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Assessing prevalence and history of fatty liver using FibroScan: A single-center study

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ABSTRACT

Background and Objectives: Cirrhosis is the primary factor of morbidity and mortality in individuals with chronic liver conditions. This study identified fatty liver prevalence, risk factors, and cirrhosis in outpatient clinics in a single-center study. **Methods:** This prospective cross-sectional study enrolled 195 patients attending an outpatient clinic who met predefined eligibility criteria. Eligible patients underwent fibrosis assessment using the FibroScan® device, a non-invasive tool for evaluating liver fibrosis. **Results:** The study sample (mean age: 45.23 years, SD = 15.1) included 48.7% young adults, 36.9% middle-aged individuals, 14.4% elderly participants, and males (54.4%). Key risk factors included smoking (51.8%), diabetes (12.3%), hypertension (5.6%), and having hepatitis B virus (4.6%). Steatosis was absent in 5.13% of cases, while 94.9% showed some degree: mild (6.15%), moderate (12.82%), or severe (75.9%). Moderate scarring was the most prevalent form of fibrosis, followed by severe scarring (9%). The prevalence of cirrhosis among outpatients was 8% in this study. Overall, the non-alcoholic fatty liver disease (NAFLD) prevalence among outpatients was 39% in this study. The cirrhosis scores were substantially higher in elderly patients compared to middle-aged and young individuals (21.43% *vs*. 11.11% and 2.11%; $P < 0.0001$). Diabetic patients also showed a higher prevalence of cirrhosis than non-diabetics (16.67% *vs*. 7.02%; $P = 0.0020$), as did hypertensive patients compared to non-hypertensive patients (27.27% *vs*. 7.07%; $P = 0.0201$). **Conclusion**: This study showed the high prevalence of cirrhosis and NAFLD in the outpatient clinic and was associated with older age, diabetes, and hypertension.

Key words: fatty liver, fibrosis, risk factors, FibroScan

INTRODUCTION

Cirrhosis represents a significant source of mortality and death for individuals with chronic liver disease.[1] In 2019, cirrhosis was responsible for 2.4% of global deaths, establishing it as one of the main causes of mortality worldwide.[2] According to Huang *et al.* (2023) and Tapper *et al.* (2022), it can result in hepatocellular cancer and hepatic decompensation, which includes variceal hemorrhage, hepatic encephalopathy, and ascites.[1,3] The main contributors to cirrhosis are nonalcoholic fatty liver disease (NAFLD), alcohol-related liver disease, and infections caused by the hepatitis B (HBV) and hepatitis C viruses (HCV).[4,5] Nevertheless, during the past decade, there has been a substantial shift in the etiology and burden of liver disease toward the NAFLD due to the growing disease burden of Metabolic Syndrome, thus NAFLD is becoming the main contributor to the morbidity and mortality.[6]

The Global Burden of Disease (GBD) Study provided an in-depth examination of the global effects of chronic liver diseases and cirrhosis, collectively categorized as "cirrhosis".[7] According to the GBD Study 2017, approximately 112 million individuals globally were estimated to have compensated cirrhosis. This corresponds to an age-adjusted prevalence rate of 1395 cases per 100,000 people.[8]

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Chronic liver disease patients may develop liver cirrhosis and accompanying consequences, including hepatocellular carcinoma, ascites, variceal hemorrhage, and liver failure.[9] Hepatocyte inflammation that persists over time and leads to hepatic fibrosis, architectural distortion, and nodule development is referred to as chronic liver disease. Viral hepatitis, alcohol, and NAFLD account for the majority of cases. The disease's prevalence is steadily increasing.[10]

NAFLD driven significantly by the increasing rates of obesity and metabolic syndrome, is one of the main causes of chronic liver disease across the world. Viral hepatitis, particularly HBV and HCV, remains a critical contributor, especially in areas with high levels of endemic infection. Furthermore, alcohol-related liver disease persists as a significant cause, fueled by the prevalence of excessive alcohol consumption globally.[11]

The incidence of cirrhosis and other related chronic liver diseases in the Middle East increased by 114.9% between 1990 and 2021, according to review research, with 7,344,030 incident cases recorded in 2021. Females' age-standardized incidence rates (ASIR) increased more sharply (9.6%) than males (7.0%).

