ORIGINAL RESEARCH

Insights Into Non-Alcoholic Fatty Liver Disease and Diabetes Mellitus in Somalia: Prevalence and Risk Factors

Mohamed Osman Omar Jeele [ID][1], Hawa Nuradin Mohamed[1], Rukia Omar Barei Addow[2], Mohamed Omar Hassan [ID][3], Bakar Ali Adam [ID][4]

[1]Department of Internal Medicine, Mogadishu Somali Turkish Training and Research Hospital, Mogadishu, Somalia; [2]Department of Public Health, Horseed International University, Mogadishu, Somalia; [3]Department of Cardiology, Mogadishu Somali Turkish Training and Research Hospital, Mogadishu, Somalia; [4]Department of Neurology, Mogadishu Somali Turkish Training and Research Hospital, Mogadishu, Somalia

Correspondence: Mohamed Osman Omar Jeele, Medical Doctor, Specialist in Internal Medicine, Mogadishu Somali Turkish Training and Research Hospital, Department of Internal Medicine, Mogadishu, Somalia, Tel +252615775226, Email drjeele@gmail.com

Introduction: NAFLD is a rapidly expanding global health issue that is distinguished by the accumulation of hepatic fat that is not associated with alcohol consumption. Parallel to the increase in obesity and type 2 diabetes mellitus (T2DM), its prevalence is also increasing. Amidst a backdrop of limited epidemiological data, Somalia, which is undergoing urbanization and dietary adjustments, is contending with escalating rates of NAFLD. Our study aims to addresses critical voids in local epidemiological data regarding this subject in Somalia.

Methods and Materials: The objective of this retrospective study was to evaluate the prevalence of NAFLD and concomitant risk factors among T2DM patients at the Mogadishu Somalia Turkish Training and Research Hospital. A total of 832 patients diagnosed with T2DM between May 2023 and March 2024 were used to analyze the data. Various variables, such as age, sex, diabetic medications, hypertension, insulin resistance, hyperlipidemia, and NAFLD grade, were obtained from electronic medical records. Statistical analyses were conducted to investigate the associations and predictors of NAFLD using descriptive analysis, logistic regression, and multiple regression.

Results: The study cohort was predominately female (57%), with a mean age of 53.48 years. The most prevalent grades of NAFLD were grade 1 and grade 2, with NAFLD being identified in 53.8% of patients. NAFLD displayed a robust correlation with insulin resistance (OR: 52.04), with hypertension (OR: 20.091) and hyperlipidemia (OR: 2.528) following shortly thereafter. These factors collectively account for 57% of the variance in NAFLD, as indicated by multiple regression analysis (R^2 = 0.57, F (6,823) = 184.302, p < 0.001).

Conclusion: This investigation emphasizes the presence of a high prevalence of NAFLD among T2DM patients in Mogadishu, Somalia, 53.8% which is substantially influenced by hypertension, insulin resistance, and hyperlipidemia. In this region, the necessity of targeted healthcare strategies to mitigate metabolic liver diseases is underscored by the results.

Keywords: NAFLD, Type 2 diabetes mellitus, insulin resistance, hepatosteatosis, Somalia

Introduction

Non-alcoholic fatty liver disease (NAFLD) is a condition that has become a major public health concern on a global scale. This condition is defined by an excessive accumulation of fat in the liver of persons who has a little or no history of alcohol usage. It comprises a spectrum of liver disorders that range from basic steatosis to non-alcoholic steatohepatitis (NASH). In severe cases, it can develop to liver cirrhosis and hepatocellular carcinoma.[1] Approximately twenty-five percent of the world's population is affected by NAFLD, which has become the most prevalent chronic liver disease globally.[2] The prevalence of NAFLD is higher in western countries, where sedentary habits, high calorie dietary regimens, and obesity are prominent,

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however, the prevalence varies from region to region. Insulin resistance, type 2 diabetes mellitus (T2DM), obesity, dyslipidemia, and metabolic syndrome are all known risk factors for NAFLD.[1]

There has been an increasing awareness throughout Africa that NAFLD is an important health concern, echoing global trends but with distinct regional differences. Increasing rates of NAFLD have been seen across East Africa, including Somalia, which can be ascribed to urbanization, shifting dietary patterns, and an increasing incidence of T2DM and obesity.[3] Studies that were carried out in nearby countries such as Kenya and Tanzania have revealed comparable patterns of NAFLD prevalence among diabetic populations. These findings highlight the necessity of conducting research that is specific to the region in order to gain an understanding of the local epidemiological determinants.[4,5]

Somalia faces with significant hurdles in terms of healthcare infrastructure and the availability of data, which makes it more difficult to adequately assess and address the prevalence of NAFLD. Our comprehension of the burden of nonalcoholic fatty liver disease (NAFLD) among diabetic patients in Mogadishu is hindered by the lack of epidemiological data in Somalia, despite the fact that the prevalence of type 2 diabetes in the country has increased.

