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Exploring the epidemiology and awareness of metabolic dysfunction-associated steatotic liver disease (MASLD) among health sciences students in an academic health care institute in India

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A R T I C L E I N F O

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A B S T R A C T

Background: Metabolic dysfunction-associated steatotic liver disease (MASLD) affects over 25 % of the global population, presenting a significant health challenge. It is often asymptomatic but linked to severe conditions like cirrhosis and liver cancer. Previous research indicates that people often underestimate MASLD risks. This study examines MASLD prevalence and awareness among medical students in an academic health care institute in India.

Material and methods: This cross-sectional study at SRM Medical College Hospital, Chennai, involved 80 medical and paramedical students aged 18–25. Exclusion criteria included history of alcohol use, neurological disorders, thyroid issues, diabetes, and hypertension. After obtaining informed consent, anthropometric data and blood samples were collected. Biochemical parameters including fasting plasma glucose, triglycerides, HDL-C, and GGT were measured. The Fatty Liver Index (FLI) was used to assess liver steatosis, with an FLI ≥60 indicating NAFLD. Data were analysed using SPSS Version 22.0, with statistical significance set at $p < 0.05$.

Results: Among 80 participants, the mean age and BMI were 20.2 ± 1.03 years and 23.16 ± 4.55 kg/m^2. The mean Fatty Liver Index (FLI) score was 15.11 ± 19.68. MASLD prevalence was 7.5 % (n = 6). Significant positive correlations were found between FLI and BMI, waist circumference, fasting plasma glucose, triglycerides, and GGT, while HDL-C showed a non-significant negative correlation. Most participants were aware of MASLD and its risk factors but showed varied adherence to preventive measures.

Conclusion: Health Sciences undergraduates had a 7.5 % MASLD prevalence, highlighting a gap in understanding and testing. Addressing this requires better guidelines, awareness, and healthcare system enhancements.

1. Introduction

Metabolic dysfunction-associated steatotic liver disease (MASLD), marked by the accumulation of fat in over 5 % of liver cells among non-alcoholic users, has emerged as a predominant liver disease [1]. It is detectable through radiological or histological assessments [2]. Nevertheless, the Fatty Liver Index (FLI) is a simple tool that has demonstrated effective diagnostic accuracy in screening for MASLD [3].

MASLD is posing a growing health challenge and a substantial disease burden for numerous countries [4]. The estimated global prevalence of MASLD stands at around 25 %, which translates to a staggering of 1.7 billion individuals affected [5]. While the Middle East and the USA have reported higher prevalence rates, Africa has shown much lower rates [6,7]. MASLD prevalence was estimated to be over 40 % in 10 of 21 countries, with the highest rates in Kuwait (45.37 %), Egypt (45.0 %), Qatar (44.4 %), and Jordan (43.3 %) [8]. However, MASLD is now becoming endemic in every nation and continent, contributing significant rising healthcare expenditures each year [9]. An estimate of 10–20 % of MASLD patients may advance to Metabolic dysfunction-associated steatohepatitis (MASH) and ultimately, 3–5% may develop cirrhosis [10]. Research has indicated MASH and liver fibrosis can eventually progress to liver cirrhosis or even to

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hepatocellular carcinoma (HCC) [11].

The way people perceive a situation shapes their reality. To encourage the general population to adhere to guidelines, adopt healthier dietary habits, make essential lifestyle changes, avoid risk factors, and adapt to the changing dynamics of a disease, it is crucial that they perceive the disease to be a threat to their well-being [12]. Misguided beliefs regarding a disease can result in irresponsible behavior, leading to harmful consequences [13].

Due to its slow progression and often asymptomatic nature, individuals with MASLD frequently misinterpret or underestimate its long-term risks, which is associated closely with metabolic syndrome type II diabetes mellitus [14,15], adverse cardiovascular events, cirrhosis and the development of HCC [16,17]. These grave consequences emphasize the importance of patients gaining a comprehensive understanding of the disease, while healthcare providers bear a parallel responsibility to recognize the need for monitoring and intervention in MASLD patients [18]. Previous studies on public perception of MASLD have shown a general lack of concern, with many participants either being unaware of the condition or not considering themselves at risk [19]. To better understand this perception, health science students were selected for the study, as their behaviours and lifestyle patterns differ from the general population. As future healthcare professionals, their understanding of MASLD could help increase public awareness of the condition [20]. Hence, this study aims to estimate prevalence and evaluate knowledge and perception of MASLD among undergraduate medical students in an academic health care institute in India.

