Digestive and Liver Disease 58 (2026) 517–526

Contents lists available at ScienceDirect

Digestive and Liver Disease

journal homepage: www.elsevier.com/locate/dld

Health inequalities in patients with cirrhosis: Investigating the impact of material deprivation on patients' outcomes

Andrea Pasta[a,b], Diletta Maria Rossi[a], Sara Labanca[a,b], Simona Marenco[a,b], Giulia Pieri[a,b], Catherine Mezzacappa[c,d], Mario Strazzabosco[c,d], Edoardo Giovanni Giannini[a,b,c,*]

[a] Gastroenterology Unit, Department of Internal Medicine, University of Genoa, Genoa, Italy
[b] IRCCS—Ospedale Policlinico San Martino, Genoa, Italy
[c] Liver Center, Department of Internal Medicine, Yale University School of Medicine, New Haven, CT, USA
[d] Smilow Cancer Hospital and Liver Cancer Program, New Haven, CT, USA

ARTICLE INFO

Article history:
Received 11 November 2025
Accepted 20 January 2026
Available online 19 February 2026

Keywords:
Socioeconomic disparities
Health inequality
Social determinants of health
Chronic liver disease
Hepatic decompensation

ABSTRACT

Background: Material deprivation (MD) is a key social determinant that may influence outcomes in cirrhosis, although its effect remains underdefined.
Aims: To assess the impact of MD on clinical outcomes in patients with cirrhosis in a universal healthcare setting.
Methods: We retrospectively studied patients with cirrhosis residing in Genoa, first attending our Unit during 2016-2022, classified MD from residential address by prespecified criteria, and dichotomized MD into low and high via cluster analysis; we assessed modality of cirrhosis diagnosis, disease stage, follow-up adherence, hepatic decompensation requiring hospitalization, and overall survival.
Results: We studied 368 patients (68.5% male, median age 63 years), most with compensated disease (57.9%). Patients with low-MD were slightly older (64 years *vs.* 62 years; $p<0.0001$), more frequently diagnosed through screening (58.6% *vs.* 14.4%; $p<0.001$), and less likely to be lost to follow-up (8.3% *vs.* 15.5%; $p<0.0001$) compared to those with high-MD. The incidence of hepatic decompensation episodes requiring hospitalization was higher (incidence rate ratio: 1.95, CI 1.29–2.99) and overall survival was shorter (66.2 months, CI 59.6–72.7 *vs.* 93.7 months, CI 83.5–103.5) in patients with high-MD.
Conclusion: MD significantly impacts clinical outcomes in patients with cirrhosis and is associated with worse prognosis, despite universal coverage.

1. Introduction

Cirrhosis is a chronic condition characterized by ongoing liver necro-inflammatory activity and fibrosis that leads to progressive impairment in liver function and portal hypertension, eventually leading to end-stage liver disease and liver-related death [1]. While compensated cirrhosis is often asymptomatic, the occurrence of decompensating events such as ascites, variceal bleeding, or hepatic encephalopathy significantly worsens patients' quality of life and prognosis [2].

Early identification of patients with chronic liver disease may help reduce the progression to cirrhosis, as etiological treatment of liver disease is associated with a decrease in the rate of development of decompensating events and with a potential improvement in patients' prognosis [3–5]. Both access to specialized care following suspicion of liver disease and causative treatment may not be uniform, and these disparities in access may lead to divergent outcomes for patients [6,7]. Moreover, patients with advanced chronic liver disease require frequent clinical follow-up to monitor their disease status and surveil for hepatocellular carcinoma [8]. Robust programs are essential to promptly identify signs and symptoms that require further testing or treatment.

Beyond clinical factors, socioeconomic determinants play a pivotal role in shaping health outcomes [9]. Non-medical determinants of health include social, economic, and environmental factors that influence disease risk and healthcare access; key contributing factors include education, employment, income, and housing conditions [10]. Lower socioeconomic status has been associated with poorer health outcomes, delayed diagnosis, and reduced adherence to screening and treatment, thus potentially delaying diagnosis and exacerbating disease progression, respectively [11]. Healthcare system structures also significantly impact patient outcomes and uni-

* Corresponding author at: Gastroenterology Unit, Department of Internal Medicine, University of Genoa, Viale Benedetto XV, no. 6, 16132, Genoa, Italy.
E-mail address: egiannini@unige.it (E.G. Giannini).

https://doi.org/10.1016/j.dld.2026.01.225

versal healthcare models, such as Beveridge and Bismarck frameworks, aim to provide equitable access to medical services. However, disparities may persist, particularly in regions with different healthcare models [12].

Focusing on liver-related diseases, socioeconomic deprivation has been linked to decreased access to early liver transplantation in patients with alcohol-associated liver disease (ALD), and worse graft and patient outcomes following liver transplantation, as previous studies have shown a higher mortality risk among patients from disadvantaged areas in the US where there is no universal health insurance coverage [13–15]. Furthermore, community-level socioeconomic factors have been found to be major determinants in hepatocellular carcinoma (HCC) incidence and survival in a country with an insurance-based healthcare system such as the US [16]. A study looking at the differences in HCC management and access to curative treatments among jurisdictions (administrative regions) with different Material Deprivation (MD) index, found significant disparities between even in a country with a universal coverage healthcare system such as Italy (1,2).

In this study we aimed to assess the impact of the degree of MD on clinical outcomes in patients with cirrhosis, examining its influence on modality of diagnosis, disease severity, adherence to treatment, risk of hepatic decompensation, and survival. This study provides a more granular view, focusing on different ZIP codes in a single metropolitan County. By analyzing these associations, our study sought to provide insights into the role of socioeconomic factors on the outcome of patients with advanced liver disease to highlight potential areas of improvement and indicate strategies to reduce healthcare disparities in this population.

2. Methods

2.1. Study design

This study is a retrospective observational analysis of medical records of patients with cirrhosis referred to the Gastroenterology Clinic of the University of Genoa, IRCCS Ospedale Policlinico San Martino, Genoa, Italy, between January 2016 and August 2022, and living in the Municipality of Genoa. Exclusion criteria were age under 18 years, residence outside the city of Genoa, incomplete data in the electronic medical record, transfer to another specialized center, or a follow-up duration of less than 2 years. Cirrhosis was diagnosed clinically (a combination of symptoms, medical history, physical examination, and laboratory test results), by unequivocal radiological evidence, or on the basis of liver histology, when available [2,17].

Our hospital serves as the main hospital for the resident population of Genoa and is the tertiary referral center for the comprehensive care of liver diseases, including liver transplantation. Based on resident population of the Municipality of Genoa, Italy, a previous study devised an index that assess the degree of MD based on (un)employment, education, home ownership, and housing overcrowding - the Genoa Deprivation Index [18]. This index highlights socioeconomic disparities within the city and their potential impact on health.

For all patients, we collected demographic data, anthropometric measurements [weight, height, body mass index (BMI)], presence of comorbidities, presence of cirrhosis complications such as ascites and hepatic encephalopathy, blood test results at the index visit (bilirubin, albumin, INR, creatinine). For each patient we measured performance status using the Eastern Cooperative Oncology Group Performance Status (ECOG-PS), and calculated the Charlson Comorbidity Index (CCI), the Model for End-stage Liver Disease (MELD), and the Child-Pugh score [19–22]. Patients' area of residence was collected using an electronic archive, and the Genoa Deprivation Index was calculated to determine the degree of MD of each patient [18].