According to an analysis based on specific causes, the ASIR for cirrhosis and other related chronic liver diseases associated with metabolic dysfunction-associated steatotic liver disease (known as MASLD) rose by 22.2%. In contrast, the ASIRs for alcohol-related causes, HBV, and HCV declined by 28.1%, 59.3%, and 30%, respectively. DALYs showed a 51.4% decline during the same time, whereas total age-standardized mortality rates across all etiologies decreased by 54.3% despite the increased incidence. Trends per country differed greatly; Oman had the largest yearly gain in ASIR (0.64%), while Qatar had the largest annual decrease in age-standardized mortality rates (-2.88%).[12]

Several methods are used for the purpose of detecting the inflammation of the hepatocytes and fibrosis. One of which is FibroScan, also known as Transient elastography, is a modern, non-invasive, rapid bed-side test used for the evaluation of the degree or severity of liver fibrosis through the measurement of liver stiffness.[13] A FibroScan is a device used for the assessment of liver fibrosis. Limitations include ascites, morbid obesity, and/or large chest wall fat.[14] By providing a non-invasive alternative to liver biopsy, FibroScan offers a safer and more comfortable option for patients, allowing for repeated assessments to monitor disease progression and treatment response.[13] This study aimed to identify the prevalence of fatty liver, its risk factors, and cirrhosis in outpatient clinics in a single-center study.

PATIENTS

Study design

This prospective cross-sectional study enrolled patients who attended the outpatient clinic of the clinician (author) who met predefined eligibility criteria. Eligible patients underwent fibrosis assessment using the FibroScan® device, a non-invasive tool for evaluating liver fibrosis. Fibrosis scores, along with demographic and medical characteristics, were recorded in a pre-designed questionnaire.

Patients were recruited from a single center in Duhok City, Kurdistan Region of Iraq, over six months. Due to limited access to other medical facilities, the study extended its recruitment period to maximize participant inclusion. Notably, the study center serves a diverse population from various areas of Duhok Governorate, ensuring the representation of patients with differing demographic and clinical profiles.

Sampling technique

The patients visiting the outpatient clinic were screened consecutively for eligibility criteria. A convenience sampling technique was used to include patients in the study. The sample size was not calculated beforehand, but an effort was made to include as many eligible patients as possible. Data collection was conducted between October 2024 and March 2025.

Data collection

The Clinico-demographic profile information was collected from the patients through the self-reported technique; including age, sex, and other relevant demographic details including alcohol consumption. The "Shear wave Quantificational Ultrasound Diagnostic System" from "HiSky" company (SN/FT-100-0016-011) was used in this study. The assessment was performed by the author for all patients. The cirrhosis scores were assessed as F0 to F1 (determined as normal liver), F2 (determined as moderate scarring), F3 (determined as severe scarring), or F4 (called as cirrhosis) for non-alcoholic fatty liver disease (NAFLD).[15]

Virology measurements

The lab obtained blood samples, which were then examined for the following diseases

• HBV: the enzyme-linked immunosorbent test (ELISA) was used to detect HBsAg.

• HCV: ELISA was used to detect anti-HCV antibodies.

Statistical analyses

The patients' medical and general data were summed up as mean (standard deviation) for age and as numbers and

percentages (categorical variables). The Pearson chi-squared test was used to examine correlations between fibrosis scores and patient attributes. *P*-values below 0.05 were identified as a statistically significant difference between two sub-groups. The magnitude of the association was determined in OR (Odds Ratio) and uncertainty with a 95% confidence interval. JMP® software (Version 18.0, SAS Institute Inc., Cary, NC, 1989–2023) was used for all analyses.

RESULTS

The mean age of the patients was 45.23 years (SD = 15.1). The largest proportion of participants were young adults (48.7%), followed by middle-aged individuals (36.9%) and elderly individuals (14.4%). Males accounted for 54.4% of the sample, while females comprised 45.6%. Regarding risk factors, 2.05% of participants reported a history of alcoholism, 51.8% were smokers, and 4.6% had a positive virology profile (4.1% HBV positive and 0.51% HCV positive). Additionally, 12.3% had diabetes, and 5.6% had hypertension. Of the examined sample, 5.13% showed no steatosis, while 94.9% exhibited some degree of steatosis: 6.15% had mild steatosis, 12.82% had moderate steatosis, and the majority (75.9%) had severe steatosis. The prevalence of Fibrosis among the examined sample was non-fibrotic F0, F1 (61.03%), moderate scarring (21.54%), severe scarring (9.23%), and cirrhosis (8.21%; Table 1).