This study aims to address the vacancy through undertaking a retrospective analysis of the prevalence of NAFLD and its associated risk factors among diabetes patients in Mogadishu, Somalia. By doing so, we hope to assist to the establishment of specific therapies and healthcare strategies in the region, as well as provide useful knowledge into the local burden of NAFLD.

Methods and Materials

This study was conducted to explore the prevalence and the risk factors of NAFLD in patients with type 2 diabetes mellitus. It is a retrospective study which enrolled all T2DM patients attended at Mogadishu Somalia Turkish Training and Research Hospital, largest referral hospital in Somalia, between 1 May 2023 and 30 March 2024.[6–8] A total number of 832 patients with type 2 diabetes mellitus were included in the study. Patients who were diagnosed with type 1 diabetes mellitus, patient with a missing data, patients with history of alcoholic consumption, patient with known chronic liver diseases such as viral hepatitis, genetic liver diseases and patients who refused to participate were excluded from the study.

The institutional review board of Mogadishu Somali Turkish Training and Research Hospital's approved the study (Approval No. MSTH-12761). The study adhered to the Helsinki Declarations, ensuring patient privacy. In addition, the anonymity of patients was safeguarded through the utilization of codes in place of their names and ID numbers. The institutional review board waived the need for informed consent because this study was retrospective in nature.

Data were collected from the Somali Turkish Research and Training Hospital electronic system. The study sample consisted of patients diagnosed with type 2 diabetes who presented between 1 May 2023 and 30 March 2024. The data collection focused on key variables including patient age, sex, type of diabetic medications, hypertension, insulin resistance, presence of hyperlipidemia, and presence of Non-alcoholic fatty liver disease and its grading.

A diagnosis of NAFLD was made by a radiologist based on imaging of the liver. Typical radiographic findings indicative of NAFLD include a heterogeneous appearance of the liver, echogenicity exceeding that of the renal cortex or spleen by ultrasound. Also, the diagnosis was including history of lack of consumption of alcohol. Given that the other potential causes of hepatosteatosis have been excluded in our participants, we will sometimes refer to the condition simply as hepatosteatosis in this manuscript. NAFLD was graded on a scale from grade 1 to grade 3 according to ultrasonographic appearance, where higher grades indicate more severe fatty liver disease.

Insulin resistance was diagnosed using by Homeostatic model assessment for insulin resistance (HOMA-IR).[9] A result more than 2 was interpreted as insulin resistance in this study.

Data were analyzed using SPSS version 26 (IBM Corporation, Armonk, NY, USA). Frequencies and percentages were computed for categorical variables. Tables of frequencies and percentages were employed to illustrate the proportions. The proportions in various categories were compared using the Chi-square test. The associations between variables were evaluated using a bivariate correlation. A statistically significant result was defined as $P < 0.05$. The odds ratio (OR) and confidence intervals (CIs) have been determined using binary logistic regression. Multiple regression was used to assess the combined effect of the predictors.

Results

The patient cohort exhibited a broad age distribution, with a mean age of 53.48 years (SD = 15.04). The age range extended from a minimum of 13 years to a maximum of 96 years, reflecting a diverse patient demographic. Regarding to the age group, the most common participants in our study were aged more than 50 years with 490 patient (58.9%) followed by 30–50 years old with 294 patients (35.3%), and less than 30 years old which constitutes 5.8% with 48 patients.

Gender distribution was slightly skewed towards females, with 474 female patients (57%) and 358 male patients (43%). Analysis of type of diabetes medication revealed that 621 patients (74.6%) were taking prescribed oral anti-diabetes medication, while 211 patients (25.4%) were on insulin injections (Table 1).

Table 1 Demographic Characteristics Among Participants

Variables	Frequency	Percentage
Age	53.48 years ±15.04	
Less than 30 years	48	5.8%
30–50 years	294	35.3%
Above 50 years	490	58.9%
Sex		
Male	358	43%
Female	474	57%
Hypertension		
Yes	384	46.2%
No	448	53.8%
Insulin resistance		
Yes	315	37.9%
No	517	62.1%
Hyperlipidemia		
Yes	453	54.4%
No	379	45.6%
Type of medications		
Insulin	211	25.4%
Oral antidiabetic medication	621	74.6%
NAFLD		
Yes	448	53.8%
No	384	46.2%
Grades of NAFLD		
Grade 1	281	33.8%
Grade 2	142	17.1%
Grade 3	25	3%

Abbreviation: NAFLD: Non-alcoholic fatty liver disease.