Etiology of the underlying liver disease and the modality of diagnosis of liver disease (*e.g.*, through blood test screening, incidental finding during evaluation carried out for other conditions, or due to symptoms/complications) were collected for each patient. We also recorded the year of diagnosis, identified based on patients' history, and the duration of disease before referral to a specialized center. Specifically, the duration of disease before referral was calculated as the interval between the earliest documented evidence of cirrhosis and the date of first assessment at our center. The earliest evidence of cirrhosis was defined hierarchically as: (i) a prior clinician-documented diagnosis in external records; or, when absent, (ii) the earliest date at which available documentation (*i.e.*, imaging reports, histology, elastography results, or laboratory/imaging findings consistent with cirrhosis) supported a diagnosis. Lastly, we recorded events of hepatic decompensation—such as variceal bleeding, new-onset ascites, and hepatic encephalopathy— and data regarding diagnosis of HCC.

Length of follow-up was calculated from the first visit at our center until the last available information, or until death or liver transplantation, and not beyond August 2024. During follow-up, in addition to outcomes such as death and liver transplantation, patient attendance at scheduled visits and alcohol consumption were also assessed.

Written informed consent for the use of personal data for research purposes was obtained from all participants.

2.2. Assessment of material deprivation

To calculate the Genoa Deprivation Index and determine the degree of MD of each city area, four indicators were considered:

- Percentage of families owning their home in the area.
- Housing overcrowding, defined as the average number of residents per room.
- Educational level of residents, expressed as the percentage of individuals with education equal to or lower than middle school (indirectly reflecting income levels).
- Unemployment rate (indicative of material resource scarcity and economic insecurity).

By mapping patients' residential addresses onto the deprivation map, each patient was assigned a specific degree of MD. Then, we used the previously reported cluster analysis to classify patients into high MD (high-MD) or low MD (low-MD) categories [18]. Briefly, we replicated the k-means cluster analysis described for the Genoa Deprivation Index, which partitions the city's census tracts into two homogeneous clusters based on their deprivation score. Methodologically, the numeric scale is the Genoa Deprivation Index—a composite score built from four census-based indicators: % of households renting, unemployment rate, % of residents with less than upper-secondary education, and overcrowding (persons per house). Each indicator is standardized to remove units and variability and then aggregated using the non-compensatory Mazziotta–Pareto Index (a penalized arithmetic mean that increases with worse values and penalizes unbalanced profiles). Higher numbers therefore denote greater material deprivation with a range from 84 to 110 points [18]. Each patient was consequently assigned to the low-MD or high-MD group according to the cluster of the tract in which they resided.

2.3. Statistical analysis

The Kolmogorov-Smirnov test was used to assess whether variables were normally distributed. Continuous variables were expressed using the median and 95% confidence interval of the me-

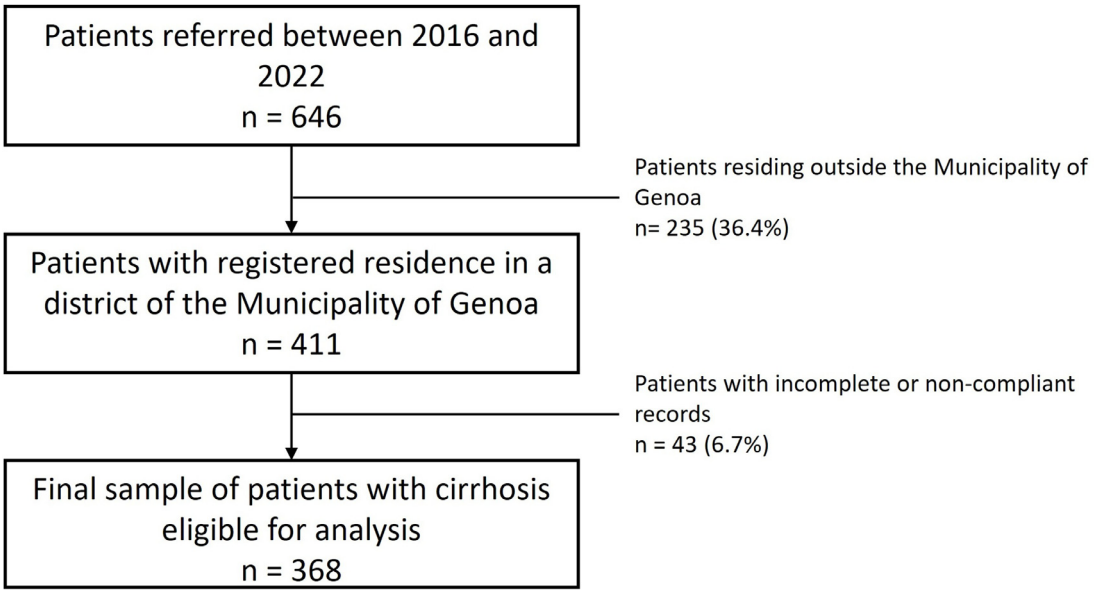

Fig. 1. Flow of patients within the study.

dian. Contingency tables were used to display the frequency and proportion of ordinal and nominal variables in the population.

The Kruskal-Wallis or Mann-Whitney non-parametric tests were used to compare continuous variables among different patient groups. Pearson's chi-square test and Spearman's rank correlation coefficient were applied to analyze the relationship between nominal and continuous variables. Incidence rates (IR) of hospitalization for hepatic decompensation were calculated by dividing the number of new decompensation events by the total person-time at risk, expressed per 100 patient-years. Comparisons between groups were made using Poisson regression, from which incidence rate ratios (IRRs) and corresponding 95% confidence intervals (95% CIs) were calculated.

Patient survival was analyzed using Kaplan-Meier curves and survival distributions were compared using the log-rank test. Transplant was considered either as a censoring event or as a death event in separate analyses. The Cox proportional hazards model was adjusted for risk factors associated with mortality identified through statistical analysis (the probability value for model inclusion was p=0.20). The association between cumulative survival probability and patients' MD levels was assessed using competing risks survival analysis, considering liver transplantation as a competing event. Fine and Gray's methodology was used for competing risk regressions. Univariate and multivariate hazard ratios with 95% CIs were reported evaluating either one of two competing events: i) death without liver transplantation, and ii) receipt of a liver transplant.

Statistical analyses were performed using IBM SPSS Statistics, Release Version 25.0 (SPSS, Inc., 2017, Chicago, IL, USA, www.spss.com) and R (R Project, version 3.4.3; R Foundation for Statistical Computing, Vienna, Austria, and EZR: https://github.com/jinkim3/ezr).

3. Results

3.1. Patients' demographics and comorbidities, severity of liver disease, and degrees of material deprivation

Fig. 1 reports the flow of patients within the study: from an initial cohort of 646 patients with cirrhosis, 235 patients (36.4%) resided outside the Municipality of Genoa and 43 patients (6.7%) had incomplete records, and were therefore not included in the study, with a total of 368 patients who represented the study cohort. The distribution of patients across different zones of the Municipality of Genoa is shown in Supplementary Figure 1. The most represented ethnicity was Caucasian (n=347, 94.3%), followed by North African/Middle Eastern (n=8, 2.2%), Latin American (n=6, 1.6%), South Asian (n=3, 0.8%), East Asian (n=2, 0.5%), and Sub-Saharan African (n=2, 0.5%).