The study found that moderate scarring was the most prevalent form of fibrosis among outpatients, followed by severe scarring (9%). The prevalence of cirrhosis among outpatients was 8% in this study. Overall, the prevalence of NAFLD among outpatients was 39% in this study (Figure 1).

The study showed that middle-aged patients were more likely to have moderate scarring (39.29%) and elderly patients were more likely to have severe scarring (37.50%) and cirrhosis (37.50%). In addition, the patients with normal waist circumference were more likely to have cirrhosis (18.75%) compared to patients with risky (0.0%) and high-risk (2.08%) waist circumference. Moreover, the patients with hypertension were more likely to have severe scarring (42.86%) and cirrhosis (42.86%; Table 2). The study showed that NAFLD is related with older age ($P < 0.0001$) and diabetes ($P = 0.0378$). The prevalence of NAFLD was not associated with other factors (Table 3).

DISCUSSION

This study included mostly young adults, followed by middle-aged individuals, and elderly participants. Key

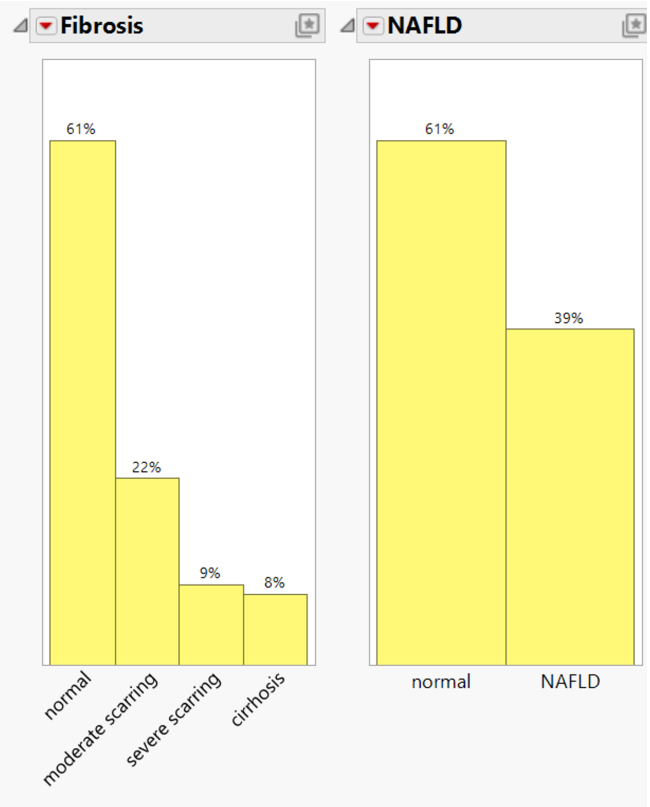

Figure 1. Prevalence of fibrosis and non-alcoholic fatty liver disease in outpatients. NAFLD: non-alcoholic fatty liver disease.

risk factors included smoking, diabetes, hypertension, and viral infections. The prevalence of NAFLD was high in this study and was associated with age and diabetes mellitus. The prevalence of cirrhosis was in outpatient clinics and was associated with older age, diabetes, and hypertension.

In several parts of the world, NAFLD is now acknowledged as the leading cause of chronic liver disease.[16] However, according to Vos *et al.*,[17] the WHO does not officially acknowledge NAFLD as a significant noncommunicable illness.

According to the most current meta-analysis, at least 30% of adults worldwide have NAFLD (1990–2019 period). However, the prevalence of NAFLD disease was projected to be as high as 38% when just data from 2016 to 2019 were taken into account.[18] Our region's NAFLD prevalence is very comparable to the worldwide average.

The combined prevalence of NAFLD for all ages has therefore steadily increased from 10.5% in 1990 to 16.0% in 2019 according to the new data.[17] According to Estes *et al.*,[19] the prevalence of NAFLD disease in adults was found to be 23.4% worldwide, rising by around 1.00% (95% CI: 0.97%–1.02%) every year. The

