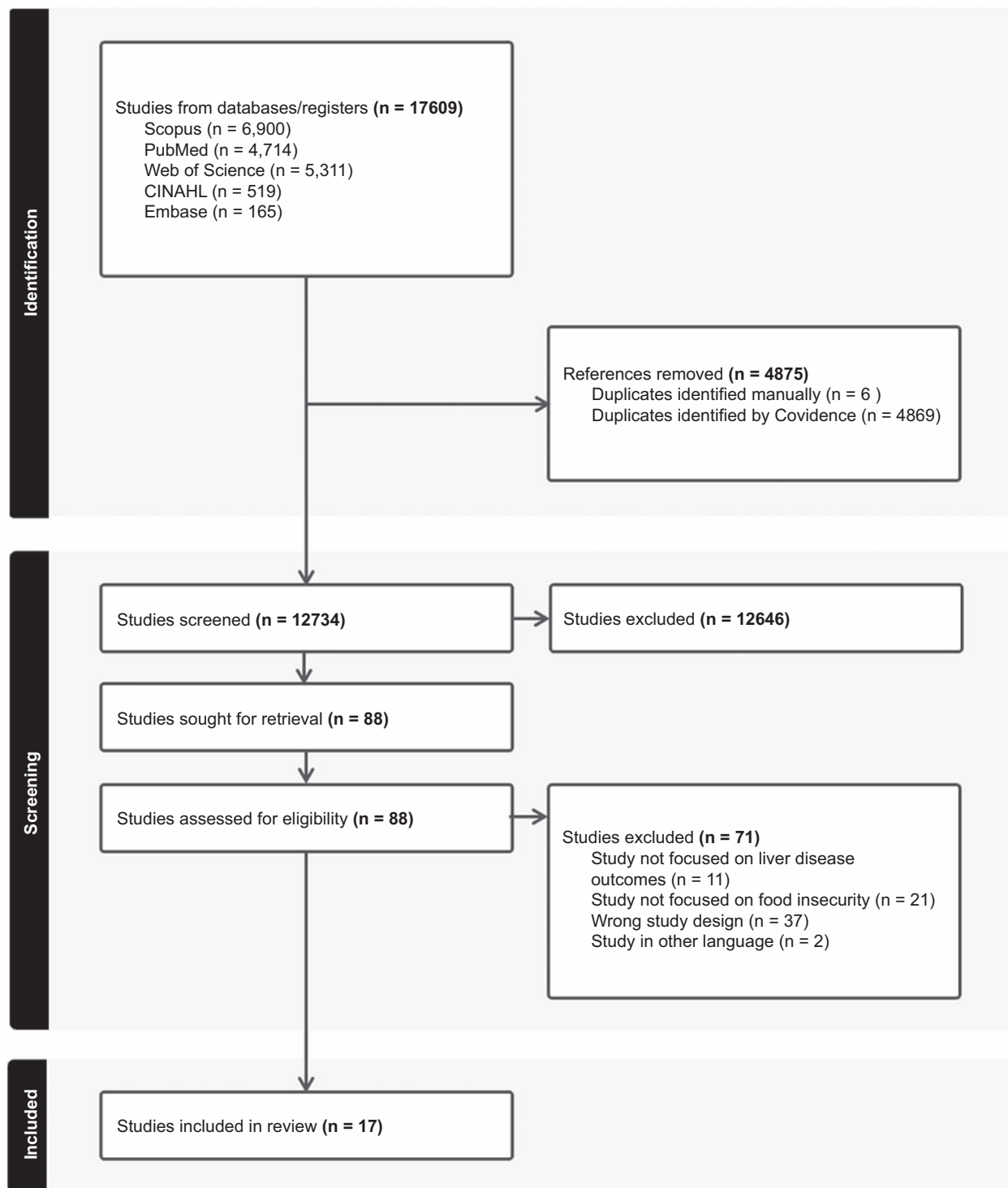


FIGURE 1 Prisma flowchart.