Overall, 252 patients (68.5%) were male, with a median age of 63 years (IQR 57-71). The study population exhibited multiple comorbidities (Supplementary Table 1), with diabetes mellitus being the most common (n=129, 35.0%), followed by arterial hypertension (n=65, 17.7%), chronic renal failure (n=27, 7.3%), chronic obstructive pulmonary disease (n=20, 5.4%), with the median CCI of 6 (IQR 5-7). Most patients were diagnosed with compensated cirrhosis (Child-Pugh class A: n=213, 57.9%; class B: n=112, 30.4%; class C: n=43, 11.7%) and the median MELD score was 10 (IQR 8-14).

The median Genoa Deprivation Index was 96.5 (IQR 94-98.5), and Supplementary Figure 2 shows the distribution of patients across different degrees of MD. Overall, 187 (50.8%) patients were classified as having high-MD, while 181 (49.2%) were categorized as having low-MD. Table 1 summarizes the demographic and liver disease characteristics of all patients, stratified by degree of MD. Patients with high-MD were slightly younger than those with low-MD (62 years, IQR 56-70 *vs.* 64 years, IQR 58-73; p<0.0001). More than half of patients (n=194, 52.7%) had multiple coexisting etiological factors for cirrhosis. Across the whole cohort (n=368), alcohol-related liver disease (ALD) was the predominant etiologic factor (41.6%) and tended to be more frequent among patients with high-MD as compared to patients with low-MD (46.0% *vs.* 37.0%; p=0.09). Metabolic dysfunction-associated steatotic liver disease (MASLD) showed a similar prevalence between groups (high-MD: 34.2% *vs.* low-MD: 30.9%; p=0.51), as did patients with MASLD and increase alcohol intake (MetALD) (high-MD: 15.5% *vs.* low-MD:19.3%; p = 0.34). Chronic viral hepatitis affected nearly half the patients (49.5%) with comparable frequencies in those with either high-MD (51.9%) or low-MD (47.0%; p=0.72).

Patients with low-MD had a lower MELD score (low-MD: 9, IQR 9-11 *vs.* high-MD: 11, IQR 8-15) although this difference did not reach the statistical significance (p=0.069), and likewise a non-significantly greater proportion of patients with low-MD had compensated or mildly decompensated cirrhosis (Child-Pugh class A

Table 1
Baseline demographic, liver-related characteristics, and cirrhosis etiology of patients stratified by degree of material deprivation (MD).

	All patients (n=368)	High-MD (n=187)	Low-MD (n=181)	p
Age *[years]*	63 (57 – 71)	62 (56 – 70)	64 (58 – 73)	**<0.0001**
Sex ***[male]***	252 (68.5)	129 (69.0)	123 (68.0)	0.83
Body mass index *[kg/m²]*	25.0 (23.0 – 28.5)	25.7 (23.0 – 29.3)	25.0 (23.0 – 27.8)	0.37
Charlson Comorbidity Index *[points]*	6 (5 – 7)	6 (5 – 8)	6 (5 – 7)	0.10
ECOG-PS *[score]*	0 (0 – 0)	0 (0 – 0)	0 (0 – 0)	0.36
MELD *[score]*	10 (8 – 14)	11 (8 – 15)	9 (8 – 13)	0.07
Child-Pugh				
A	213 (57.9)	100 (53.5)	113 (62.4)	0.09
B	112 (30.4)	65 (34.8)	47 (26.0)	0.06
C	43 (11.7)	22 (11.8)	21 (11.6)	0.98
Etiology				
ALD	153 (41.6)	86 (46.0)	67 (37.0)	0.09
MASLD	120 (32.6)	64 (34.2)	56 (30.9)	0.51
MetALD	64 (17.4)	29 (15.5)	35 (19.3)	0.34
HCV	139 (37.8)	73 (39.0)	66 (36.5)	0.61
HBV	37 (10.1)	21 (11.2)	16 (8.8)	0.45
HBV/HDV	6 (1.6)	3 (1.6)	3 (1.7)	0.69
AIH	8 (2.2)	5 (2.7)	3 (1.7)	0.50
PBC	14 (3.8)	8 (4.3)	6 (3.3)	0.63
PSC	7 (1.9)	3 (1.6)	4 (2.2)	0.67
Diagnostic modality				
Screening	133 (36.1)	27 (14.4)	106 (58.6)	
Incidental	95 (25.8)	71 (38.0)	24 (13.3)	**<0.001**
Symptomatic	140 (38.1)	89 (47.6)	51 (28.2)	
Delay in referral to the specialist center *[months]*	24 (12 – 96)	36 (12 – 108)	24 (0 – 60)	**<0.001**

Data are shown as absolute value and frequency, and as median and interquartile range.
Abbreviations: MELD, Model for End-stage Liver Disease; ECOG-PS, Performance Status according to Eastern Cooperative Oncology Group; HCV, Hepatitis C Virus; HBV, Hepatitis B Virus; HBV/HDV, Hepatitis B Virus / Hepatitis D Virus; ALD, alcohol-related liver disease; MASLD, Metabolic Disfunction-Associated Steatotic Liver Disease; MetALD, MASLD and increase alcohol intake; AIH, Autoimmune Hepatitis; PBC, Primary biliary cholangitis; PSC, Primary sclerosing cholangitis.

and B) as compared to patients with high-MD (62.4% *vs*. 53.5%; p=0.16). No statistically significant differences were observed between high-MD and low-MD groups regarding sex, BMI, CCI, and ECOG-PS.

3.2. Modality of diagnosis

The most common mode of cirrhosis diagnosis (n=140, 38.0%) was presentation with symptoms or decompensating events, while 133 (36.1%) were diagnosed through blood test screening or imaging techniques, and 95 (25.8%) through incidental findings during examinations carried out for other diseases. Patients with high-MD were less frequently diagnosed through screening tests compared to those with low-MD (14.4% *vs*. 58.6%; p<0.001). Additionally, once cirrhosis was diagnosed, the delay to specialist referral was longer for patients with high- as compared to those with low-MD (36 months, IQR 12-108 *vs*. 24 months, IQR 0-60; p<0.001). Overall, 149 (40.5%) patients were referred due to the presence of HCC, with no difference in prevalence between patients with various degrees of MD (high-MD: 40.5% *vs*. low-MD: 40.9%; p=0.1).

3.3. Adherence to follow-up

After referral to our center, patients were followed for a median of 31 months (IQR 20.7–65.9). During this period, a total of 44 patients (12.0%) were lost to follow-up, and among these significantly more patients had high-MD (high-MD: 15.5% *vs*. low-MD: 8.3%; p<0.0001).

Among patients who consumed any amount of alcohol at cohort entry, significantly more patients with high-MD (n=56, 29.9%) resumed or continued consuming alcohol compared to patients with low-MD after adequate counselling (n=23, 12.7%; p<0.0001).

3.4. Incidence of decompensating events

After the first access to our center, 194 patients (52.7%) were hospitalized for an episode of hepatic decompensation, while 19 patients (5.2%) required hospitalization for events unrelated to liver disease (6 for infections, 4 for acute kidney injury unrelated to liver disease, 4 for trauma, 3 for cerebrovascular events, 2 for biliary colic). Overall, the most frequent liver-related cause of hospitalization was ascites (n=133, 68.6%), followed by variceal hemorrhage (n=59, 30.4%) and hepatic encephalopathy (n=40, 20.6%).

The overall IR of decompensating events that required hospitalization was 3.2 *per* 100 patients at risk *per* year. Patients with high MD experience twice as many hospitalizations for decompensating events of patients with low MD: 4.4/100 patients at risk *per* year *vs*. 2.2/100 patients at risk *per* year (IRR: 1.95, 95%CI 1.62–2.35; p=0.001).