Table 1: General and medical characteristics of outpatient patients

Characteristics (n = 195)		All patients No. (%)	Gender No. (%)		P
			Female	Male	
			89 (45.64)	106 (54.36)	
Age	Young	95 (48.72)	36 (40.45)	59 (55.66)	0.0189
	Middle	72 (36.92)	34 (38.20)	38 (35.85)	
	Elderly	28 (14.36)	19 (21.35)	9 (8.49)	
Waist circumference	Normal	124 (63.59)	54 (60.67)	70 (66.04)	0.4361
	Risky	9 (4.62)	3 (3.37)	6 (5.66)	
	High Risk	62 (31.79)	32 (35.96)	30 (28.30	
Smoking	No	94 (48.21)	85 (95.51)	9 (8.49)	< 0.0001
	Yes	101 (51.79)	4 (4.49)	97 (91.51)	
Alcohol	None	191 (97.95)	89 (100)	102 (96.23)	0.1269
	Yes	4 (2.05)	0 (0.00)	4 (3.77)	
Virology outcomes	None	186 (95.38)	86 (96.63)	100 (94.34)	0.5828
	HBV	8 (4.10)	3 (3.37)	5 (4.72)	
	HCV	1 (0.51)	0 (0.00)	1 (0.94)	
Diabetes	No	171 (87.69)	76 (85.39)	95 (89.62)	0.3705
	Yes	24 (12.31)	13 (14.61)	11 (10.38)	
Hypertension	No	184 (94.36)	82 (92.13)	102 (96.23)	0.2332
	Yes	11 (5.64)	7 (7.87)	4 (3.77)	
FibroScan findings/fibrosis score	F0 (Normal)	81 (41.54)	34 (38.20)	47 (44.34)	0.5086
	F1 (Normal)	38 (19.49)	20 (22.47)	18 (16.98)	
	F2 (Moderate scarring)	42 (21.54)	20 (22.47)	22 (20.75)	
	F3 (Severe scarring)	18 (9.23)	10 (11.24)	8 (7.55)	
	F4 (Cirrhosis)	16 (8.21)	5 (5.62)	11 (10.38)	
FibroScan findings/steatosis score	None	10 (5.13)	6 (6.74)	4 (3.77)	0.3422
	Mild	12 (6.15)	8 (8.99)	4 (3.77)	
	Moderate	25 (12.82)	11 (12.36)	14 (13.21)	
	Severe	148 (75.90)	64 (71.91)	84 (79.25)	

HBV: hepatitis B virus; HCV: hepatitis C virus

Middle East and North Africa have the greatest frequency of NAFLD (26.5%). NAFLD liver mortality rates (per 100,000) have also grown yearly by 0.77% (95% CI: 1.75–2.18) in addition to the rising prevalence. Central Latin America has the highest all-age NAFLD liver fatalities (5.90 deaths per 100,000 individuals).[20] According to different research, the Middle East is the region with the greatest prevalence of NAFLD among all liver illnesses worldwide. Egypt, Kuwait, Qatar, Bahrain, the United Arab Emirates, Saudi Arabia, Iran, Jordan, Tunisia, and Libya were among the top 10 nations with the highest prevalence of NAFLD.[21]

Furthermore, a hierarchy of disease risk factors developed by the GBD indicates to all stakeholders where progress is being made and where further interventions are needed to advance. Level 1 risk factors include the following behavioral factors. The behavioral factors are smoking, alcohol, drug use, *etc.*), along with occupational (such as exposure to toxic chemicals, injuries, *etc.*), and metabolic factors (such as high low-density lipoprotein cholesterol level, high fasting plasma glucose level, and high systolic blood pressure).[17]

Cirrhosis

An updated analysis using Global Burden of Disease data revealed that the number of prevalent cases of cirrhosis rose by 74.5% between 1990 and 2017 (with an annual increase of 0.75% in the ASR). When broken down by 21 geographical regions, East Asia, South Asia, and Southeast Asia accounted for the highest number of cases. The study found that the prevalence of cirrhosis was 8%, with an estimated incidence rate of 20.7 cases per 100,000 in 2015, and that it has increased by 13% since 2000.[4] The incidence of cirrhosis declined most quickly in sub-Saharan Africa, whereas it increased most rapidly in the Caribbean and Latin America. The country with the most growth was the United Arab Emirates. Furthermore, the countries with the greatest ASR were the United Arab Emirates, Qatar, and Egypt. Finally, the countries with the fastest ASR growth were Oman, Iran, and Saint Vincent & the Grenadines. However, the rate of cirrhosis prevalence drop was the fastest in Mozambique.[22]