Liver disease focus and outcome

Out of the 17 studies, 15 (88%) focused on NAFLD, or MASLD, updated on the new classification, 5 (29%) on liver fibrosis, 1 (6%) on liver cirrhosis, 1 (6%) on HCC, and 1 (6%) on liver transplant. Of the outcomes, 13 (76%) studies focused on the prevalence or development of liver disease, 3 (18%) on mortality, and 1 (6%)

on perioperative outcomes following HCC resection. Liver disease outcomes were assessed using a variety of methods. Ten studies (59%) relied on noninvasive techniques to measure liver stiffness and fibrosis. Transient elastography, specifically using vibration-controlled transient elastography (VCTE), was used to evaluate liver stiffness and fibrosis in 6 studies (35%). In addition, other noninvasive scoring systems, such as

the NAFLD Fibrosis Score (NFS) and Fibrosis-4 (FIB-4) index, were employed to estimate the degree of fibrosis in patients. One study used MRI proton density fat fraction (MRI-PDFF) to assess hepatic steatosis, and another study employed ultrasound-based elastography to evaluate liver disease. One study used biochemical markers such as ALT and AST to assess for liver injury in relation to food insecurity. In addition, 4 studies (24%) evaluated liver-related mortality and transplant metrics using national registries.

Food insecurity measurement

Food insecurity was most frequently measured with the *USDA Household Food Security Survey Module* (10, 59%). This is an 18-item survey that is used to assess different levels of household food security and is typically considered the gold standard in measuring food insecurity.^[41] Other food insecurity measures included the *Six-Item Short Form Household Food Security Survey* (2, 12%) and the *Food Insecurity Experience Scale* (1, 6%) which are both adapted from the USDA household Food Security Survey, data from the *Food Environment Atlas* (2, 12%), data from the *Feeding America: Mapping the Meal Gap* reports (1, 6%), and the *Hunger Vital Sign* (1, 6%), which is a validated 2-item food insecurity screening tool.^[42]

Key findings

The review revealed an association between food insecurity and development, prevalence, and poor liver disease outcomes. According to the findings by Maxwell et al,^[35] experiencing household food insecurity at 4 years of age was associated with an almost fourfold increased odds of MASLD in later childhood. In addition, Paik et al^[28] found that adolescents 12–18 years old from low-income households with food insecurity had a 3-fold increased risk of MASLD. Among adults, in a case–control study by Tutunchi et al,^[37] food insecurity was significantly more prevalent among patients with MASLD compared with control groups, with rates of 56.8% and 26.1% respectively ($p < 0.001$). Studies demonstrated that food insecurity was associated with a higher prevalence of liver disease, with one reporting an increased OR of 1.38 and 2.20 for the presence of MASLD and advanced liver fibrosis, respectively.^[26,29,40] Food-insecure individuals consistently exhibited higher rates of hepatic steatosis, liver fibrosis, and elevated liver stiffness, suggesting a strong link between poor food access and liver disease progression.^[33,34,36] In the study by Kim et al,^[26] food-insecure patients had a 40% higher risk of developing advanced fibrosis compared with food-secure individuals (OR: 1.40, 95% CI: 1.04–1.88). Kardashian et al^[30]

found food insecurity to be associated with a higher risk of all-cause mortality in both MASLD (HR 1.46, 95% CI: 1.08–1.97) and advanced fibrosis (HR: 1.37, 95% CI: 1.01–1.86) after adjustment for demographic, socio-economic, and metabolic risk factors. In this same study, food insecurity was also associated with increased outpatient health care utilization among MASLD patients (OR: 1.31, 95% CI: 1.05–1.63).^[30] The study by Paik et al^[38] highlighted that counties with the highest MASLD-related mortality had higher rates of food desert (8.7% vs. 5.8%, $p < 0.001$) compared with those with the lowest mortality. In fact, it was found that MASLD mortality was twice as high in counties with the greatest food desert burden compared with those with the least (25.65 vs. 12.75 per 100,000; 95% CI: 2.66–4.72). Furthermore, Younossi et al's multi-country study found that in high Socio-Demographic Index (SDI) countries, MASLD prevalence was significantly higher in those in the top tertile of food insecurity compared with the bottom tertile (mean, 26.73% vs. 18.87%, $p = 0.0001$). In contrast, in low SDI countries, the opposite was true (19.45% vs. 24.96%, $p = 0.0008$).^[39] Of the included studies, only one discusses the effect of participating in the Supplemental Nutrition Assistance Program (SNAP). In this study by Paik et al,^[38] it was found that counties with a higher percentage of SNAP participation among the eligible population were associated with lower MASLD-related mortality rates ($p < 0.001$). These studies highlight the importance of food insecurity as a potentially modifiable risk factor in developing and managing liver disease and preventing further progression. The results from each study are summarized in [Table 2](#).

