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ORIGINAL ARTICLE

Potential predictors of chronic liver disease among adults: Key determinants for promoting healthy aging

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ABSTRACT

Aim: This study aimed to find out predictors of chronic liver disease (CLD) in adults and evaluate key determinants that may influence healthy aging.

Materials and Methods: A case-control study was conducted among adults who were receiving care at a tertiary care center. Demographics, lifestyle factors, and clinical variables like BMI were collected. Statistical analysis was performed using chi-square testing for association and logistic regression analysis to identify independent factors that predict CLD, p-value of <0.05 was used to identify significance for all information collected.

Results: Significant links were found between CLD and several factors. Males were significantly more affected with CLD (78.5%, $p < 0.001$), making gender one of the factors that predict CLD. Similarly, age was a significant factor, with those aged 40-60 being the most affected (33%, $p = 0.039$). Abnormal BMI was strongly associated with CLD, found in 84.6% cases ($p = 0.008$). Alcohol consumption demonstrated a marked association with chronic liver disease ($p < 0.001$), with former and current alcohol use substantially more common among cases. After logistics regression analysis, male gender, abnormal BMI, and alcohol consumption are significant independent predictors of CLD.

Conclusions: The study highlights gender (male), age (40-60), abnormal BMI and alcohol consumption as significant predictors of CLD in the studied population. These findings emphasize the urgent need for targeted screening and lifestyle-based preventive interventions, particularly focusing on metabolic health and weight management, to mitigate the rising burden of liver disease and promote healthy aging.

KEY WORDS: liver fibrosis, case–control study, body mass index, alcohol use, sex differences, metabolic risk factors

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INTRODUCTION

Chronic liver disease is one of the most common disorders that causes significant morbidity and mortality, even among young adults. Although chronic liver disease was most associated with older individuals, today there is a significant shift in that trend, with even adolescents aged 15 years–21 years being affected, this is largely attributable to shifting trends in lifestyle and disease patterns [1]. CLD encompasses a spectrum of disorders, including Metabolic dysfunction associated with steatotic liver disease, chronic hepatitis caused by viral etiology, autoimmune hepatitis, and liver cirrhosis, which can ultimately lead to liver failure [2]. Previously, chronic hepatitis caused by viral etiology was known to be most commonly associated with chronic liver disease among young adults, but according to recent studies, it is observed that MASLD is seen more commonly than chronic hepatitis among the young population [2]. Alcohol-associated liver disease is also an increasing feature in adults, notably in populations where alcohol consumption is increasing, thus adding to the overall burden of CLD within this age spectrum [6].

Despite this rising trend of CLD among adults, especially the young population, there seems to be a lack of aware-

ness regarding the same. For instance, a study from the U.S focused on awareness of MAFLD in young adults showed that awareness regarding the same among young adults aged 18–29 was significantly low [3]. This is complicated by the fact that liver diseases are often asymptomatic, therefore making it significantly difficult to diagnose them and in turn leading to a delay in treatment and worse prognosis [4].

Beyond liver-related morbidity, affected young adults face metabolic complications, impaired quality of life, psychological distress, and reduced productivity, which together contribute to an increasing socio-economic and healthcare burden [5]. Early onset of the disease often goes undiagnosed due to its asymptomatic nature, delaying intervention and increasing the risk of progression to later liver cirrhosis, hepatocellular carcinoma, or requirement for liver transplantation [6].

Globally, CLD currently remains a very significant public health concern. It encompasses a wide spectrum of liver diseases, including non-alcoholic fatty liver disease, chronic viral hepatitis due to HBV and HCV, alcohol-related liver disease, autoimmune liver diseases, and cirrhosis. Worldwide, it is estimated that about 1.5 billion people were diagnosed with CLD in 2017; the highest burden for the mentioned year was from NAFLD (~59% of cases), followed by chronic hepatitis B (~29%) and hepatitis C (~9%) [7]. The results of the Global Burden of Disease study in 2021 estimated that there were 58.4 million incident cases of cirrhosis and other forms of chronic liver disease, leading to approximately 1.43 million deaths and 46.4 million Disability-adjusted life years (DALYs) [8]. Ensuring efficient vaccination campaigns and antiviral therapies in most developed and developing countries has led to a decrease in viral hepatitis in the past decade. However, metabolic-associated liver disease, particularly Metabolic dysfunction-associated steatohepatitis, has notably risen due to the increase in metabolic risk factors such as obesity, type 2 diabetes, and dyslipidemia [9]. Cirrhosis and other chronic liver diseases account for 2.46% of global mortality and 1.3% of total DALYs, indicating that despite progress in prevention and treatment, CLD remains an important contributor to global morbidity and mortality [9].