In patients with compensated liver disease, the IR of decompensating events that required hospitalization was 1.6 per 100 patients at risk *per* year at risk and was markedly higher in those with high-MD (high-MD, 2.3/100 patients at risk *per* year *vs.* low-MD, 1.1/100 patients at risk *per* year; IRR: 2.17, 95% CI 1.56–3.06; p<0.001).

In patients with decompensated liver disease, the IR of decompensating events requiring hospitalization was 5.9 *per* 100 patients at risk *per* year and remained significantly higher in those with high-MD (high-MD, 7.3/100 patients at risk *per* year *vs.* low-MD, 4.5/100 patients at risk *per* year; IRR: 1.60, 95% CI 1.28–2.00; p<0.001).

3.5. Survival and liver transplantation

During follow-up, 88 (23.9%) patients died, and among these 52 patients (27.8%) had high-MD and 36 patients (19.9%) low-MD. Overall, 48 deaths (54.5%) were attributed to liver-related decompensation or complications of portal hypertension, 36 (40.9%) to tumor-related causes (HCC/CCA), and 4 (4.5%) to non liver-related causes. One hundred three patients (28.0%) underwent liver transplantation, with no difference between those with high- (n=53, 28.3%) and low-MD (n=50, 27.6%; p=0.908).

When liver transplantation was considered a censored event, overall survival was 85.7 months (95%CI: 77.3–94.2) and was sig-

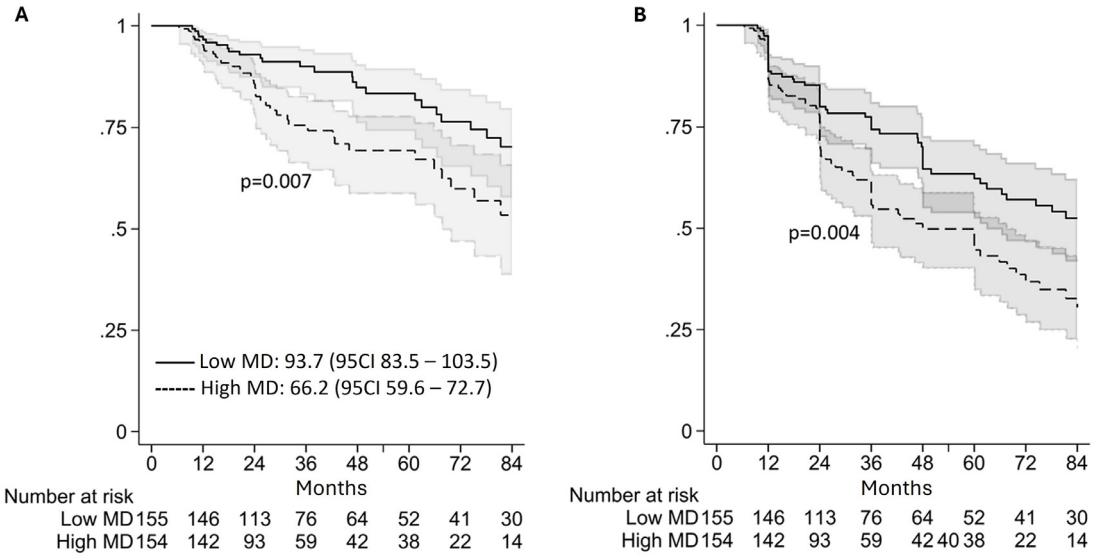

Fig. 2. Kaplan-Meier curves showing cumulative survival of patients with cirrhosis according to various degrees of material deprivation (MD). Panels consider liver transplantation as the end of follow-up (A) and death (B).

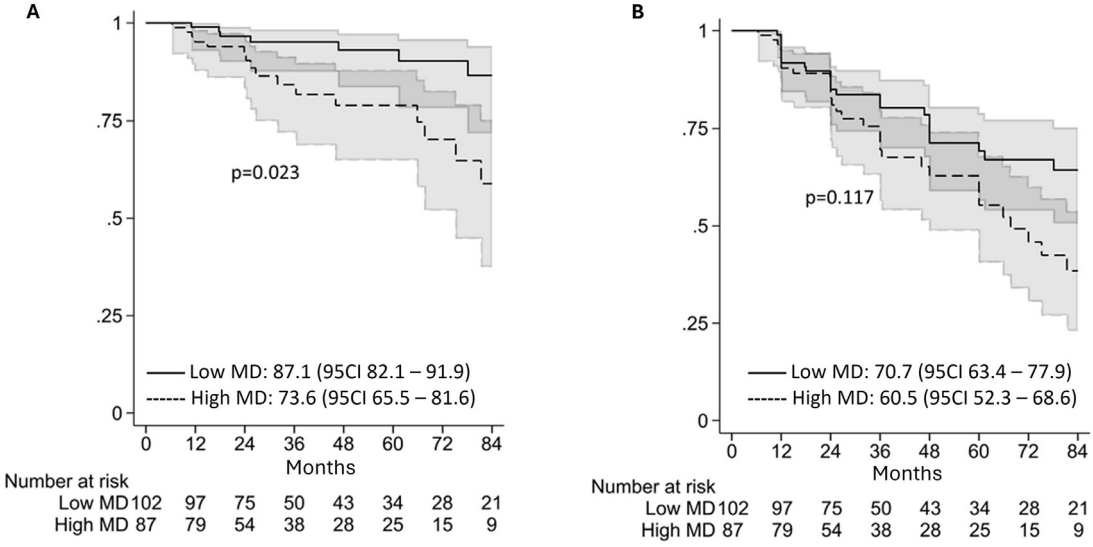

Fig. 3. Kaplan-Meier curves showing cumulative survival of patients with compensated cirrhosis (Child-Pugh class A) according to the influence of various degrees of material deprivation (MD). Panels consider liver transplantation as the end of follow-up (A) and death (B).

nificantly shorter in patients with high-MD (66.2 months, 95% CI: 59.6–72.7) than in those with low-MD (93.7 months, 95%CI: 83.5–103.5; p=0.007, Fig. 2A). This comparison was repeated considering the event liver transplantation equal to death, and the survival disadvantage for patients with high-MD persisted (48.7 months, 95% CI: 42.7–54.7 *vs*. 65.2 months, 95% CI: 57.3–73.1; p=0.004, Fig. 2B).

In the sub-analysis of patients that presented with compensated cirrhosis, when liver transplantation was considered a censored event, survival was significantly shorter in those with high-MD as compared to those with low-MD (73.6 months, 95% CI: 65.5–81.6 *vs*. 87.1 months, 95% CI: 82.1–91.9; p=0.03, Fig. 3A). Then, among these patients, when transplant was equated to death, the difference in survival did not persist (high-MD, 60.5 months, 95% CI: 52.3–68.6 *vs*. low-MD, 70.7 months, 95% CI: 63.4–77.9; p=0.12, Fig. 3B).

A confirmatory survival analysis was performed in patients with compensated cirrhosis, excluding those who underwent liver transplantation, and survival was again significantly shorter in patients with high-MD (71.5 months, 95% CI: 62.4–80.6 *vs*. 86.6 months, 95% CI: 81.2–91.9; p=0.02, Supplementary Figure 3).

A multivariate Cox analysis was performed to evaluate independent predictors of mortality, and Table 2 presents the results of this analysis along with the univariate comparisons. Two models were created to address the collinearity of the MELD (Model 1) and Child-Pugh (Model 2) variables. An increased risk of death was independently associated with a poorer ECOG-PS [Model 1: HR 2.15 (95% CI: 1.48–3.11); Model 2: HR 2.13 (95% CI: 1.47–3.09)], high-MD [Model 1: HR 1.58 (95% CI: 1.01–2.60); Model 2: HR 1.82 (95%CI: 1.08–3.04], and worse liver function as indicated by higher MELD score [HR 1.06 (95% CI 1.02–1.10)] or worse Child-Pugh class [Class B vs A: HR 1.96 (95% CI: 1.19–3.24); Class C vs A: HR 3.50 (95%CI: 1.87–6.55)].