The Mixed Methods Appraisal Tool was used to evaluate the quality of each selected study and the assessment of the risk of bias. These results are reported in the Supplemental Materials as Tables S2–S4, <http://links.lww.com/HC9/C103>, based on whether the paper utilized a cohort, cross-sectional, or case–control study design, respectively. Most studies (15/17, 88%) met 5/5 criteria, thus were high quality and low risk of bias. The remaining 2 studies (12%) met 4/5 criteria, due to not accounting for confounders in the study design.

DISCUSSION

This systematic review highlights the previously unexplored relationship between food insecurity and liver disease, an issue that has garnered increased attention in the wake of the COVID-19 pandemic. Notably, all studies included in this review were published within the last 5 years, reflecting a growing recognition of food insecurity as a structural determinant of health relevant to liver disease. The economic strain and social disruptions caused by the pandemic brought

TABLE 1 Characteristics of each study

Authors	Publication year	Country	Type of study	Sample size	Database/study	Descriptive characteristics
Endo et al ^[24]	2024	US	Retrospective cohort analysis	2710 counties	Scientific Registry of Transplant Recipients & Center for Disease Control and Prevention's Wide-ranging Online Data for Epidemiologic Research	County data on adults aged between 15 and 74 years between 2010 and 2020
Kardashian et al ^[25]	2024	US	Prospective cohort study	654	HIV NASH Clinical Research Network	18 years or older on antiretroviral therapy without known liver diseases, enrolled from July 2021 to July 2023
Kim et al ^[26]	2024	US	Cross-sectional study	3441	NHANES 2017–2018	Adults 20 years or older with available data on food security, physical activity, total calorie intake, economic status, and data on body mass index
Orkin et al ^[37]	2021	US	Retrospective cohort analysis	271	Steatohepatitis Center of Cincinnati Children's Hospital Medical Center	4–21-year-olds at the time of initial questionnaire completion with NAFLD
Paik et al ^[28]	2024	US	Cross-sectional study	771	NAHNES 2017–2018	Adolescents 12–18 years
Golovaty et al ^[29]	2020	US	Cross-sectional study	2627	NHANES 2005–2014	Adults 20 years or older
Kardashian et al ^[30]	2021	US	Population-based cohort study	6470	NHANES 1999 to 2014	Adults 20 years or older
Orkin et al ^[31]	2024	US	Cross-sectional study	73	Steatohepatitis Center of Cincinnati Children's Hospital Medical Center (CCHMC) and Yale New Haven Children's Hospital	< 21 years old with histologically confirmed NAFLD between 2017 and 2021
Chinaemelum et al ^[32]	2023	US	Population-based cohort study	Hepatocellular: n = 11,937	Surveillance, Epidemiology, and End Results (SEER)-Medicare database	Patients diagnosed with HPB cancer between 2010 and 2015
Tapper et al ^[33]	2023	US	Cross-sectional study	3502	NHANES 2017–2018	Adults 20 years and older
Tamargo et al ^[34]	2021	US	Cross-sectional study	603	Miami Adult Studies on HIV (MASH) cohort	Adults 40 years or older with and without HIV or HCV infection
Maxwell et al ^[35]	2024	US	Prospective cohort design	136 children	Two longitudinal birth cohorts: Hispanic Eating and Nutrition (HEN) cohort (2006–2007) and Latino, Eating, and Diabetes (LEAD) cohort (2011–2013) at the University of California, San Francisco, and Zuckerberg San Francisco General Hospital	Children primarily of Mexican and Central American origins, with reported household food insecurity at 4 years of age
Niezen et al ^[36]	2024	US	Cross-sectional study	6945	NHANES, 2017–2020	Adults 20 years and older, with a focus on Hispanic and non-Hispanic populations

Tutunchi et al^[37]	2021	Iran	Case-control study	210	Imam Reza Hospital Jan-June 2019	Cases: Iranian adults 20–50 years with US-diagnosed NAFLD controls: adults without NAFLD
Paik et al^[38]	2025	US	Cross-sectional study	3127 counties	USDA Food Environment Atlas, CDC WONDER, County Health Rankings, and the U.S. Census Bureau	Counties with MASLD-related mortality data available from 2016 to 2020
Younossi et al^[39]	2025	Multi-country	Cross-sectional study	204 countries	Global Burden of Disease (GBD) 2021, Food and Agriculture Organization (FAO), NCD Risk Factor Collaboration, CIA World Factbook	Country-level data on MASLD prevalence, liver-related mortality, obesity, type 2 diabetes, physical activity, SDI, and food insecurity indicators
Sohrabi et al^[40]	2024	Iran	Cross-sectional	275 patients	Primary data collected from patients at a liver clinic in Firoozgar Hospital, Tehran, Iran (June 2017–June 2019)	Adults without viral or autoimmune hepatitis or significant alcohol use; 51.6% male; mean age 44.4 years; assessed for obesity, diabetes, SES, and NAFLD