Chronic liver disease remains a major and increasing health burden for the entire MENA region, with metabolic dysfunction-associated steatotic liver disease being the leading cause. In a meta-analysis, MASLD was estimated to have a prevalence of about 39.4% among the general adult population and nearly 68.7% among the patients with type 2 diabetes in this setting [10]. Between 2010 and 2021, modelling based on Global Burden of Diseases (GBD) and other sources suggested that MASLD prevalence in MENA increased from 26.3% (~118 million people) to 27.7% (~164 million), with marked increases in adults aged ≥20 years, from 37.1% to 41.0%, and an APC for cirrhosis of ~2.2% yearly [11]. Another investigation from 1990 to 2021 shows a 13.8% increase in MASLD incidence and a 26.4% increase in age-standardized MASLD prevalence, with high fasting plasma glucose as a major contributing factor [12]. While incidence associated with MASLD rose, viral hepatitis and alcohol-related cases decreased, and incident CLD/cirrhosis more than doubled in the area of interest between 1990 and 2021 [13].

In the United Arab Emirates, metabolic risk factors are the primary cause of CLD, which has become a significant and expanding health concern. The major cause of CLD in the UAE includes metabolic dysfunction–associated steatotic liver disease [14,15,16]. It occurs in a relatively high percentage of patients with Type 2 Diabetes Mellitus, and it could be diagnosed non-invasively using FIB-4, NFS, liver ultrasonography, FibroScan, and the Hamachi ultrasound grading system [16]. Cases of HCC in the UAE number approximately 60–100 annually, and with the rising prevalence of obesity and diabetes, this number is expected to increase [15]. Liver transplantation for HCC in the UAE and the wider GCC follows the Milan criteria. Twenty-five liver transplants have been performed in the UAE for HCC, with very good short-term results, and 96% of the transplanted livers are functioning well with no recurrence of cancer reported [15]. The development of chronic liver disease is attributed to harmful alcohol consumption, obesity, viral hepatitis, and MASLD. In addition, genetic predisposition, lifestyle factors like smoking, diet, and lower physical activity levels are also strong contributors [17, 18]. This research will provide data that public health experts can utilize to develop strategies aimed at preventing chronic liver disease by identifying key risk factors linked to its onset in adults.

AIM

This study aimed to identify potential predictors of chronic liver disease among adults and to determine key demographic, clinical, and lifestyle factors associated with its occurrence to support strategies for promoting healthy aging.

MATERIALS AND METHODS

RESEARCH DESIGN AND STUDY POPULATION

This study employs a case–control design and is conducted among adults aged 18 years and above in the UAE. Cases include records of patients with confirmed liver disease, encompassing both genders and any nationalities, while records with incomplete data will be excluded. Controls

Table 1. Association between key determinants and chronic liver disease

Variables	Group	Cases		Controls		p-value
		N	[%]	[N]	[%]	
Age Group	Less than 40	69	46.3	175	58.3	0.039
	40 to 60	67	45.0	99	33.0	
	Above 60	13	8.7	26	8.7	
Gender	Male	117	78.5	154	51.3	<0.001
	Female	32	21.5	146	48.7	
Marital Status	Single	29	19.5	44	14.7	NS (0.195)
	Married	120	80.5	256	85.3	
Nationality	Eastern Mediterranean Region (EMRO)	83	55.7	180	60.2	NS (0.659)
	South-East Asia Region (SEARO)	53	35.6	95	31.8	
	Others	13	8.7	24	8.0	
BMI	Normal	23	15.4	80	26.7	0.008
	Abnormal	126	84.6	220	73.3	
Alcohol Consumption	Never	113	75.8	293	97.7	<0.001
	Former Use	15	10.1	6	2.0	
	Current Use	21	14.1	1	0.3	

Source: Own materials

consist of records of adults without liver disease, including both genders and any nationalities, with exclusion limited to records containing incomplete data.

