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RESEARCH ARTICLE

Silent Liver Epidemic in Rural India: Community-Level Screening for MASLD and Metabolic Risks

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Abstract: ***Background***: The most common etiology of chronic liver disease in the world is metabolic dysfunction-associated steatotic liver disease (MASLD), which was previously named as non-alcoholic fatty liver disease. The condition has a high epidemiological correlation with metabolic syndrome factors and especially where there is a high lifestyle transition. ***Objective:*** To estimate the prevalence of MASLD and assess hepatic fibrosis burden among adults participating in community-based screening programs within a rural population. ***Methods:*** A community-based cross-sectional study was conducted in Koovanur Village, Tamil Nadu, during June-August 2025. Adults aged ≥18 years underwent screening using the Community-Based Assessment Checklist. High-risk individuals received biochemical evaluation and non-invasive fibrosis assessment using FIB-4 Index. ***Results:*** Among 520 individuals screened, 290 (55.8%) were categorized as high-risk. Of 200 participants providing blood samples, fibrosis assessment was completed in 55 individuals. Mild fibrosis (FIB-4: 1.3-2.67) was identified in 45 participants (81.8%), while advanced fibrosis (FIB-4 >2.67) was present in 10 participants (18.2%). ***Conclusion:*** The study demonstrates substantial metabolic risk burden in rural populations, with significant hepatic fibrosis prevalence among screened individuals. These findings underscore the necessity for integrating MASLD screening protocols into existing primary healthcare infrastructure and implementing targeted lifestyle intervention programs.

Keywords: Metabolic Dysfunction-Associated Steatotic Liver Disease, Nonalcoholic Fatty Liver Disease, Liver Fibrosis, Obesity, Diabetes Mellitus, Body Mass Index, Waist Circumference, CBAC Checklist

INTRODUCTION

Steatotic liver disease (MASLD) is a continuum of hepatic diseases associated with an excess of lipids in hepatocytes, which is present in the persons who neither have alcohol intake in substantial amounts nor have any secondary causes of hepatic steatosis. The pathophysiology of MASLD is insulin resistance and oxidative stress, lipotoxicity, and low-grade chronic inflammation, which result in liver cell damage and eventual fibrosis. (3) Currently, MASLD is a disease that impacts about 38% of adults worldwide and its prevalence estimates that it may rise to 55% by the year 2040. The morbidity and mortality rates of cardiovascular diseases are not limited to the hepatic signs of the disease as MASLD increases the risk of cardiovascular morbidity and mortality significantly which represents the top cause of mortality among infected individuals. (4)

Most patients are asymptomatic at the early stages of the disease and pose diagnostic challenges and late clinical identification. Some of them develop metabolic dysfunction-related steatohepatitis (MASH), and lead to cirrhosis, Hepatocellular carcinoma, and end-stage liver disease that needs transplantation. Non-invasive modalities of imaging such as ultrasonography and transient elastography are used as the main diagnostic techniques, with the support of the validated fibrosis scoring system. Although the diagnosis and staging of MASLD is best established through liver biopsy, population-level screening is increasingly depending on non-invasive biomarkers and risk stratification instruments due to increasing prevalence of the disease in the Indian subcontinent in correlation with urbanization, changes in diet and adoption of sedentary lifestyles. (5,6) Nevertheless, there is limited epidemiological data regarding populations in rural areas although these communities have experienced the same shift in metabolic transitions.

Early disease identification, risk classification and preventive intervention before complications arise is achievable through community based screening programs. (7) Since MASLD has a silent course and multi system connotations, the study was conducted to evaluate the disease burden by means of community-based screening and to describe the metabolic risk profiles and fibrosis patterns in a rural population. The aim of the study was to estimate the prevalence of MASLD in adults attending community-based screening programs and to assess the hepatic fibrosis in the suspected cases of MASLD.

MATERIAL AND METHODS

The study was a community based cross-sectional research conducted at Koovanur village, Tiruvannamalai District, Tamil Nadu, India in June to August 2025. The village is a medical field practice site of Arunai Medical College, and it is a typical rural South Indian demographic and socioeconomic area. A multi-stage screening protocol was used in the study to identify the prevalence of MASLD and the severity of hepatic fibrosis. The population under study was the adults aged 18 years and above and permanently residing in villages at least six months. The exclusion criteria were that the participants were of critical alcohol intake of 30 grams per day in males and 20 grams per day in females, had chronic liver disease of other etiology, acute severe illness during screening, and pregnant women. Simple random sampling was carried out to recruit the participants based on the village census records formed by the community health workers. Sample size calculation was performed assuming 38.6% MASLD prevalence with 95% confidence interval and 5% absolute precision, yielding a required sample size of 364 participants using the formula: $n = (Z^2 \times p \times [1-p]) / d^2 = (3.84 \times 0.386 \times 0.614) / (0.05)^2 = 364$.