A competitive risk analysis was conducted to identify independent predictors of mortality and liver transplantation. Table 3

Table 2
Univariate and multivariate Cox regression analysis of predictors of mortality.

Variable	Univariate analysis		Multivariate analysis Model 1[†]		Multivariate analysis Model 2[†]	
	HR (95% CI)	p	HR (95% CI)	p	HR (95% CI)	p
Sex (Female=ref)	1.52 (0.93 – 2.49)	0.09	1.32 (0.79 – 2.20)	0.29	1.32 (0.79 – 2.20)	0.29
Age (+1 year)	0.99 (0.97 – 1.01)	0.44				
Body mass index (+1 kg/m^2)	0.99 (0.95 – 1.05)	0.96				
Material deprivation (Low=ref)	1.82 (1.17 – 2.83)	**0.008**	1.58 (1.01 – 2.60)	**0.046**	1.82 (1.08 – 3.04)	**0.024**
Charlson Comorbidity Index (+1 point)	1.08 (0.96 – 1.21)	0.22				
ECOG-PS (+1 point)	2.48 (1.75 – 3.54)	**<0.0001**	2.15 (1.48 – 3.11)	**<0.0001**	2.13 (1.47 – 3.09)	**<0.0001**
MELD score (+1 point)	1.07 (1.03 – 1.10)	**<0.0001**	1.06 (1.02 – 1.10)	**0.004**		
Child-Pugh class (A=ref)						
B	2.32 (1.43 – 3.77)	**0.001**			1.96 (1.19 – 3.24)	**0.009**
C	3.90 (2.18 – 6.97)	**<0.0001**			3.50 (1.87 – 6.55)	**<0.0001**
Modality of diagnosis (surveillance=ref)	2.45 (1.50 – 4.00)	**<0.0001**	1.67 (0.95 – 2.95)	0.08	1.32 (0.72 – 2.41)	0.37
Hepatocellular carcinoma (absent=ref)	1.42 (0.93 – 2.18)	0.11	1.32 (0.84 – 2.07)	0.23	1.45 (0.92 – 2.29)	0.11

[†] Model 1: including MELD score; Model 2: including Child-Pugh classification
Abbreviations: HR, Hazard Ratios; 95%CI, 95% Confidence Interval; ECOG-PS, Performance Status according to Eastern Cooperative Oncology Group; MELD, Model for End-stage Liver Disease.

presents the results of both univariate and multivariate analyses, considering two models to address collinearity (Model 1 incorporating MELD score, Model 2 incorporating the Child-Pugh classification). An increased risk of death was independently associated with a poorer ECOG-PS [Model 1: HR 2.26 (95% CI: 1.63–3.15); Model 2: HR 2.31 (95% CI: 1.66–3.22)], decompensated liver disease [Child-Pugh class B vs A: HR 1.71 (95% CI: 1.26–2.33),; class C vs A: HR 2.56 (95% CI: 2.00–3.42)], a higher MELD score [HR 1.04 (95% CI: 1.01–1.07)], and the presence of HCC [Model 1: HR 1.67 (95% CI: 1.10–2.53); Model 2: HR 1.50 (95% CI: 0.99–2.28)]. Additionally, the presence of high-MD was associated with an increased mortality risk in Model 1 [HR 1.54 (95%CI: 1.02–2.43)], although this association was not significant in Model 2 [HR 1.40 (95%CI: 0.90–2.20)].

Regarding liver transplantation, a lower BMI [Model 1: HR 0.96 (95% CI 0.91–1.00); Model 2: HR 0.95 (95% CI 0.91–0.99)], a lower CCI [Model 1: HR 0.80 (95% CI 0.72–0.90); Model 2: HR 0.79 (95% CI 0.71–0.89)], a poorer ECOG-PS [Model 1: HR 0.36 (95% CI 0.15–0.87); Model 2: HR 0.35 (95% CI 0.15–0.86)] and worse liver function as indicated by higher MELD score [HR 1.06 (95% CI 1.02–1.09)] and worse Child-Pugh class [CPT B vs A: HR 1.49 (95% CI 1.15–1.94); CPT C vs A: HR 2.24 (95% CI 1.72–2.91)] were associated with higher probability of receiving liver transplantation.

3.6. Sensitivity analysis by underlying etiology

A subgroup analysis was performed by stratifying patients according to etiological components. Demographic and liver disease–related characteristics, stratified by degree of MD, are reported in Supplementary Table 2 for patients with an alcohol-related component, in Supplementary Table 3 for those with a metabolic dysfunction component, and in Supplementary Table 4 for patients with history or active viral hepatitis.

Diagnostic modality differed significantly by MD across all subgroups ($p<0.001$), with fewer screening diagnoses and more incidental diagnoses in the High-MD group. In the metabolic dysfunction component subgroup, patients with High-MD had a higher MELD score ($p=0.046$) and a longer delay in referral to the specialist center ($p=0.016$). In the viral hepatitis subgroup, patients with High-MD had a higher MELD score ($p=0.044$) and a longer delay in referral ($p=0.045$).

Across etiological components, patients with high MD experienced higher hospitalization rates for decompensating events than patients with low MD: alcohol-related component, 5.4/100 patients at risk per year vs. 4.2/100 patients at risk per year (IRR 1.29, 95% CI 1.02–1.62; $p=0.026$), metabolic dysfunction component, 4.7/100 vs. 2.0/100 patients at risk per year (IRR 2.39, 95% CI 1.80–3.19; $p<0.001$), and viral hepatitis, 4.0/100 vs. 1.6/100 patients at risk per year (IRR 2.51, 95% CI 1.87–3.39; $p<0.001$).

The median overall survival was shorter patients with high MD than in those with low MD in the MASLD (94.9 months, 95% CI 90.8–98.9 vs. 110.0 months, 95% CI 105.8–112.4; $p=0.022$, Supplementary Figure 4a) and viral hepatitis subgroups (86.0 months, 95% CI 82.0–90.0 vs. 105.0 months, 95% CI 101.0–109.0; $p=0.002$, Supplementary Figure 4b), whereas no significant difference was observed in the alcohol-related component subgroup (81.5 months, 95% CI 61.8–101.1 vs. 93.7 months, 95% CI 81.4–106.1; $p=0.252$, Supplementary Figure 4c).

4. Discussion

Socioeconomic inequalities have been widely recognized as pivotal factors influencing health outcomes at both local and global levels. MD has emerged as a main determinant of health, often capturing the cumulative impact of limited financial resources, inadequate housing, and restricted access to essential services [23]. MD is one of the most suitable measures to understand mortality disparities within urban areas, and previous studies have found an association between measures of material deprivation, alcohol-related and total mortality [24,25]. Against this background, our study sought to explore the extent to which socioeconomic disparities, as defined by various degrees of MD, intersect with clinical outcomes among patients diagnosed with cirrhosis. Our investigation enabled us to highlight how MD represents a negative prognostic factor in patients with cirrhosis, as we observed that higher degrees of MD are associated with a variety of negative predictors of outcome such as diagnosis due to symptoms rather than screening, delay in referral of patients to tertiary centers, and lack of adherence to recommendations and follow-up. In turn, this had a clear impact on patients' prognosis, independently of severity of liver disease. In fact, patients with high-MD had a higher rate of decompensating events and a shorter survival, although once patients were included in a liver transplant program their life expectancy was similar to patients with low-MD. This convergence likely reflects the impact of intensive, structured follow-up inherent to liver transplantation programs: frequent scheduled visits, rapid access pathways, proactive management of portal-hypertensive complications, and targeted nutrition care.