The primary cause of cirrhosis in 2017 was nonalcoholic steatohepatitis (NASH), but the number of cases of cirrhosis linked to HBV and HCV was declining. Male and female cirrhosis cases rose at an APC of 0.78% and 0.71%, respectively, between 1990 and 2017. It's interesting to note that females exhibited greater APCs for ALD (APC, 0.97% *vs.* 0.77%) and NASH (APC,

Table 2: Association of moderate, severe, and cirrhosis fibrosis with general and medical characteristics compared to normal patients in outpatient's patients

Characteristics (n = 195)	Fibrosis No. (%)			
	Normal	moderate scarring	Severe scarring	Cirrhosis
Age	75			
Young	34	14 (15.73)	4 (5.06)	2 (2.60)
Middle	10	22 (39.29)	8 (19.05)	8 (19.05)
Elderly		6 (37.50)	6 (37.50)	6 (37.50)
P		0.0039	0.0009	< 0.0001
Sex	65			
Male	54	22 (25.29)	8 (10.96)	11 (14.47)
Female		20 (27.03)	10 (15.63)	5 (8.47)
P		0.8022	0.4199	0.4216
Waist circumference	65			
Normal	7	32 (32.99)	12 (15.58)	15 (18.75)
Risky	47	1 (12.50)	1 (12.50)	0 (0.00)
High risk		9 (16.07)	5 (9.62)	1 (2.08)
P		0.0479	0.6151	0.0113
Smoking	60			
No	59	19 (24.05)	10 (14.29)	5 (7.69)
Yes		23 (28.05)	8 (11.94)	11 (15.71)
P		0.5636	0.6846	0.1872
Alcohol	117			
None	2	41 (25.95)	18 (13.33)	15 (11.36)
Yes		1 (33.33)	0 (0.00)	1 (33.33)
P		1.000	1.000	0.3172
Virology	5			
HBV	0	3 (37.50)	0 (0.0)	0 (0.00
HCV	114	1 (100)	0 (0.00)	0 (0.0)
None		38 (25.00)	18 (13.64)	16 (12.31)
P		0.1767	1.000	0.4034
Diabetes	109			
No	10	39 (26.35)	11 (9.17)	12 (9.92)
Yes		3 (23.08)	7 (41.18)	4 (28.57)
P		1.000	0.0003	0.0637
Hypertension	115			
No	4	41 (26.28)	15 (11.54)	13 (10.16)
Yes		1 (20.00)	3 (42.86)	3 (42.86)
P		1.000	0.0480	0.0360

HBV: hepatitis B virus; HCV: hepatitis C virus

1.82% vs. 1.69%) compared to males, based on the etiology of liver disease.[22]

Age and NAFLD

Based on the 2016 meta-analysis that employed age stratification, the prevalence of NAFLD worldwide was 28.9% in those aged 60–69 and 34.0% in people aged 70–79.[23] According to studies including older and elderly people, the incidence increased with age and decreased as people aged. NAFLD prevalence in the 75–79, 80–84, and > 85 age groups was 39.6%, 32.1%, and 21.1%, respectively, according to Rotterdam research.[24] In community-based research of elderly Taiwanese people (China) aged 65 and above, the prevalence of NAFLD among those with an ultrasonographic diagnosis was 41.9%. The study also discovered that the prevalence of NAFLD decreased with age, going from 45% in those aged 65–70 to 31.8% in those aged > 80 (P = 0.01). Additionally, the logistic regression study of older persons revealed a negative correlation between age and fatty liver.[25]

Liver function, hepatic volume, and hepatic blood flow all decrease by up to 25% between 20 and 70 years.[26] The pharmacokinetic profiles of medications that undergo obligatory hepatic oxidation tend to change as a result of reduced liver volume and hepatic blood flow in the elderly. However, the exact effects are unknown.[27]

Hypertension

A review study comprised data from 11 cohort studies with an average follow-up of 5.7 years and 390348 participants (52% male). Overall, NAFLD was associated with a slightly higher incidence of incident hypertension (HR: 1.66; 95% CI; P < 0.001). Sensitivity tests revealed that estimates were unaffected by the follow-up period, geographic location, or correction for baseline blood pressure readings. However, the observed variability was partially explained by the fact that the size