Household visits by field teams of Accredited Social Health Activists (ASHA), trained health workers, and medical social workers who administered the Community-Based Assessment Checklist (CBAC) were done following the guidelines of National Programme to Prevent and Control Cancer, Diabetes, Cardiovascular Diseases and Stroke (NPCDCS). (8) CBAC tool measured sociodemographic, behavioral risk factors that included tobacco use, alcohol use, dietary habits, and physical activity, anthropometric measurements such as height and weight, waist circumference and body mass index, blood pressure readings, and self-reported diabetes mellitus or hypertension history. Individuals scoring ≥4 on CBAC were designated high-risk and invited for subsequent evaluation stages.

Venous blood collection on high-risk participants has been conducted after overnight fasting. Laboratory assessment comprised of fasting plasma glucose, hepatic transaminases (alanine aminotransferase and aspartate aminotransferase), and complete blood count containing platelets count. Respondents who possessed biochemical abnormalities indicating MASLD, namely, high hepatic enzymes and metabolic risk factors, were taken to the non-invasive fibrosis analysis. Fibrosis risk stratification employed the Fibrosis-4 (FIB-4) Index, calculated as: [Age (years) × AST (U/L)] / [Platelet count (10^9/L) × √ALT (U/L)]. Participants were categorized as low risk (FIB-4 <1.3), intermediate risk (FIB-4 1.3-2.67), or high risk for advanced fibrosis (FIB-4 >2.67).

To reduce transcription errors, data were entered into EpiCollect5 digital platform on the field. Demographic variables and clinical parameters were calculated by means of descriptive statistics (frequencies, percentages, and standard deviations of means). The percentage of people with MASLD was determined as the percentage of possible cases in the total population screened. The fibrosis burden was reported as the ratio of mild and advanced fibrosis of the assessed subjects. The Institutional Ethics Committee gave ethical approval before the beginning of the study. Informed consent written or witnessed thumbprint consent was taken of all participants after thorough explanation of aims of the study, methods, possible risks and benefits in the local Tamil language. Data confidentiality was ensured by the use of distinctive participant identification codes where the personal identifiers were stored safely. The respondents who were diagnosed with metabolic disorders such as hyperglycemia, hypertension, or hepatic fibrosis had referral documentation to manage the conditions in the relevant healthcare facilities. The involvement was voluntary and could be stopped without affecting normal access to healthcare.

RESULTS AND OBSERVATIONS:

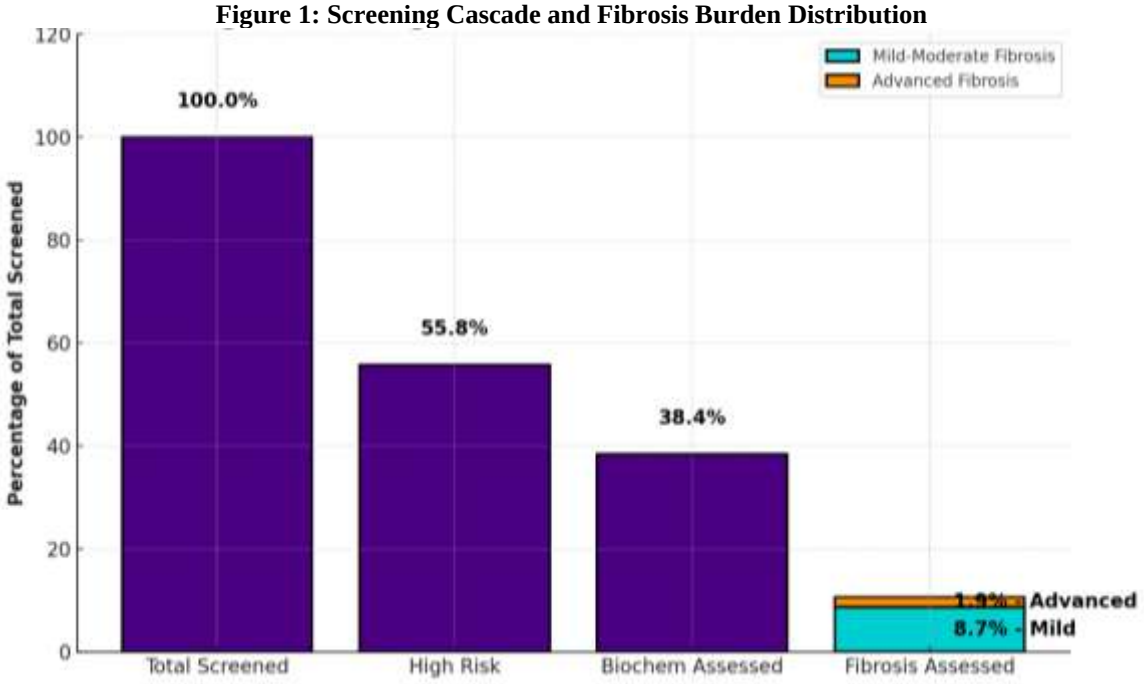
The rural field practice area was screened using MASLD community screening program on 520 individuals. Among them, 290 (55.8%) subjects were considered to be high-risk according to the CBAC scoring system. Out of high-risk patients, 200 (68.9%) were found willing to undergo phlebotomy to determine the biochemical profile, and 90 subjects (31.0%) refused to do this. The full evaluation of fibrosis by means of FIB-4 Index was conducted in 55 participants whose detailed laboratory records are provided. Of these, 45 (81.8%) showed the results of FIB-4 ranging between 1.3 and 2.67 representing mild-moderate fibrosis, and 10 (18.2%) participants reported results that were above 2.67 representing advanced fibrosis or cirrhosis. Table 1 shows the screening cascade and distribution of fibrosis as shown in Figure 1.