2. Materials and methods

This cross-sectional research, conducted at SRM Medical College Hospital and Research Centre in Kattankulathur, Chennai, Tamil Nadu, involved 80 undergraduate medical and paramedical students aged 18–25 years. Health science students who provided written consent were included in the study based on random sampling technique. Approval was obtained from the institutional ethics committee [IEC no: SRMIEC-ST1122-232]. Participants with medical histories of alcohol consumption, neurological disorders, thyroid conditions, diabetes mellitus, or hypertension, as determined through self-reported information using a structured proforma, were excluded from the study by the principal investigator. Following ethical guidelines, first-year health science students were excluded from the study as they belong to a vulnerable group. Variables such as blood pressure and various anthropometric measurements such as height, weight, BMI and waist circumference were recorded. Participants were required to fill out a simple questionnaire designed to record the baseline patient characteristics and their perceptions of MASLD. The questionnaire used the term NAFLD since the study was conducted from 2022 to -2023 to ensure participants' understanding [21]. After the evaluation, all participants received a brief update on the definition of MASLD, its risk factors, complications, and preventive measures.

Sample size calculation formula: $4pq/d^2$

n = Sample size, p = prevalence of MASLD [22], q = 100-p, d = 20 % precision.

Substituting in the formula

$n = 4 \times 60 \times 40/20 \times 20$

n = 66.

Hence, in the present study, sample size of **80** was taken.

N = 80.

A 3 ml fasting venous blood sample was collected from the participants using sodium fluoride and plain vacutainers to measure various parameters, including fasting plasma glucose, triglycerides, high-density lipoprotein cholesterol (HDL-C) and gamma-glutamyl transferase (GGT). The fasting plasma glucose was analysed by hexokinase method, triglycerides by enzymatic, end point method, HDL-C by direct measure, immunoinhibition method and GGT by G-glutamyl-carboxy-nitro-anillide method in Beckman Coulter Auto analyse AU480. To quantify the degree of liver steatosis, the Fatty Liver Index (FLI) was utilized. FLI was computed using the following formula: FLI= (e0.953 × loge (triglycerides) + 0.139 × BMI + 0.718 × loge (GGT) + 0.053 × waist circumference − 15.745)/(1 + e0.953 × loge (triglycerides) + 0.139 × BMI + 0.718 × loge (GGT) + 0.053 × waist circumference − 15.745) × 100. The participants with FLI score of ≥60 were considered to be MASLD-positive [23].

The data were entered and processed utilizing the Statistical Package for the Social Sciences (SPSS) Version 22.0. For the quantitative variables, analysed biochemical parameters and FLI score, the mean and standard deviations was calculated. Meanwhile, for qualitative variables and the responses of 'Yes' or 'No' in the questionnaire, frequencies and percentages was determined. Pearson's correlation analysis was conducted to identify the association of FLI score with anthropometric measurements and analysed biochemical parameters. Linear regression was used to evaluate the association of correlated variables with MASLD risk. A p-value of less than 0.05 indicates statistical significance.

3. Results

A total of 80 participants were enrolled, evenly split between medical (MBBS) and paramedical students. Mean age and BMI were 20.2 ± 1.03 years and 23.16 ± 4.55 kg/m2, respectively (Table 1). Fatty Liver Index (FLI) was calculated using biochemical parameters, resulting in a mean score of 15.11 ± 19.68 (Table 2). Participants with FLI ≥60 were diagnosed with MASLD, revealing a prevalence of 7.5 % (n = 6), illustrated in Fig. 1. The mean BMI and waist circumference of MASLD positive individuals were 32.73 ± 6.58 kg/m^2 and (91 ± 7.7 cm) respectively.

Pearson's correlation analysis examined the association of FLI score with anthropometric measurements and analysed biochemical parameters in the participant group. Significant and positive correlations of FLI score with BMI, waist circumference, fasting plasma glucose, triglycerides and GGT were observed. However, HDL-C levels exhibited a statistically insignificant negative correlation with the FLI score. Table 3 presents the correlation coefficients and their significance levels.