The results of our study, which measures clinical outcomes associated with MD in a country with a universal healthcare system, are of particular relevance as they highlight the pervasive nature of material deprivation beyond economic factors such as health insurance and ability to pay for care, unlike results obtained in

Table 3
Univariate and multivariate competitive risk analysis of predictors of mortality and liver transplantation.

Variable	Competing risk of death						Competing risk of receiving liver transplantation					
	Univariate analysis		Multivariate analysis Model 1[†]		Multivariate analysis Model 2[†]		Univariate analysis		Multivariate analysis Model 1[†]		Multivariate analysis Model 2[†]	
	HR (95% CI)	p	HR (95% CI)	p	HR (95% CI)	p	HR (95% CI)	p	HR (95% CI)	p	HR (95% CI)	p
Sex (Female=ref)	1.41 (0.86 – 2.31)	0.17					1.17 (0.75 – 1.82)	0.49				
Age (+1 year)	1.01 (0.99 – 1.03)	0.51					0.95 (0.94 – 0.97)	**<0.0001**				
Body mass index (+1 kg/m^2)	1.00 (0.96 – 1.04)	0.96					0.96 (0.92 – 1.01)	0.09	0.96 (0.91 – 1.00)	0.07	0.95 (0.91 – 0.99)	**0.045**
Material deprivation (Low=ref)	1.56 (1.02 – 2.38)	**0.04**	1.54 (1.02 – 2.43)	**0.04**	1.40 (0.90 – 2.20)	0.140	1.08 (0.73 – 1.61)	0.70				
Charlson Comorbidity Index (+1 point)	1.14 (1.01 – 1.27)	0.03	1.10 (0.98 – 1.24)	0.11	1.09 (0.96 – 1.23)	0.190	0.76 (0.68 – 0.85)	**<0.0001**	0.80 (0.72 – 0.90)	**<0.0001**	0.79 (0.71 – 0.89)	**<0.0001**
ECOG-PS (+1 point)	2.61 (1.93 – 3.53)	**<0.0001**	2.26 (1.63 – 3.15)	**<0.0001**	2.31 (1.66 – 3.22)	**<0.0001**	0.34 (0.14 – 0.84)	**0.02**	0.36 (0.15 – 0.87)	**0.02**	0.35 (0.15 – 0.86)	**0.021**
MELD score (+1 point)	1.04 (1.01 – 1.07)	**0.02**			1.04 (1.00 – 1.07)	0.060	1.06 (1.03 – 1.10)	**<0.0001**	1.06 (1.02 – 1.09)	**0.001**		
Child-Pugh score (A=ref)												
B	1.70 (1.30 – 2.23)	**<0.0001**	1.71 (1.26 – 2.33)	**<0.0001**			1.50 (1.16 – 1.95)	**0.002**			1.49 (1.15 – 1.94)	**0.003**
C	2.45 (1.90 – 3.20)	**<0.0001**	2.56 (2.00 – 3.42)	**<0.0001**			2.53 (1.95 – 3.28)	**<0.0001**			2.24 (1.72 – 2.91)	**<0.0001**
Modality of diagnosis (surveillance=ref)	2.03 (1.26 – 3.25)	**0.003**	1.14 (0.66 – 1.96)	0.64	1.42 (0.85 – 2.35)	0.180	1.01 (0.67 – 1.51)	0.97				
Hepatocellular carcinoma (absent=ref)	1.49 (0.98 – 2.26)	0.06	1.67 (1.10 – 2.53)	**0.02**	1.50 (0.99 – 2.28)	0.055	0.81 (0.54 – 1.22)	0.32				

[†] Model 1: including MELD score; Model 2: including Child-Pugh classification.
Abbreviations: HR, Hazard Ratios; 95%CI, 95% Confidence Interval; ECOG-PS, Performance Status according to Eastern Cooperative Oncology Group; MELD, Model for End-stage Liver Disease.

other countries with different, less inclusive healthcare systems [13–16,26]. In Italy, access to care is universal for Italian citizens and legal residents, and although some services may require cost-sharing through copayments, individuals with low income, who are unemployed, and patients with chronic conditions are exempt from copayment, thus further enhancing the role of social rather than merely economic determinants [26].

Overall, we observed that patients with higher degrees of MD more often seek medical attention later, *i.e.*, when liver disease is symptomatic, or decompensating events have already developed. These findings are a concerning call to action as we increasingly recognize the need to prevent, or diagnose as early as possible, progressive liver disease. The relationship we observed in our study is consistent with the literature indicating that non-healthcare determinants of health, including MD, negatively influence not only the incidence of various chronic diseases, but also their clinical outcomes [10,13–15,27,28]. Late diagnosis among socioeconomically disadvantaged patients can primarily be attributed to lower participation in screening programs [29,30]. Various factors may contribute to this gap, including lower awareness of health risks—often tied to lower educational levels—and the need to prioritize basic subsistence over preventing potential future illnesses. Additional contributing factors might include long waiting times for appointments and tests within the National Health Care services, which are aspects that mainly affect those who cannot afford private healthcare or discounted insurance plans even in countries, such as Italy, with a universal healthcare system [31]. According to a report by the Italian Association of Private Hospitals, produced in collaboration with Censis, a large percentage of lower-income patients had to forgo healthcare because they were unable to afford the costs or tolerate what were deemed excessively long waiting lists [32].

We also observed that once patients were engaged in care in a specialized center, patients with high-MD were almost twice as likely to be lost to follow-up compared to patients with low-MD. Similarly, among patients with high-MD, the proportion of those who resumed or continued drinking alcohol after referral, despite receiving adequate counselling and support, was more than twice the figure of those with low-MD. The causes of poor adherence to follow-up and medical recommendations among patients with high-MD require additional study, but may largely coincide with the factors determining lower participation in screening: reduced awareness of health risks, the urgency of dealing with other economic and social issues, potential difficulty understanding medical instructions due to a lower educational level, and a possible lack of trust in the physician [33]. These data suggest that MD associates with poor adherence to medical treatment and recommendations.

Furthermore, individuals in high-deprivation areas were younger and with a greater severity of cirrhosis than those in low-deprivation areas, and these findings surmise that patients in high-deprivation areas may have developed liver disease earlier. This hypothesis stems from the many unfavorable conditions already mentioned, including limited awareness of the risks associated with excessive alcohol consumption and other harmful habits, greater economic and cultural barriers to maintaining a healthy lifestyle, poorer diet quality due to economic constraints, and an increase in metabolic diseases related to obesity and diabetes [11]. Similar trends were noted in another Italian study focusing on the impact of MD on HCC at the national level, which found that the median age at diagnosis was 69 years among patients with low deprivation, compared to nearly 67 among those with higher deprivation—a finding that confirms the influence of socioeconomic factors on the natural history of liver disease [34].