Table 1: Screening Cascade and Fibrosis Distribution in Rural Population (N = 520)

Parameter	Classification	Number (n)	Percentage (%)
Total individuals screened	—	520	100.0
High-risk classification (CBAC ≥4)	—	290	55.8
Biochemical assessment completed	—	200	68.9
Biochemical assessment declined	—	90	31.0
Complete fibrosis assessment	—	55	27.5
FIB-4 Index 1.3-2.67	Mild-moderate fibrosis	45	81.8
FIB-4 Index >2.67	Advanced fibrosis	10	18.2

Rural population showed moderate to high rates of metabolic risk factors with more than half of the population passing high-risk criteria based on a CBAC screening. The fact that fibrosis was identified in 18.2% of evaluated participants though no overt signs of a disease were present, suggests that the prevalence of occult disease is significant in this population.

Figure 1: Screening Cascade and Fibrosis Burden Distribution



DISCUSSION

The community-based research determined that high metabolic risk burden existed in 55.8% of rural adults on screening, and advanced hepatic fibrosis was detected in 18.2% of individuals who were evaluated. The same findings are correlated with newly emerging evidence that MASLD is spreading to rural Indians in previously unthought of areas that were believed to be safeguarded by traditional lifestyle patterns. Our study of high-risk (55.8) prevalence aligns with a recent systematic review by Shalimar et al., which has shown overall Indian NAFLD prevalence was 38.6 with significantly high prevalence in high-risk groups.(9) NAFLD prevalence in a multi-center study of North India by Asadullah et al. reported disease prevalence of 62.5% in rural populations and 63.8% in urban populations, which show similar disease prevalence across geographic areas. (10) Likewise, NAFLD prevalence of 61.5 % in urban populations of tertiary care in Chennai was reported by Anton et al., when obesity became the primary risk factor. (11)

Urban-rural convergence implies that the effects of lifestyle transition have saturated the traditional rural environment with westernization of diet, decreased occupational physical activity, and increased sedentary time. Particular clinical focus should be paid to the 18.2% rate of the advanced fibrosis found in our study. The consensus statement of the key Indian gastroenterology and endocrinology societies by Duseja et al. indicates that the detection of fibrosis at an early stage is one of the most significant factors to consider in prognosis, since it is associated with the risk of higher mortality rate. (12) Singhai et al. studied NAFLD in a large-scale community study in Bhopal and found that 43.6% of apparently healthy adults had NAFLD, but the

fibrotic analysis was not systematically conducted. (13) Sahoo et al. reported NAFLD prevalence 36% in diabetic populations with significant correlations to microvascular complication such as nephropathy and neuropathy, indicating the existence of common pathophysiological pathways involving metabolic dysfunction associated with dysfunction of many organs. (14)

Meta-analytic data on global comparative prevalence of MASLD show that the prevalence will be close to 38% with a projection to 55% by 2040. (15) The pathophysiologic mechanism underlying this epidemic is multifactorial as it comprises insulin resistance and hepatic lipid accumulation, oxidative stress and pro-inflammatory cytokines activation. (16) Instead of causing liver-related complications, cardiovascular disease is the major cause of mortality in the MASLD patients, which highlights the systemic metabolic nature of the condition. (17) The FIB-4 Index used in this analysis has a large negative predictive value of ruling out advanced fibrosis in the community, which was confirmed by Blanco-Grau et al. in Spanish populations. (18) Chen et al.'s Recent meta-analysis of FIB-4 as a non-invasive fibrosis assessment method showed that this test has a satisfactory sensitivity and specificity in clinical diagnosis when used as a community screening tool (19). The fact that such simple assessment tools are based on calculations makes them readily implementable in resource constrained primary care settings that do not have access to the advanced imaging modalities.