SAMPLE SIZE

The prevalence of chronic liver disease, specifically non-alcoholic fatty liver disease (NAFLD), among adults in the United Arab Emirates was reported to be 25% [16]. High alcohol intake was associated with a twofold increased risk of developing chronic liver disease [19]. These estimates were used to determine the sample size for the study population. For this case–control study, the minimum required sample size for cases was calculated as 149, assuming a study power of 90% and a significance level of 0.05. With a case–control ratio of 1:2, approximately 300 control subjects were required. A convenience sampling technique was adopted to recruit participants.

METHODOLOGY

The study was conducted after obtaining approval from the Institutional Review Board (IRB). Permission to carry out the research and access the required data was granted by the University Hospital administration. All study procedures were performed in accordance with institutional ethical guidelines, and confidentiality of participant information was strictly maintained throughout the study. Relevant information, including demographic characteristics and details of presenting symptoms, was extracted from the charts. Strict confidentiality and data protection protocols were always followed, and no personal identifiers were included in the study dataset.

DATA ANALYSIS

After data collection, the data were downloaded into an Excel spreadsheet and subsequently transferred to SPSS (Version 30) for statistical analysis. Both descriptive and inferential statistics were performed. Descriptive results were expressed as frequencies and percentages where appropriate. Associations between dependent and independent variables were assessed using the Chi-square test. Binary and multivariable logistic regression analyses were conducted to identify predictors. Statistical significance was set at a p-value ≤ 0.05.

ETHICAL ASPECTS

Approval for the proposal was granted by the Institutional Review Board (IRB Ref. no. IRB-COM-STD-119-Dec-2025) of Gulf Medical University. No information revealing participants' identities was recorded to ensure anonymity. Data were analyzed in aggregate form, and access was restricted to the researchers, IRB members, and statisticians in accordance with Gulf Medical University research policies. The research was conducted according to the Helsinki Declaration.

RESULTS

The analysis outlines the distribution of sociodemographic and clinical characteristics among participants with chronic liver disease (cases) and those without

Table 2. Logistic regression for socioeconomic factors and chronic liver disease

Variables	Group	Chronic Liver Disease					
		Crude			Adjusted		
		OR	CI	p-value	OR	CI	p-value
Age Group	Less than 40	0.79	0.38 - 1.62	NS(0.519)	--	--	--
	40 to 60	1.35	0.65 - 2.82	NS(0.419)	--	--	--
	Above 60	1	--	--	--	--	--
Gender	Male	3.47	2.21 - 5.45	<0.001	3.03	1.88 - 4.90	<0.001
	Female	1	--	--	1	--	--
BMI	Normal	1	--	--	1	--	--
	Abnormal	1.99	1.19 - 3.33	0.008	2.33	1.30 - 4.20	0.005
Alcohol Consumption	Never	1	--	--	1	--	--
	Former Use	6.48	2.45 - 17.12	<0.001	5.62	2.07 - 15.26	<0.01
	Current Use	54.45	7.24 - 409.57	<0.001	53.35	6.87 - 414.15	<0.001

Source: Own materials

chronic liver disease (controls). Several variables illustrate key differences between these two groups, indicating potential patterns as seen in the study sample associated with chronic liver disease as seen in table 1.

For age group analysis, participants were stratified into three age groups: <40 years, 40-60 years, and ≥60 years. A greater percentage of participants under 40 years of age were controls (58.3% vs 46.3%). However, participants 40 to 60 years old were more often represented among cases, 45.0% of chronic liver disease and 33.0% of control participants. The number of participants over 60 years of age had a small percentage of representation in both the case and control groups (8.7%). Overall, the total chronic liver disease distribution across age categories was statistically significant (p=0.039), indicating variation in chronic liver disease occurrence across different age groups.