Our study also found a significant association between MD and the rate of hepatic decompensating events leading to hospital admission. Indeed, the incidence rate of decompensation was nearly double among patients with high-MD compared to those with low-MD, both overall and within the groups of patients with compensated and decompensated cirrhosis at start of follow-up. A large US study, conducted within a health insurance system markedly different from Italy's, identified socioeconomic status as a critical factor in predicting hospital readmissions among patients with cirrhosis [35]. In this study, lower median household income was associated with higher odds of being readmitted at 30-, 90-, and 180-day in patients with decompensated cirrhosis, even after adjusting for demographic and clinical confounders. Both our study and the US study cited here demonstrate that socioeconomic disparities may play a key role in hospital re-admissions independent of liver disease severity, possibly due to reduced access to healthcare resources, lower health literacy, and inadequate post-discharge support [35]. Some factors related to healthcare access in that study, for example insurance coverage for post-hospitalization care, may not be directly transferable to the Italian context, but other causes underlying the correlation with MD appear to be shared in our healthcare setting as well.

One of the most relevant results of our study is that MD had a significant and independent impact on mortality in patients with cirrhosis. The survival benefit in patients with low-MD was approximately two years in the overall cohort, and more than one year in patients with initially compensated cirrhosis. Noteworthy, this difference persisted when liver transplantation was treated as an exclusion criterion, a censoring event, or as a competing outcome, demonstrating the proportional association between higher degree of MD and mortality. This association with mortality likely captures the impact of MD on all phases of the trajectory of disease: from diagnosis to adherence to follow-up and care, and incidence of liver disease-related events requiring hospitalization. We feel that the reduced life expectancy among individuals living in highly deprived urban areas may be the consequence of the systematic effect that socioeconomic inequalities exert on every aspect of the management of cirrhosis. In this context, our results align with those of a Danish study showing that indicators of socioeconomic deprivation are associated with lower survival in patients with cirrhosis, while a more recent US study found a direct link between MD and mortality among patients on the waiting list for liver transplantation [36,37].

How can these results be used to improve the overall management and outcome of patients affected by cirrhosis who live in more deprived settings? It is well known that a structural intervention would require long-term social and economic policies to reduce inequalities, but, in the short-term, measures to improve clinical management and prevention are possible [38]. Firstly, communication with the patient is crucial and primary care physicians should provide clear, understandable information, tailored to the patient background, explaining the importance of vaccination for preventable liver diseases such as hepatitis B virus infection, attention to potential sources of infection for hepatitis C virus, and above all particular attention to maintenance of a healthy lifestyle in order to prevent development of liver diseases attributable to unhealthy diets, sedentariness, and unsafe alcohol use. In this regard, targeted campaigns in more disadvantaged areas can raise awareness of unhealthy behaviors and highlight the benefits of early diagnosis [39]. Targeted awareness and easier access to care might help reduce these disparities and should be paired with broader efforts to address socioeconomic inequalities.

Our findings align with those of Flemming et al. [40], who observed lower rates of liver transplantation among individuals living in low-income, materially resource-deprived, and housing-unstable areas. However, a limitation of that study is the use of neighborhood-level indicators, which may not accurately reflect

individual-level socioeconomic conditions and introduces potential ecological bias.

Finally, our sensitivity analysis by etiological subgroup reinforces the robustness of the main results. In alcohol-related disease, MASLD, and viral hepatitis, higher material deprivation was consistently linked to fewer screening-based diagnoses and to more frequent hospitalizations for decompensating events, suggesting that deprivation shapes outcomes beyond etiological differences. The survival gap associated with high MD was apparent in the MASLD and viral hepatitis strata, but it did not reach statistical significance in the alcohol-related subgroup. This between-group variability may partly reflect competing risks, differences in disease course, and limited power within strata. At the same time, in alcohol-related liver disease the prognostic impact of ongoing alcohol use may be so strong that it blunts the incremental signal captured by MD. Finally, harmful alcohol consumption is often embedded in broader social and cultural vulnerability, which may reduce the added discriminatory value of MD indices within this specific etiological context.

Our study has limitations. First, the retrospective observational design limits causal inference and we cannot exclude residual confounding from unmeasured factors, despite adjustment for major clinical covariates. Second, the Genoa Deprivation Index is an area-level measure based on census data and does not capture individual income, educational attainment, employment status, or household conditions. Therefore, individual socioeconomic status may diverge from neighborhood averages, introducing ecological misclassification and an ecological fallacy risk; accordingly, our findings should be interpreted as associations with area-level deprivation, and we could not distinguish contextual from individual-level socioeconomic effects. Third, we lack information on the change of residence before enrollment, which could affect our findings. While this was a single-center study within one metropolitan area, the external generalizability of our estimates may be limited; however, the deprivation construct relies on census indicators (education, unemployment, tenure, overcrowding) that are shared with widely used international deprivation indices, supporting conceptual portability beyond Genoa. Unfortunately, because MD was measured as a composite area-level score (Genoa Deprivation Index) and patients were dichotomized via k-means clusters, we cannot identify which single component is primarily responsible for the observed associations [41–43]. Lastly, on clinical grounds, the proportion of patients with HCC was high, although this is because our center acts as referral center for patients with HCC in the area. This may have introduced referral bias and, in turn, influenced survival comparisons. While our sensitivity analyses partially mitigate this concern, our cohort should not be considered fully representative of the typical compensated cirrhosis population.

In conclusion, our study showed that patients with cirrhosis who live in more deprived areas receive untimely diagnosis of disease, often incidentally rather through screening, and have a lower adherence to follow-up care and abstinence from alcohol. Patients with cirrhosis who live in highly-deprived areas also show a higher rate of liver-related events requiring hospitalization and shorter survival compared to patients with cirrhosis living in less deprived areas. Noteworthy, despite prognostic determinants of patients with cirrhosis are heterogeneous, a higher degree of MD was independently associated with worse prognosis, and given that socio-economic disparities among neighborhoods are unlikely to change in the short-term, possible solutions should include targeted health education and prevention campaigns for more deprived communities.

Funding

None.

Author contributions

Andrea Pasta: Conceptualization, Methodology, Investigation, Data curation, Writing - original draft. **Diletta Maria Rossi**: Methodology, Investigation, Data curation, Writing - original draft. **Sara Labanca**: Investigation. **Simona Marenco**: Investigation. **Giulia Pieri**: Investigation. **Catherine Mezzacappa**: Writing - review & editing. **Mario Strazzabosco**: Writing - review & editing. **Edoardo Giovanni Giannini**: Conceptualization, Investigation, Writing - review & editing.

Data transparency statement

Data, analytic methods, and study materials will be made available to other researchers upon reasonable request.

Declaration of competing interest

None to report.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.dld.2026.01.225.