Current international guidelines from European Association for the Study of the Liver (EASL), European Association for the Study of Diabetes (EASD), and European Association for the Study of Obesity (EASO) recommend systematic MASLD screening in high-risk populations, emphasizing lifestyle modification as first-line intervention. (20) Evidence demonstrates that 5-10% body weight reduction can reverse hepatic steatosis and potentially regress early fibrosis stages. (21) The integration of MASLD screening into India's existing NPCDCS infrastructure, utilizing the validated CBAC tool, provides a pragmatic implementation pathway.

MASLD screening should be implemented into the current infrastructure of NPCDCS in India through the use of the validated CBAC tool, which will offer a feasible implementation pathway. The implications of our findings to public health are important and there are a few that we have identified that need immediate action. To begin with, the high rates of progressed fibrosis among asymptomatic patients require comprehensive surveillance of the community. Second, the similar urban-rural disease burden suggests that the influence of lifestyle transition has taken place in the traditional rural environments. Third, it can be implemented with the use of resource-constrained settings due to the availability of simple non-invasive assessment tools. The strategies to implement are MASLD screening as part of the existing NCD programs, building capacity among community health workers to handle CBAC administration and risk counseling, the development of referral channels to those who have suspected advanced fibrosis, and the development of culturally sensitive lifestyle change interventions with a focus on dietary changes and promotion of physical activity.

Limitations

This study has several limitations. The single-village design may limit generalizability to broader rural, tribal, or urban populations. A fibrosis evaluation was done only in a subset of high-risk persons and this may have created selection bias. It has a limitation of lack of imaging confirmation by use of ultrasonography or transient elastography but FIB-4 Index shows acceptable performance attributes in community screening. The cross-sectional design does not allow causal inferences of the risk factors and the disease outcomes. These findings need longitudinal studies that are imaging-confirmed and with wider geographic coverage as a way of validating them.

Recommendations

Our systematic suggestions, as per the research results, are to create a systematic approach to MASLD screening integration into primary care systems through the existing CBAC instruments and frameworks of NCD programs. Community health workers should be trained on risk assessment, lifestyle counseling as well as proper referral procedures through capacity building initiatives. This is necessary in development and implementation of culturally customized lifestyle intervention program, which emphasizes dietary modification, weight management, and promotion of physical activity. Referral pathways that are crucial in the timely assessment and management of people with suspected advanced fibrosis must be established. Evidence-based policy decisions need to be made by developing longitudinal surveillance systems that can track the disease progression and intervention outcomes.

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CONCLUSION

The present community based screening study shows that there is high burden of metabolic risk and prevalence of hepatic fibrosis in a rural Indian community. The results point to the fact that steatotic liver disease related to metabolic dysfunction has

progressed into a pan-rural epidemic instead of a mostly urban one, as there are general shifts in nutritional and lifestyle. The prevalence rate of high-grade fibrosis in the asymptomatic group indicates the major significance of the systematic screening programs conducted in the community. The introduction of MASLD screening into the current primary healthcare systems, using the validated non-invasive assessment tools, is a feasible and sustainable solution to this escalating health issue among the population. The possibility of limiting disease progression as well as minimizing long-term complications within the impacted populations is associated with early detection and evidence-based lifestyle interventions.