Linear regression analysis was conducted to determine the odds of MASLD risk associated with variables such as BMI, waist circumference, fasting plasma glucose, triglycerides, and GGT. Increased BMI was associated with a 3.76-fold higher likelihood of elevated FLI scores. Waist circumference and GGT levels were associated with a 1.0 % and 1.7 % increase in MASLD risk, respectively. Although fasting plasma glucose and triglycerides also predicted MASLD risk significantly, their associated odds were relatively low as presented in Table 3.

Among the study group, 87.7 % were familiar with MASLD and 44.4 % were aware of its potential impact on children. Notably, participants, predominantly Health Sciences Program undergraduates, exhibit a strong understanding of MASLD risk factors, namely diabetes, dyslipidemia, hypertension, obesity, and liver disorders. Additionally, 75.3 % emphasize the importance of radiological diagnosis in improving MAFLD detection. Despite their knowledge, while most participants

Table 1
Characteristics of the participants involved in the study.

Variables	N (80) Mean ± SD
Age (Years)	20.2 ± 1.03
Gender (%)	
Male	47 (58. 8 %)
Female	33 (41.2 %)
Height (m)	2.74 ± 0.33
Weight (Kg)	63.16 ± 12.77
BMI (kg/m^2)	23.16 ± 4.55
Waist circumference (Cm)	80.52 ± 11.99
Blood pressure	
Systole (mm Hg)	119.3 ± 16.13
Diastole (mm Hg)	78.1 ± 11.37

Table 2
Analysed biochemical parameters and FLI score of the participants included in the research.

Parameters	N (80) Mean ± SD
Fasting plasma glucose (mg/dl)	90.71 ± 8.48
Triglycerides (mg/dl)	75.67 ± 36.59
HDL-C (High-density lipoprotein cholesterol) (mg/dl)	45.05 ± 8.26
GGT (Gamma-glutamyl transferase) (IU/L)	14.83 ± 7.08
Fatty Liver Index (FLI)	15.11 ± 19.68

The data was represented as Mean ± SD for numerical data.

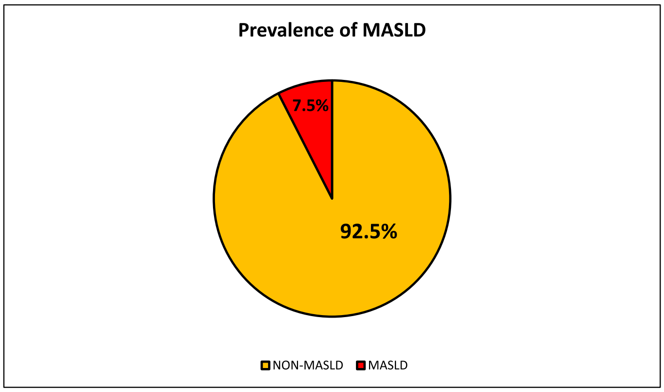

Fig. 1. The prevalence of MASLD in study population.

Table 3
Pearson's correlation between FLI scores and anthropometric/biochemical parameters and their association with MASLD risk assessed via linear regression.

Variables	[a]r value (p value)	[b]β (95%CI)	[b]p value
BMI (kg/m^2)g	0.870 (0.0001*)	3.67 (3.2–4.1)	0.0001*
Waist circumference (cm)	0.678 (0.0001*)	1.0 (0.8–1.3)	0.0001*
Fasting Plasma Glucose (mg/dl)	0.224 (0.046*)	0.5 (0.06–1.0)	0.02*
TGL (mg/dl)	0.449 (0.0001*)	0.2 (0.1–0.3)	0.0001*
HDL-C (mg/dl)	−0.072 (0.523)		
GGT (IU/L)	0.639 (0.001*)	1.7 (1.2–2.1)	0.0001*

Abbreviation: BMI-Body Mass Index. TGL- Triglyceride, GGT- Gamma Glutamyl Transferase.

[a] r value represents correlation coefficient.

[b] β – represents the regression coefficient value. A p-value of less than 0.05* indicates statistical significance.

Table 4
Results of the survey on the perception of NAFLD.