Abbreviations: NHANES, National Health and Nutrition Examination Survey; SES, socioeconomic status.

food insecurity to the forefront of public health discussions, particularly in the context of chronic disease.^[43]

The findings of this review emphasize the need for a stronger focus on food insecurity in future hepatology research. There are significant gaps in the literature, particularly concerning diseases other than MASLD, such as alcohol-associated liver disease, autoimmune liver disease, or viral hepatitis. It is also important to note that some studies in this review were conducted before the adoption of the new MASLD nomenclature and used older definitions such as NAFLD. This variation in disease definitions may contribute to heterogeneity in the findings and limit the ability to fully compare outcomes across studies. Future research should apply updated MASLD criteria to improve consistency and relevance in hepatology research.

There is also limited data regarding the role of food insecurity in the complications patients with liver disease face, including progression of disease and health care utilization. Evidence suggests that experiences of food insecurity increase overall health care costs and utilization.^[44] The additive contributions of already higher rates of hospitalization in liver disease^[45,46] with increases related to experiences of food insecurity, deserve further evaluation. The unique dietary needs of liver disease patients, which may differ substantially from other metabolic disorders, necessitate a tailored approach to addressing food insecurity. Among patients with liver diseases, specific subgroups may additionally have distinct dietary recommendations (eg, compensated vs. decompensated cirrhosis, MASLD vs. alcohol-associated liver disease), adding further complexity to disease management. While food insecurity is a well-established contributor to poor health, most studies in this review did not directly assess diet quality as an independent variable in relation to liver disease outcomes. Poor or inadequate nutrition in liver disease patients not only worsens outcomes but can also accelerate the progression of liver fibrosis and worsen cirrhosis complications.^[6,9] Understanding how food insecurity interacts with these dietary requirements in the setting of underlying food insecurity will be essential in developing more effective, patient-specific interventions. Understanding how food insecurity can directly and indirectly contribute to poor diet quality will be important in future research.

Moreover, very few studies have explored the link between food insecurity and malnutrition, frailty, or sarcopenia risk, despite the fact that patients with liver disease are at an increased baseline risk of these conditions.^[5] Decompensated patients are particularly vulnerable, facing the highest morbidity and mortality risks and the most complex dietary needs.^[9,47,48] Understanding where food insecurity fits into this pathway is essential for ensuring optimal outcomes.

Pre-liver and post-liver transplant patients also warrant consideration. Food insecurity may significantly

TABLE 2 Tools and results of each study

References	Disease focus	Measurement of food insecurity	Outcome	How the outcome was measured	Findings on the association between food insecurity and liver disease
Endo et al ^[24]	Steatotic liver disease and liver transplantation	2010–2015 Food Environment Atlas (Food Desert)	- Prevalence of SLD-related deaths - Access to LT listing - Graft survival	Data extracted from the databases	Strong association between county-level SLD-related mortality and increased severity of county-level food desert scores. Access to LT also decreased incrementally relative to the food desert score (low: 102.9 per 1000 SLD-related deaths, IQR 87.3–125.2 vs. medium: 98.8 per 1000 SLD-related deaths, IQR 80.3–122.8 vs. high: 93.7, IQR 77.5–109.2, $p < 0.001$). Although individuals residing in high food desert counties were less likely to undergo LT, among patients who did undergo LT, post-transplant graft survival was comparable, irrespective of food desert designation.
Kardashian et al ^[25]	NAFLD and liver fibrosis	Six-Item Short Form Household Food Security Survey	Prevalence of NAFLD and/or advanced liver fibrosis	Vibration-controlled transient elastography (VCTE)	Among adults with HIV infection, food insecurity is highly prevalent and associated with lower odds of NAFLD. By contrast, among diabetic PWH, food insecurity is associated with greater odds of advanced fibrosis. - Highlights that food insecurity may influence liver disease differently in HIV infection. - In multivariable logistic regression models, food insecurity was associated with lower odds of NAFLD (OR, 0.57; 95% CI, 0.37–0.88; $p = 0.01$) - Trend toward higher odds of advanced fibrosis with food insecurity (OR, 1.81; 95% CI, 0.95–3.43), but this was attenuated and not significant