References

[1] Parola M, Pinzani M. Liver fibrosis: pathophysiology, pathogenetic targets and clinical issues. Mol Aspects Med 2019;65:37–55.
[2] European Association for the Study of the Liver. EASL Clinical Practice Guidelines for the management of patients with decompensated cirrhosis. J Hepatol 2018;69:406–60.
[3] Xia S, He ZY, Wu XN, et al. Etiology control for reducing hepatic vein pressure gradient in patients with cirrhosis and portal hypertension: A systematic review and meta-analysis. J Dig Dis 2025;26:31–43.
[4] Chen Y, Wen H, Li Y, et al. Recompensation in patients with autoimmune hepatitis-related decompensated cirrhosis following immunosuppressive therapy. JHEP Rep 2025;7:101496.
[5] Romano A, Zeni N, Caspanello AR, et al. Follow-up post-HCV virological response to DAA in advanced chronic liver disease. Liver Int 2024;44:3138–50.
[6] Su GL, Glass L, Tapper EB, et al. Virtual consultations through the Veterans Administration SCAN-ECHO project improves survival for Veterans with liver disease. Hepatology 2018;68:2317–24.
[7] Mellinger JL, Moser S, Welsh DE, et al. Access to subspecialty care and survival among patients with liver disease. Am J Gastroenterol 2016;111:838–44.
[8] Pelizzaro F, Vitale A, Sartori A, et al. Surveillance as Determinant of Long-Term Survival in Non-Transplanted Hepatocellular Carcinoma Patients. Cancers (Basel) 2021;13(4):897. doi:10.3390/cancers13040897.
[9] Hahn RA. What is a social determinant of health? Back to basics. J Public Health Res 2021;10(4):2324. doi:10.4081/jphr.2021.2324.
[10] Tøge AG, Bell R. Material deprivation and health: a longitudinal study. BMC Pub Health 2016;16:747. doi:10.1186/s12889-016-3327-z.
[11] Benach J, Muntaner C. Precarious employment and health: developing a research agenda. J Epidemiol Community Health 2007;61:276–7.
[12] Lameire N, Joffe P, Wiedemann M. Healthcare systems–an international review: an overview. Nephrol Dial Transplant 1999;14(Suppl 6):3–9.
[13] Forman LM, Jackson WE, Arrigain S, et al. Socioeconomic deprivation is associated with worse patient and graft survival following adult liver transplantation. Liver Transpl 2025;31:211–20.
[14] Hendele JB, Nichols JT, Vutien P, et al. A retrospective cohort study of socioeconomic deprivation and post-liver transplant survival in adults. Liver Transpl 2024;30:816–25.
[15] Flanary JT, Chen PH, Shan S, Mitchell J, Gurakar A, Strauss AT, Diener-West M, Desjardins MR, Weeks SR, Herrick-Reynolds K, Teles M, Yilmaz S, Warren D, King E, Cameron A. Access to early liver transplantation is adversely impacted by social determinants of health: A retrospective cohort study. *Liver transplantation : official publication of the American Association for the Study of Liver Diseases and the International Liver*. Transplant Soc 2025;31(12):1472–87. doi:10.1097/LVT.0000000000000653.
[16] Mezzacappa C, Rossi R, Jaffe A, et al. Community-level factors associated with hepatocellular carcinoma incidence and mortality: an observational registry study. Cancer Epidemiol Biomark Prev 2024;33:270–8.
[17] Udell JA, Wang CS, Tinmouth J, et al. Does this patient with liver disease have cirrhosis? JAMA 2012;307:832–42.
[18] Landi S, Ivaldi E, Testi A. Measuring change over time in socio-economic deprivation and health in an urban context: the case Study of Genoa. Soc Indic Res 2018;139:745–85.
[19] Pugh RN, Murray-Lyon IM, Dawson JL, et al. Transection of the oesophagus for bleeding oesophageal varices. Br J Surg 1973;60:646–9.

[20] Oken MM, Creech RH, Tormey DC, et al. Toxicity and response criteria of the Eastern Cooperative Oncology Group. Am J Clin Oncol 1982;5:649–55.
[21] Charlson ME, Pompei P, Ales KL, et al. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. J Chronic Dis 1987;40:373–83.
[22] Giannini E, Botta F, Testa E, et al. The 1-year and 3-month prognostic utility of the AST/ALT ratio and model for end-stage liver disease score in patients with viral liver cirrhosis. Am J Gastroenterol 2002;97:2855–60.
[23] Belau MH. Material and social deprivation associated with public health actual causes of death among older people in Europe: longitudinal and multilevel results from the Survey of Health, Ageing and Retirement in Europe (SHARE). Front Public Health 2024;12:1469203.
[24] Erskine S, Maheswaran R, Pearson T, Gleeson D. Socioeconomic deprivation, urban-rural location and alcohol-related mortality in England and Wales. BMC Public Health 2010;10:99.
[25] Borrell C, Marí-Dell'olmo M, et al. Socioeconomic inequalities in mortality in 16 European cities. Scand J Public Health 2014;42:245–54.
[26] Ricciardi W, Tarricone R. The evolution of the Italian National Health Service. Lancet 2021;398:2193–206.
[27] Karlsen TH, Sheron N, Zelber-Sagi S, et al. The EASL–Lancet Liver Commission: protecting the next generation of Europeans against liver disease complications and premature mortality. Lancet 2022;399:61–116.
[28] Long C, Cinque F, Kablawi D, et al. Material deprivation is associated with liver stiffness and liver-related outcomes in people with HIV. Liver Int 2024;44:2615–24.
[29] Meshefedjian GA, Ouimet MJ, Frigault LR, et al. Association of material deprivation Status, access to Health Care services, and lifestyle with screening and prevention of disease, Montreal, Canada. Prev Chronic Dis 2012;2016(13):E137.
[30] Wang F, Luo L, McLafferty S. Healthcare access, socioeconomic factors and late-stage cancer diagnosis: an exploratory spatial analysis and public policy implication. Int J Public Pol 2010;5:237–58.
[31] Riganti A, Siciliani L, Fiorio CV. The effect of waiting times on demand and supply for elective surgery: evidence from Italy. Health Econ 2017;26(Suppl 2):92–105.
[32] 58° Rapporto sulla situazione sociale del Paese/2024 | CENSIS. https://www.censis.it/rapporto-annuale/58%C2%B0-rapporto-sulla-situazione-sociale-del-paese2024-0 (accessed on 01 September 2025).
[33] Fernandez-Lazaro CI, Adams DP, Fernandez-Lazaro D, Garcia-González JM, Caballero-Garcia A, Miron-Canelo JA. Medication adherence and barriers among low-income, uninsured patients with multiple chronic conditions. Res Soc Admin Pharm : RSAP 2019;15(6):744–53. doi:10.1016/j.sapharm.2018.09.006.
[34] Cucchetti A, Gramenzi A, Johnson P, et al. Material deprivation affects the management and clinical outcome of hepatocellular carcinoma in a high-resource environment. Eur J Cancer 2021;158:133–43.
[35] Brahmania M, Wiskar K, Walley KR, et al. Lower household income is associated with an increased risk of hospital readmission in patients with decompensated cirrhosis. J Gastroenterol Hepatol 2021;36:1088–94.
[36] Jepsen P, Vilstrup H, Andersen PK, et al. Socioeconomic status and survival of cirrhosis patients: a Danish nationwide cohort study. BMC Gastroenterol 2009;9:35.
[37] Cullaro G, Ge J, Lee BP, et al. Association between neighborhood-based material deprivation and liver transplant waitlist registrants demographics and mortality. Clin Transplant 2024;38:e15189.
[38] Ford J, Sowden S, Olivera J, et al. Transforming health systems to reduce health inequalities. Future Healthc J 2021;8:e204.
[39] Sharkiya SH. Quality communication can improve patient-centred health outcomes among older patients: a rapid review. BMC Health Serv Res 2023;23:886.
[40] Flemming JA, Muaddi H, Djerboua M, Neves P, Sapisochin G, Selzner N. Association between social determinants of health and rates of liver transplantation in individuals with cirrhosis. Hepatology 2022;76(4):1079–89 Oct.
[41] Jarman B, Townsend P, Carstairs V. Deprivation indices. BMJ 1991;303:523.
[42] Guillaume E, Pornet C, Dejardin O, et al. Development of a cross-cultural deprivation index in five European countries. J Epidemiol Community Health 2016;70:493–9.
[43] Caranci N, Biggeri A, Grisotto L, et al. The Italian deprivation index at census block level: definition, description and association with general mortality. Epidemiol Prev 2010;34:167–76.