PERCEPTION	YES %	NO %
Are you familiar with the term NAFLD?	87.7 %	12.3 %
Can NAFLD be encountered in children?	44.4 %	55.6 %
Can NAFLD occur in diabetics?	80.2 %	19.8 %
Are you willing to get your sugar levels checked in regards to NAFLD?	66.7 %	33.3 %
Have you checked your blood sugar levels in regards to NAFLD?	27.2 %	72.8 %
Is NAFLD associated with dyslipidemia?	81.5 %	18.5 %
Are you willing to get your blood cholesterol levels checked in regards to NAFLD?	70.4 %	29.6 %
Have you checked your blood cholesterol levels in regards to NAFLD?	14.8 %	54.2 %
Is NAFLD associated with hypertension?	77.8 %	22.2 %
Are you willing to get your BP levels checked in regards to NAFLD?	61.7 %	38.3 %
Have you checked your BP in regards to NAFLD?	13.6 %	86.4 %
Is NAFLD associated with obesity?	88.9 %	11.1 %
Are you willing to lose your weight in regards to NAFLD?	70.4 %	29.6 %
Have you tried losing your weight in regards to NAFLD?	11.1 %	88.9 %
Can NAFLD be seen in thin and lean individuals?	66.7 %	33.3 %
Can NAFLD progress to cirrhosis of liver?	90.1 %	9.9 %
Are blood tests (LFT HBsAg HCV) required for diagnosis of NAFLD?	46.9 %	53.1 %
Are you willing to get LFT HBsAg HCV checked in regards to NAFLD?	44.4 %	55.6 %
Have you checked your LFT HBsAg HCV in regards to NAFLD?	12.3 %	87.7 %
Can radio imaging give clue in diagnosing NAFLD?	75.3 %	24.7 %
Are you willing to get radio-diagnosis in regards to NAFLD?	45.7 %	54.3 %
Have you undergone any radio-diagnosis procedure regards to NAFLD?	8.6 %	91.4 %
Do you feel NAFLD can be treated by dietary modifications and exercise?	88.9 %	11.1 %
Are you willing to adopt dietary modifications and exercise in regards to NAFLD?	87.7 %	12.3 %
Have you adopted any dietary modifications with regards to NAFLD?	17.3 %	82.7 %
What is the mode of treatment for NAFLD?	61.7 %	38.3 %
Do you feel that fatty liver is preventable?	91.4 %	8.6 %

expressed a willingness to undergo testing for these risk factors, only a few have undergone specific testing of parameters related to MASLD.

About 70.4 % of participants believe that weight loss can reduce MASLD risk, with 11.1 % actively attempting weight loss. Additionally, 66.7 % acknowledge MASLD's impact on thin individuals, while the majority recognize the importance of improved weight management and admit to unhealthy eating habits. Specifically, 87.7 % understand the need for dietary adjustments and increased physical activity, yet only 17.3 % have implemented dietary changes. So far over 61.7 % are knowledgeable about MASLD treatment options and a significant 91.4 % believe fatty liver is preventable. Table 4 summarizes the results of this MASLD perception survey.

4. Discussion

This study brings attention to key elements regarding the occurrence and awareness of MASLD among undergraduate medical students. The research included 80 participants, evenly divided between medical students (MBBS) and paramedical students. The research found a 7.5 % prevalence of MASLD among participants, with 6 individuals scoring 60 or higher. MASLD affects 25–30 % of the global population, with prevalence varying from 13.5 % in Africa to 31.8 % in the Middle East [24]. After the evaluation, all participants were provided with a summary of MASLD, covering its definition, risk factors, complications, and preventive measures. This is anticipated to enhance awareness and understanding of MASLD among health science students, which could potentially reduce the Fatty Liver Index (FLI) and promote healthier lifestyle practices. These improved practices could, in turn, contribute to more effective public health interventions.

Magnetic resonance imaging (MRI) has been suggested as a method to evaluate the broad spectrum of MASLD [25,26]. The prevalence of MASLD was notably higher in males (83.3 %), aligning with results observed in various population-based epidemiological studies [2,3]. Likewise, individuals with MASLD exhibited elevated BMI (32.73 ± 6.58 kg/m2) and larger waist circumferences (91 ± 7.7 cm).