					- Relationship between food insecurity and advanced fibrosis stratified by diabetes status, food insecurity was associated with significantly greater odds of advanced fibrosis among people with diabetes (OR, 3.83; 95% CI, 1.15–12.73), but not among nondiabetics (OR, 1.12; 95% CI, 0.47–2.98)
Kim et al ^[26]	Metabolic dysfunction–associated steatotic liver disease (MASLD) and liver fibrosis	USDA Household Food Security Survey Module	Prevalence of MASLD or liver fibrosis	Transient elastography	- Food insecurity increased the odds of the prevalence of MASLD by 42% (OR: 1.42, 95% CI: 1.12–1.78) after adjustment for demographic, lifestyle, and metabolic risk factors. The addition of diabetes and obesity did not change this association (OR: 1.36, 95% CI: 1.03–1.78). - The multivariable model showed an independent relationship between food insecurity and significant hepatic fibrosis (OR: 1.40, 95% CI: 1.04–1.88) after adjustment for demographic, lifestyle, and metabolic risk factors, although the association was attenuated and changed insignificantly after adjustment for diabetes and obesity. - Food insecurity was associated with higher odds for MASLD. While there is a relationship between food insecurity and significant hepatic fibrosis, this relationship changed insignificantly after adjustment for diabetes and obesity.
Orkin et al ^[27]	NAFLD	Two-item validated screening tool as part of a broader health-related social needs questionnaire administered at clinic visits (hunger vital sign test)	Prevalence of health-related social needs among youth with NAFLD	Questionnaires completed at office visits	Food insecurity was significantly associated with the presence of other health-related social needs and the persistence of unmet needs over time. Families reporting food insecurity were 27 times more likely to have persistent unmet

TABLE 2. (continued)

References	Disease focus	Measurement of food insecurity	Outcome	How the outcome was measured	Findings on the association between food insecurity and liver disease
					health-related needs in subsequent visits, indicating a strong association between food insecurity and ongoing social challenges that may impact NAFLD management and outcomes.
Paik et al ^[28]	MASLD	USDA Child Food Security Survey Module	Prevalence of MASLD	VCTE	Food-insecure adolescents had a higher prevalence of MASLD (17.4%) compared with food-secure adolescents (9.4%). Adolescents from low-income households with food insecurity had a 3-fold increased risk of MASLD.
Golovaty et al ^[29]	NAFLD and liver fibrosis	USDA Household Food Security Survey Module	Prevalence of NAFLD or liver fibrosis	US Fatty Liver Index or NAFLD fibrosis score	In models adjusted for demographic, socioeconomic, and behavioral health characteristics food insecurity was associated with higher odds of estimates of NAFLD (AOR: 1.38; 95% CI: 1.08, 1.77; <i>p</i> < 0.01) and advanced fibrosis (AOR: 2.20; 95% CI: 1.27, 3.82; <i>p</i> < 0.01) compared with living in a food-secure household.
Kardashian et al ^[30]	NAFLD and liver fibrosis	USDA Household Food Security Survey Module	All-cause mortality and health care utilization	Mortality data were obtained from the National Death Index, and health care utilization was assessed based on the number of inpatient and outpatient visits	Food insecurity was associated with a higher risk of all-cause mortality in both NAFLD (HR: 1.46) and advanced fibrosis (HR: 1.37) after adjusting for demographic, socioeconomic, and metabolic factors. Food insecurity was also associated with increased outpatient health care utilization among NAFLD patients.
Orkin et al ^[31]	NAFLD	USDA Household Food Security Survey Module	Presence of NAFLD and disease severity	Liver disease severity was assessed using histologic evaluation, including the NAFLD Activity Score	Food insecurity was associated with a younger age at NAFLD diagnosis (on average, 2 years earlier than food-secure counterparts). However, there