The two groups also exhibited a significant difference in gender distribution. Male participants made up a greater percentage of chronic liver disease cases (78.5%) than did males in the control group (51.3%). In contrast, females represented a much larger percentage of controls (48.7%) than did females in cases (21.5%). This disparity was statistically significant (p<0.001) and demonstrates a strong association of male gender with chronic liver disease.

Marital status showed no apparent statistically significant difference between the two groups. Married individuals comprised the majority of both cases (80.5%) and controls (85.3%), while single participants represented a smaller proportion within each group. The observed difference in marital status distribution was not statistically significant (p = 0.195), suggesting the relationship does not appear to be associated with chronic liver disease.

Similarly, chronic liver disease did not vary significantly across different nationalities. Participants from the Eastern Mediterranean Region formed the largest subgroup among both cases (55.7%) and controls (60.2%), followed by individuals from the South-East Asia Region and other regions, including the Western Pacific Region, African Region, Region of the Americas, and European Region. The distribution across nationality categories was comparable between cases and controls, and no statistically significant difference was observed (p = 0.659).

The level of Body Mass Index differed significantly between cases and controls. Abnormal BMI, including underweight, overweight, and obese classifications, was more prevalent among cases (84.6%) than controls (73.3%). In contrast, fewer populations without chronic liver disease were classified as having a normal body mass index (26.7%) compared to the number of patients with chronic liver disease (15.4%). Therefore, the association between abnormal body mass index and chronic liver disease was statistically significant (p = 0.008).

Alcohol consumption showed a strong and statistically significant association with chronic liver disease (p < 0.001). Never alcohol users constituted 75.8% of cases compared with 97.7% of controls. In contrast, former alcohol use was more common among cases (10.1%) than controls (2.0%), and current alcohol use was markedly overrepresented among cases (14.1%) compared with controls (0.3%). Details are given in Table 1.

Binary logistic regression analysis was used in order to determine independent factors that were associated with chronic liver disease (Table 2). In crude analysis, gender (male), abnormal body mass index, and alcohol consumption were significantly associated with chronic liver disease; however, there is no statistically significant association between age group, marital status, or nationality and the presence of chronic liver disease.

Male gender remained independently associated with chronic liver disease (adjusted OR = 3.03; 95% CI: 1.88–4.90;

$p < 0.001$), indicating approximately threefold higher odds of disease among males compared with females.

Abnormal BMI was also independently associated with chronic liver disease (adjusted OR = 2.33; 95% CI: 1.30–4.20; $p = 0.005$), suggesting more than twofold increased odds of disease among individuals with abnormal BMI relative to those with normal BMI.

Alcohol consumption emerged as the strongest independent predictor. Compared with never drinkers, former alcohol users had significantly higher odds of chronic liver disease (adjusted OR = 5.62; 95% CI: 2.07–15.26; $p < 0.01$), while current alcohol users demonstrated markedly elevated odds (adjusted OR = 53.35; 95% CI: 6.87–414.15; $p < 0.001$). Although the confidence interval for current alcohol use was wide, the association remained statistically significant.

In contrast, associations for age groups that were shown in univariate analyses became attenuated after multivariable adjustment and did not independently predict chronic liver disease. Similarly, marital status and nationality did not have independent associations with chronic liver disease when analyzed with the multivariate model, as indicated by confidence intervals crossing unity and non-significant p-values.

In summary, the analysis identified that male gender, abnormal BMI, and alcohol consumption are significant independent predictors of chronic liver disease in this tertiary care setting. independent associations with chronic liver disease when analyzed with the multivariate model, as indicated by confidence intervals crossing unity and non-significant p-values.

DISCUSSION

CLD is a significant health challenge that continues to garner considerable attention, especially in the middle-aged and elderly, as a result of the established association with lifestyle, comorbidity, and socio-economic factors. The current study evaluated the socio-demographic risk factors in CLD, focusing on patients within the socio-economic landscape of a tertiary healthcare center in Ajman, UAE.