We conducted Pearson's correlation analysis to explore the relationship between FLI score and anthropometric measurements, finding a significant positive correlation with BMI and waist circumference. Our study aligns with existing literature, revealing that individuals with MASLD have higher BMIs, larger waist circumferences and increased metabolic risk factors [27]. South Asians have higher rates of metabolic problems and mortality, which vary based on region, urbanization, lifestyle, and cultural influences [28]. Biochemical parameters such as fasting plasma glucose, triglycerides, and GGT demonstrated a significant positive association with an elevated FLI score, while HDL-C levels showed a statistically insignificant negative correlation. Our results are consistent with an observation of Butt N and Nguyen M et al., highlighting dyslipidemia in MASLD characterized by elevated triglycerides, increased small, dense LDL particles, and decreased HDL cholesterol [29,30].

Linear regression analysis assessed the impact of significantly correlated variables on MASLD risk. Higher BMI was associated with a 3.76-fold increased likelihood of elevated FLI scores, while waist circumference and GGT were linked to a 1.0 % and 1.7 % increase in MASLD risk, respectively. Research confirms that MAFLD/MASH risk escalates linearly with BMI, with a 5- to 9-fold increased risk at BMI 30–32.5 kg/m^2 and a 10- to 14-fold increased risk at BMI 37.5–40 kg/m^2, relative to BMI 20–22.5 kg/m^2 [31].

In our study group, 87.7 % were familiar with MASLD, and 44.4 % recognized its impact on children. A study by Butt et al. in low-income urban areas showed lower awareness (26.4 %) of MASLD diagnosis, with only 14.5 % aware of associated cardiovascular risks. Notably, Health Sciences Program undergraduates displayed strong awareness of MASLD risk factors, such as diabetes (80.3 %), dyslipidemia (81.5 %), hypertension (77.8 %), obesity (88.9 %), and liver disorders (46.9 %). The established links between obesity, type 2 diabetes, dyslipidemia, and MASLD were consistent with existing literature [32–34]. About 75.3 % of participants believe that radiological diagnostics enhance MASLD diagnosis accuracy. Additionally, those aware of associated risk factors expressed willingness for testing, with 66.7 % open to checking blood glucose levels, 70.4 % for blood cholesterol, 31.7 % for blood pressure, 44.4 % for LFT, HBsAg, and HCV tests and 45.7 % were contemplating radiological imaging for MASLD.

Although participants expressed willingness for MASLD testing, a minority had already undergone specific parameter checkups: 27.2 % for blood glucose levels, 14.8 % for blood cholesterol, 13.6 % for blood pressure, 12.3 % for LFT, HBsAg, and HCV tests, and only 8.6 % for MASLD radio imaging. Approximately 70.4 % believe weight loss reduces MASLD risk, and 11.1 % have attempted weight loss. Despite 66.7 % acknowledging MASLD risk in thin individuals, most recognize the importance of weight management. Specifically, 87.7 % see the need for dietary adjustments and increased physical activity, but only 17.3 % implemented changes. Weight loss and adopting healthier eating and nutrition practices are considered the primary strategies for managing MASLD [35]. Over 61.7 % are aware of MASLD treatment options, and 91.4 % believe fatty liver is preventable through proper measures. The assessment of perception is constrained by the small number of participants and the observation being conducted at a single centre.

4.1. Limitations

Increasing the sample size and integrating research across institutions to include health science students from all divisions would provide a more accurate prevalence rate and highlight the importance of understanding MASLD among students.

5. Conclusion

Health Sciences Program undergraduates showed a 7.5 % MASLD prevalence, indicating a gap between their understanding of the disease, the characteristics, implication and actual testing and diagnosis rates were quite low. Bridging this gap requires implementing clinical guidelines, awareness programs and healthcare system improvements, including establishing registries. Improving health science students' perception of MASLD could increase their awareness and understanding, potentially reduce the Fatty Liver Index (FLI), and encourage healthier lifestyles, ultimately leading to more effective public health interventions.

CRediT authorship contribution statement

Umasankari S.: Writing – original draft, Methodology, Investigation, Formal analysis. **S. Aishwarya:** Writing – original draft, Formal analysis. **S.K. Aishwarya:** Methodology, Investigation, Formal analysis. **Shivangi Bhardwaj:** Writing – original draft, Formal analysis, Data curation. **R.B. Pavithra:** Writing – original draft, Visualization. **Soumili Ray:** Writing – original draft, Formal analysis. **V.M. Vinodhini:** Writing – review & editing, Supervision, Resources, Formal analysis.

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Declaration of competing interest

Authors have no conflict of interest to disclose.

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