				(NAS) and fibrosis staging from liver biopsies	was no significant difference in histologic severity between food-secure and food-insecure patients. Lipidomic analysis showed distinct lipid profiles related to food insecurity, suggesting possible mechanistic links to NAFLD pathogenesis.
Chinaemelum et al ^[32]	Hepatopancreaticobiliary (HPB) cancers	Data on county-level FI were obtained from the Feeding America: Mapping the Meal Gap reports between 2010 and 2015, and the average household income	Perioperative outcomes (eg, complications, extended length of stay, 90-day readmission, 90-day mortality) and long-term survival (1-year, 3-year, and 5-year mortality rates) following resection of HPB cancers	Data extracted from the database	Patients with HCC residing in high food insecurity counties had significantly lower odds of achieving textbook outcomes and higher risks of perioperative complications, 90-day mortality, and reduced 1-year, 3-year, and 5-year survival rates compared with those in low food insecurity counties.
Tapper et al ^[33]	Liver fibrosis and cirrhosis	USDA Household Food Security Module	Liver stiffness measurements are indicative of liver fibrosis and cirrhosis	VCTE	Food insecurity was significantly associated with higher liver stiffness measurements among adults aged 50 years and older. Specifically, food-insecure individuals in this age group had increased odds of advanced fibrosis (LSM ≥ 9.5 kPa; OR: 2.50) and cirrhosis (LSM ≥ 12.5 kPa; OR: 3.07). - There was no significant association between food insecurity and liver stiffness among younger adults. - There was no difference in CAP, ALT, or AST by food security status.
Tamargo et al ^[34]	NAFLD and liver fibrosis	USDA Household Food Security Module	The presence of nonalcoholic fatty liver (steatosis) and fibrosis	NAFLD was measured using magnetic resonance imaging-proton density fat fraction (MRI-PDFF), and liver fibrosis was assessed using magnetic resonance elastography (MRE)	- For every 5 kg/m ² increase in BMI, the odds of NAFLD increased by a factor of 3.83 (95% CI, 2.37–6.19) in food-insecure participants compared with 1.32 (95% CI, 1.04–1.67) in food-secure participants. - Food insecurity was associated with increased odds for any liver fibrosis (OR, 1.65; 95%

TABLE 2. (continued)

References	Disease focus	Measurement of food insecurity	Outcome	How the outcome was measured	Findings on the association between food insecurity and liver disease
					CI, 1.01–2.72) and advanced liver fibrosis (OR, 2.82; 95% CI, 1.22–6.54), adjusted for confounders. - The relationship between food insecurity and liver fibrosis did not differ between infected and uninfected participants.
Maxwell et al ^[35]	MASLD	USDA Household Food Security Module	Development of MASLD	Elevated ALT level ($\geq$ 95th percentile for age/gender) and body mass index (BMI) $\geq$ 85th percentile for age	- 48.6% of the MASLD group reported household food insecurity compared with 20.7% in the non-MASLD group ($p < 0.01$) - Household food insecurity at 4 years of age was associated with an almost 4-fold increased odds of MASLD in later childhood.
Niezen et al ^[36]	MASLD	USDA Household Food Security Module	Risk of hepatic steatosis and fibrosis	VCTE to assess liver stiffness and controlled attenuation parameter (CAP) scores to determine fibrosis and steatosis	Hispanic individuals with food insecurity had significantly higher CAP scores, indicating greater liver fat content and risk of hepatic steatosis compared with food-secure Hispanic individuals. The association was stronger among those with food insecurity, even after adjusting for age, sex, income, BMI, and diabetes.
Tutunchi et al ^[37]	NAFLD	USDA Household Food Security Survey Module	Presence of NAFLD	Ultrasonography	- Food insecurity prevalence was 56.8% in cases and 26.1% in controls, and this difference was statistically significant ($p < 0.001$). - OR for NAFLD in the food-insecure subjects was 2.7 (95% CI: 1.37–3.93) times more in comparison with the controls.
Paik et al ^[38]	MASLD	2020 release of the Food Environment Atlas	MASLD mortality	Age-adjusted death rates for fatty liver disease (ICD-10 code K76.0) from	- Counties with the highest mortality (fourth quartile) had higher rates of