Age has long been identified as a major risk factor for various chronic health complications. This includes chronic liver diseases. In the present study, patients between the ages of 40 and 60 showed a larger proportion of CLD. Patients less than 40 years of age showed a lower proportion of CLD. Although age was statistically significant in predicting CLD in the bivariate analysis, it was not significant in the logistic regression analysis. This implies that it could be lifestyle habits and comorbid conditions that are more associated with the occurrence of CLD rather than age. Global epidemiological data indicate that CLD incidence increases with age, peaking in middle-aged and elderly populations, although the pattern varies depending on the etiology [19–21]. Aging decreases hepatic regenerative capacity and alters drug metabolism, while increasing the burden of comorbid conditions like diabetes and hypertension. All these factors enhance the vulnerability to liver injury [22,23]. However, increasing metabolic disorders in younger adults have shifted some of the risk to middle-aged individuals [24,25]. It is vital to have early lifestyle modifications and metabolic control in this middle-aged group to prevent progression to advanced liver disease later in life [26]. In agreement with this, the present study suggests that prevention strategies must focus on early detection and management of risk factors throughout the course of adult life, especially in middle-aged individuals.

Gender differences in the levels of CLD burden and progression are well documented across the world. In the present study, it was found that men were more at risk of CLD than women, which is in agreement with the data obtained from the rest of the world. This association was maintained even after controlling for other variables, suggesting the strong influence of male gender in the risk of CLD. Across the world, in the context of CLD burden, the male population has more instances of CLD in terms of incidence, prevalence, and mortality due to diverse reasons, including viral infections, alcohol use, and NAFLD [27–29].

Biologically, estrogen exerts hepatoprotective action by influencing inflammation and fibrosis, while androgen-related mechanisms could potentially exacerbate liver damage in males [29]. Behavior-wise, males are more inclined to alcohol use, smoking, and an unhealthy diet, coupled with a reluctance to seek medical care promptly, which often results in a late-stage diagnosis in males [30]. Indeed, retrospective cohort studies showed faster fibrosis progression in males compared to females [30]. The values of these androgen and estrogen variations in the pathogenesis of liver fibrosis warrant active focus in prevention and screening, especially behavior-wise in males.

High BMI levels were strongly identified as independent determinants for CLD. Abnormal BMI was identified as associated with a high probability of CLD, as predicted in crude and adjusted models, which strongly supports studies of the association between obesity and NAFLD and the progression of CLD to hepatocellular carcinoma [31, 32, 39].

Cross-sectional studies using transient elastography support the findings, showing clearly that generalized as well as abdominal obesity play a major role in increasing the risk of NAFLD [32]. Longitudinal data have also shown that BMI patterns over a lifetime predict NAFLD, independent of age and metabolic status [31]. Even data from the Middle East show a high prevalence of obesity and metabolic syndrome, mirroring the rising burden of NAFLD [11, 33, 34, 36].

These findings also highlight the significance of emphasizing the prevention of obesity and metabolic risk for

the effective management of CLD. Considerable attention should be given to the screening of high BMI and metabolic disorders in clinical practices, especially for high-risk groups. Again, community-based interventions for healthy lifestyle habits and obesity prevention are considered significant for minimizing the increasing incidence of chronic liver diseases.

In this study, marital status and nationality were not independently associated with CLD after multivariable adjustment. While married participants were a larger group of cases and controls, it did not predict CLD in logistic regression. Similarly, participants from different WHO regions did not exhibit clinically significant risk for CLD differences, and thus, national or regional origin is not a determinant when other risk factors are accounted for. These findings are in line with hospital-based studies, which indicate that demographic factors like nationality or marital status have little independent impact on NAFLD or other CLD forms [37]. Though ethnicity or regional origin may influence the outcome of CLD due to genetic or dietary and lifestyle factors, the impact is most often mediated through metabolic risk rather than nationality per se [38]. The findings stress the primary role of metabolic and behavioral factors over merely nominal demographic categories, although cultural and social determinants should not be disregarded at the level of public health planning.