Table 3: Associated factors with NAFLD among outpatients

Characteristics (*n* = 195)	NAFLD No. (%)		OR (95% CI)	*P*
	Normal	NAFLD		
Age	75 (78.95)	20 (21.05)		< 0.0001
Young	34 (47.22)	38 (52.78)	Ref	
Middle	10 (35.71)	18 (64.29)	4.19 (2.13–8.24)	
Elderly			6.75 (2.7–16.89)	
Sex	65 (61.32)	41 (38.68)		0.9265
Male	54 (60.67)	35 (39.33)	Ref	
Female			1.03 (0.58–1.83)	
waist circumference				0.0049
Normal	65 (52.42)	59 (47.58)	Ref	
Risky	7 (77.78)	2 (22.22)	0.31 (0.06–1.58)	
High Risk	47 (75.81)	15 (24.19)	0.35 (0.18–0.69)	
Smoking				0.4386
No	60 (63.83)	34 (36.17)	Ref	
Yes	59 (58.42)	42 (41.58)	1.26 (0.71–2.24)	
Alcohol				0.6437
None	117 (61.26)	74 (38.74)	Ref	
Yes	2 (50.00)	2 (50.00)	1.58 (0.22–11.47)	
Virology				0.4542
HBV	5 (62.50)	3 (37.50)	0.95 (0.22–4.1)	
HCV	0 (0.00)	1 (100)	1.57 (0.1–25.49)	
None	114 (61.29)	72 (38.71)	Ref	
Diabetes				0.0378
No	109 (63.74)	62 (36.26)	Ref	
Yes	10 (41.67)	14 (58.33)	5.46 (1.03–5.87)	
Hypertension				0.1125
No	115 (62.50)	69 (37.50)	Ref	
Yes	4 (36.36)	7 (63.64)	2.92 (0.82–10.33)	

HBV: hepatitis B virus; HCV: hepatitis C virus; OR: odds ratio

of the connection was smaller in studies that controlled for baseline adiposity than in those that did not. According to this extensive meta-analysis, there is a ~1.6-fold higher chance of having hypertension if you have NAFLD.[28] The impact of NAFLD severity on incident hypertension in terms of inflammation and fibrosis requires more research.[28]

According to a recently released review, several cross-sectional studies conducted over the previous 10 years have shown a correlation between the existence of prehypertension and hypertension with the prevalence and severity of NAFLD.[29] Hypertension was found to be an independent predictor of NAFLD in a number of cross-sectional and prospective cohort studies.[30–32] It's interesting to note that prehypertension was linked to NAFLD as well since odd ratios rose within a particular blood pressure range.[33,34]

Diabetes and NAFLD

A person with diabetes has a higher risk of developing more severe NAFLD, which is linked to consequences including cirrhosis and death. Diabetics had a higher standardized mortality ratio from cirrhosis (2.52) in one large cohort of research.[35] Additionally, it was discovered that co-occurring type 2 diabetes was an independent risk factor for fibrosis in a group of 432 individuals with biopsy-proven NAFLD.[36]

Although the pathophysiology of NAFLD is linked to insulin resistance in the liver and extra-hepatic tissues like skeletal muscle and adipose tissue, there is new evidence of hepatic steatosis that can occur without insulin resistance, especially in people who have single nucleotide polymorphisms in the PNPLA3 gene, which codes for the enzyme patatin-like phospholipase 3.[37] Triacylglycerol (TAG) builds up in the liver from three sources: food accounts for 14%, de novo lipogenesis (DNL) for 26%, and circulating free fatty acids (FFAs) for 59%.[38]

Strengths and weaknesses of study

This study showed a high prevalence of NAFLD and cirrhosis in the Kurdistan Region of Iraq. The higher prevalence of NAFLD in this region was associated with having previous hypertension and diabetes and being old in outpatients. The main strength of this study was our effort to extend the study period in order to include as many patients as possible from diverse socio-demographic backgrounds. However, the findings reported in this study may not be generalizable to other settings across the rest of the country, as we only included patients from a single center.

DECLARATIONS

Author contributions
Issa RS designed the study, collected and analyzed the data, and wrote the article.

Use of large language models, AI and machine learning tools
None declared.

Informed consent
Written informed consent was obtained from all participants.

Ethical approval
The ethical approval of the study protocol was received from the Duhok General Directorate of Health's Local Health Ethics Committee (Reference No. 08012025-1-25, dated January 8, 2025). In compliance with ethical guidelines, patient confidentiality was safeguarded by anonymizing personal data. All required permissions were obtained from relevant institutional authorities before data collection.

Conflict of interest
The authors reported no relevant conflicts of interest for this article.

Data sharing statement
No additional data is available.

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