				CDC WONDER (2016–2020)	food desert (8.7% vs. 5.8%) and a higher food swamp ratio (5.69 vs. 4.28), compared with those with the lowest mortality (first quartile). - MASLD mortality was twice as high in counties with the greatest food desert burden compared with those with the least (25.65 vs. 12.75 per 100,000).
Younossi et al ^[39]	MASLD	FAO indicators: Food Insecurity Experience Scale (FIES), undernourishment, cost of a healthy diet, unaffordability of a healthy diet	MASLD prevalence and liver-related mortality	GBD 2021 country-level estimates of MASLD prevalence and mortality (ICD-based, modeled estimates)	- For high SDI countries, MASLD prevalence was higher in countries with the top tertile of food insecurity compared with those countries with the bottom tertile of food insecurity (26.73% vs. 18.87%; adjusted difference = 7.85%, 95% CI 4.06%–11.65%, $p = 0.0001$). - The data from low SDI countries suggest that MASLD prevalence is lower in the countries with the top tertile of food insecurity (19.45% vs. 24.96%; adjusted difference of -5.51%, 95% CI -8.65% to -2.36%, $p = 0.0008$).
Sohrabi et al ^[40]	MASLD	Six-item Short Questionnaire of Household Food Security	Presence of MASLD	Diagnosed via ultrasonography and FibroScan (steatosis > 240 dbm); confirmed with clinical and laboratory parameters	Food insecurity was significantly associated with increased odds of NAFLD (adjusted OR = 2.95, 95% CI: 1.02–8.57). Path analysis showed food insecurity had a direct effect on NAFLD ($\beta = 0.12$, $p = 0.03$), alongside general and abdominal obesity.

Abbreviations: LT, liver transplantation; SLD, steatotic liver disease.

impact nutritional optimization before transplant, which is critical for surgical outcomes, and post-transplant, where patients must adhere to strict dietary regimens to prevent complications and support recovery.^[7] These populations remain underrepresented in the current literature and deserve further attention.

Despite the associations identified in this review, significant gaps remain in the research, particularly regarding intervention studies and clinical trials. To date, no studies have employed causal approaches to understand the directionality of the relationship between food insecurity and liver disease. This lack of causal evidence limits our ability to determine whether food insecurity exacerbates liver disease progression or whether advanced liver disease increases the likelihood of food insecurity due to socioeconomic factors. There is also a lack of implementation studies on systematically identifying food insecurity in hepatology clinics. Incorporating this screening into clinical workflows would not only provide valuable data to deepen our understanding of this relationship but also create opportunities to design and test tailored interventions. By addressing food insecurity proactively in hepatology clinics, researchers and clinicians can better identify at-risk populations and evaluate which interventions are most effective in improving both nutritional status and liver health outcomes.

While evidence-based practices are urgently needed, efforts should be made to address food insecurity and the surrounding food environment in adults and children, given its demonstrated link to liver disease. Eligible patients should be referred to evidence-based food resources, including benefit programs like the Supplemental Nutrition Assistance Program (SNAP),^[49] as well as local food pantries and soup kitchens. Screening for food insecurity within hepatology clinics and implementing patient-specific interventions could transform care and improve long-term outcomes. While one study we looked at found that counties with higher SNAP (also known as food stamps) enrollment had lower MASLD-related mortality, there is limited evaluation of SNAP as a program and its impact on liver disease. Future research should evaluate interventions aimed at addressing food insecurity in liver disease populations, like SNAP, and assess whether these interventions can slow disease progression or reduce health care utilization.

Limitations

This review faces several limitations, specifically regarding the scope of the studies analyzed. A large proportion (6, 42.8%) of the included studies utilized data from the National Health and Nutrition Examination Survey (NHANES), thus several studies may be using overlapping data and repeat a single finding among a static population rather than capture different aspects of

food insecurity and liver disease faced by varying populations. Another consideration of the repeated use of NHANES data is that it only provides cross-sectional information. This design lacks temporal information, meaning it cannot clarify whether the exposure (food insecurity) occurred before the outcome (liver disease) or vice versa. It should be considered that food insecurity in these studies is identified by self-reported questionnaires, and could be subject to recall bias, social desirability bias, and potential misunderstanding of questions.

CONCLUSIONS

While current research demonstrates a recent uptick in interest in the relationship between food insecurity and liver disease, there remain significant gaps in the evidence. Opportunities exist for causal methodology to understand the direction of the relationship between food insecurity and liver disease. Better data collection at the individual level will inform the prevalence of food insecurity across liver disease etiologies and allow for the development of interventions to improve food insecurity rates. Given the increased attention to structural determinants of health since the COVID-19 pandemic, care for patients with liver disease must continue apace to include food insecurity as a likely modifiable risk factor in the care of patients.

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CONFLICTS OF INTEREST

The authors have no conflicts of interest.

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