In our study, alcohol consumption demonstrated a strong and independent association with chronic liver disease, with both former and current use linked to higher odds of disease compared with abstainers. This observation is aligning with extensive epidemiological evidence demonstrating that alcohol is a major risk factor for chronic liver pathology; for instance, a systematic review and meta-analysis reported that heavier alcohol intake is associated with a progressively increased risk of liver cirrhosis and other chronic liver outcomes [39], additionally large prospective study from the China Kadoorie Biobank similarly found positive dose-response associations between regular alcohol consumption and various chronic liver diseases, including alcoholic liver disease and cirrhosis [40].

These finding is in agreement with epidemiological evidence showing that there is a well-documented dose-response relationship between alcohol exposure and liver disease, such that greater intake and longer duration increase the risk of fibrosis, cirrhosis, and related complications [41].

The markedly elevated adjusted odds ratio observed among current users should therefore be interpreted with caution, as the very wide confidence intervals likely reflect sparse data and limited statistical precision. The association among former users may partly represent reverse causation ("sick quitter" effect) [42]. While alcohol consumption is generally lower in Gulf settings, alcohol-related liver injury remains clinically relevant [43]. Emerging evidence further suggests that alcohol and elevated BMI may act synergistically, indicating a potentially high-risk combined phenotype that warrants longitudinal evaluation [44].

Together, these studies conclude that sustained alcohol exposure significantly contributes to the development of chronic liver disease, supporting the pattern observed in our analysis that alcohol use is a critical determinant of liver health.

Several limitations need to be mentioned with respect to this study. In this case-control study, it was conducted in one center and in a hospital-based setting, which may reduce generalizability. Lifestyle variables include alcohol intake assessed by self-report and could be subject to recall or social desirability bias. Although the multivariable regression is adjusted for many covariates, residual confounding by unmeasured factors, which might include but are not limited to genetics, environmental exposure, or comorbidities, cannot be excluded. Reliance on hospital records might also underestimate undiagnosed or asymptomatic CLD cases. Despite these limitations, the present study provides important baseline evidence of both modifiable and non-modifiable predictors of CLD in the UAE, informing future longitudinal studies and preventive strategies.

CONCLUSIONS

This study identifies critical preventable and inherent determinants of CLD within the adultpopulation of Ajman, UAE. The findings reveal that the male gender, middle age (40-60 years), an abnormal BMI and alcohol consumption are significantly associated with a higherrisk of developing CLD.

For the subjects studied here, alcohol was the strongest predictor of chronic liver disease. Independent associations between current and former alcohol use and developing chronicliver disease were statistically significant, but the effect of current alcohol use was strongerthan that of former alcohol use. Elevated BMI had a significant independent association withan increased risk for chronic liver disease, which suggests that there are metaboliccontributions to the disease. Even after controlling for both alcohol use and BMI, being male remained an independent predictor for having a chronic liver disease; thus, demographic factors may outlive behaviors.

The results of this study are compatible with the regional epidemiological transition ofmetabolic dysfunction- associated steatosis, which is developing into the primary cause ofchronic liver disease (CLD) and highlights the need for early identification of individuals atrisk. While age and gender are intrinsic characteristics

that cannot be changed, supported bytheir inherent biological characteristics, they are still valid and useful indicators to informtargeted screening and surveillance efforts. Alternatively, abnormal body mass index (BMI) and alcohol consumption is a significant and preventable risk factor, which then creates anopportunity for preventive intervention through lifestyle changes, weight management, andthe control of metabolic risk.

Therefore, this study supports the development of a preventive approach to supporting healthy aging with care by emphasizing the promotion of metabolic health in addition to theimplementation of a demographic risk-based approach to risk profiling. The concepts ofearly screening and patient education should be utilized both in public health and clinicalpractice. Community-based obesity prevention and optimizing habits among middle-aged.

Men should also be a priority area, as they are at higher risk than women. By addressing modifiable as well as non-modifiable determinants, substantial decreases in the burden of chronic liver disease can be accomplished, resulting in improved long-term outcomes for both the liver and the overall health of the population in the region.

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CONFLICT OF INTEREST

The Authors declare no conflict of interest

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