REFERENCES

1. Rinella ME, Lazarus JV, Ratziu V, Francque SM, Sanyal AJ, Kanwal F, et al. A multi-society Delphi consensus statement on new fatty liver disease nomenclature. J Hepatol. 2023;79(6):1542-56.
2. Younossi ZM, Golabi P, Paik JM, Henry A, Van Dongen C, Henry L. The global epidemiology of nonalcoholic fatty liver disease (NAFLD) and nonalcoholic steatohepatitis (NASH): a systematic review. Hepatology. 2023;77(4):1335-47.
3. Friedman SL, Neuschwander-Tetri BA, Rinella M, Sanyal AJ. Mechanisms of NAFLD development and therapeutic strategies. Nat Med. 2018;24(7):908-22.
4. Younossi ZM, Kalligeros M, Henry L. Epidemiology of metabolic dysfunction-associated steatotic liver disease. Clin Mol Hepatol. 2025;31(Suppl):S32-S50.
5. Castera L, Friedrich-Rust M, Loomba R. Noninvasive assessment of liver disease in patients with nonalcoholic fatty liver disease. Gastroenterology. 2019;156(5):1264-81.
6. Chalasani N, Younossi Z, Lavine JE, Charlton M, Cusi K, Rinella M, et al. The diagnosis and management of nonalcoholic fatty liver disease: Practice guidance from the American Association for the Study of Liver Diseases. Hepatology. 2018;67(1):328-57.
7. Wong VW, Chan WK, Chitturi S, Chawla Y, Dan YY, Duseja A, et al. Asia-Pacific Working Party on Non-alcoholic Fatty Liver Disease guidelines 2017-Part 1: Definition, risk factors and assessment. J Gastroenterol Hepatol. 2018;33(1):70-85.
8. Ministry of Health and Family Welfare, Government of India. Operational Guidelines: National Programme for Prevention and Control of Cancer, Diabetes, Cardiovascular Diseases and Stroke (NPCDCS). New Delhi: Directorate General of Health Services; 2010.
9. Shalimar, Elhence A, Bansal B, Gupta H, Anand A, Singh TP, et al. Prevalence of non-alcoholic fatty liver disease in India: A systematic review and meta-analysis. J Clin Exp Hepatol. 2022;12(3):818-29.
10. Asadullah M, Shivashankar R, Shalimar, Kandasamy D, Kondal D, Rautela G, et al. Rural-urban differentials in prevalence, spectrum and determinants of non-alcoholic fatty liver disease in North Indian population. PLoS ONE. 2022;17(2):e0263768.
11. Anton MC, Shanthi B, Sridevi C. Prevalence of non-alcoholic fatty liver disease in urban adult population in a tertiary care center, Chennai. Indian J Community Med. 2023;48(4):601-4.
12. Duseja A, Singh SP, Saraswat VA, Acharya SK, Chawla YK, Chowdhury S, et al. Non-alcoholic fatty liver disease and metabolic syndrome-position paper of the Indian National Association for the Study of the Liver, Endocrine Society of India, Indian College of Cardiology and Indian Society of Gastroenterology. J Clin Exp Hepatol. 2015;5(1):51-68.
13. Singhai A, Yadav V, Joshi R, Burande MA. Prevalence, metabolic profile, and associated risk factors of non-alcoholic fatty liver disease in an adult population of India. Cureus. 2023;15(1):e33977.
14. Sahoo NR, Dalai MK, Dash DK, Sethy G. Prevalence, metabolic consequences of non-alcoholic fatty liver disease (NAFLD) and its association with microvascular complications and ventricular dysfunction in patients with type 2 diabetes mellitus. Med J DY Patil Vidyapeeth. 2024;17(1):149-55.
15. Riazi K, Azhari H, Charette JH, Underwood FE, King JA, Afshar EE, et al. The prevalence and incidence of NAFLD worldwide: a systematic review and meta-analysis. Lancet Gastroenterol Hepatol. 2022;7(9):851-61.
16. Tilg H, Moschen AR, Roden M. NAFLD and diabetes mellitus. Nat Rev Gastroenterol Hepatol. 2017;14(1):32-42.
17. Targher G, Byrne CD, Tilg H. NAFLD and increased risk of cardiovascular disease: clinical associations, pathophysiological mechanisms and pharmacological implications. Gut. 2020;69(9):1691-705.
18. Blanco-Grau A, Gabriel-Medina P, Rodriguez-Algarra F, Villena Y, Lopez-Martinez R, Augustin S, et al. Assessing liver fibrosis using the FIB4 index in the community setting. Diagnostics (Basel). 2021;11(12):2236.
19. Chen M, Guo C, Ouyang K, Liu N. Diagnostic role of the fibrosis-4 index and nonalcoholic fatty liver disease fibrosis score as a noninvasive tool for liver fibrosis scoring. Medicine (Baltimore). 2024;103(43):e40214.
20. European Association for the Study of the Liver (EASL), European Association for the Study of Diabetes (EASD), European Association for the Study of Obesity (EASO). EASL-EASD-EASO clinical practice guidelines on the management of metabolic dysfunction-associated steatotic liver disease (MASLD). J Hepatol. 2024;81(3):492-542.
21. Vilar-Gomez E, Martinez-Perez Y, Calzadilla-Bertot L, Torres-Gonzalez A, Gra-Oramas B, Gonzalez-Fabian L, et al. Weight loss through lifestyle modification significantly reduces features of nonalcoholic steatohepatitis. Gastroenterology. 2015;149(2):367-78.