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Regarding the comorbidities, the prevalence of hyperlipidemia in our participants was significant, affecting 453 patients (54.4%), whereas 379 (45.6%) patients did not have this condition. When analyzing the presence of hypertension in our patients, 448 patients or in other words 53.8% of them were normotensive while hypertension was present in 384 participants (46.2%). Insulin resistance was also examined in this study. The majority of our patients were not resistant to insulin with 517 patients (62.1%) while insulin resistance was present in the remaining 315 patients who makes 37.9% of the participants (Table 1).

NAFLD was identified in 448 patients (53.8%), with most cases not advancing beyond Grade 2. Specifically, 281 patients were diagnosed with Grade 1, 142 with Grade 2, and 25 with Grade 3, indicating a relatively lower incidence of advanced hepatosteatosis within the studied population. NAFLD was more common in females with 57.8% and in older patients aged more than 50 years with 56.4%.

The binary logistic regression analysis showed a strong correlation between hepatosteatosis and insulin resistance ($P < 0.001$). Patients with insulin resistance were 52 times more likely to develop NAFLD than patients without insulin resistance (95% CI: 27.531–98.388, OR: 52.04). Furthermore, there was a positive correlation between NAFLD and the presence of hypertension (95% CI: 12.507–32.274, OR: 20.091, $P < 0.001$). In this finding we highlighted that patient living with hypertension were 20 times more like to develop NAFLD than patients without hypertension. Regarding the association between NAFLD and hyperlipidemia, we found that the patients with hyperlipidemia were 2 times more likely to develop NAFLD than patients without hyperlipidemia (95% CI: 1.589–4.023, OR: 2.528, $P < 0.001$) (Table 2).

Table 2 Binary Logistic Regression Analysis Between NAFLD and Patient Related Factors

Age (Years)	NAFLD		Odd ratio	95% CI	p value
	Yes	No			
<30	28	20	0.696	0.478–1.014	<0.059
30–50	167	127			
Above 50	253	237			
Sex					
Male	189	169	1.123	0.714–1.764	<0.616
Female	259	215			
Hypertension					
Yes	335	49	**20.175**	**12.556–32.418**	**<0.0001**
No	113	335			
Insulin resistance					
Yes	300	15	**52.49**	**27.780–99.191**	**<0.0001**
No	148	369			
Hyperlipidemia					
Yes	260	193	**2.530**	**1.590–4.025**	**<0.0001**
No	188	191			
Type of medications					
Insulin	112	99	1.000	0.591–1.690	<0.999
Oral medications	336	285			

Notes: Variables in bold means statistically significant.
Abbreviations: CI, Confidence interval; NAFLD, Non-alcoholic fatty liver disease.

Table 3 Multiple Regression Analysis of the Combined Variables Towards NAFLD

Model Summary					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	
I	0.757[a]	0.573	0.570	0.327	
ANOVA[b]					
Model		Sum of Squares	df	Mean Square	F	Sig.
I	Regression	118.255	6	19.709	184.302	0.000[a]
	Residual	88.011	823	0.107		
	Total	206.266	829			

Notes: [a]Predictors: (Constant), Hypertension, AgeGroup, HYPERLIPIDEMIA, TYPE OF MEDICATIONS, Sex, Insulinresistence. [b]Dependent Variable: NAFLD.

In this study we also examined the combined effect of the patients age group, sex, presence of hypertension, presence of insulin resistance, hyperlipidemia, and the type of medications used for diabetes mellitus as a group towards the development of hepatosteatosis by performing multiple regression test. We have found that the combined effect of the aforementioned predictors to have significant association with the development of hepatosteatosis. We have found that there $R^2 = 0.57$, which indicates that they have a 57% variance in the prevalence of hepatosteatosis among type 2 diabetic patients with a significance of F $(6,823) = 184.302$, $p < 0.001$ (Table 3).

Discussion

Non-alcoholic fatty liver disease (NAFLD) refers to a range of liver diseases where there is an abnormal buildup of fat in the liver, unrelated to alcohol consumption. The spectrum of liver conditions associated with NAFLD spans from basic fat accumulation in the liver (steatosis) to a more severe form known as non-alcoholic steatohepatitis (NASH), which involves liver inflammation and has the potential to proceed to fibrosis, cirrhosis, and hepatocellular cancer. NAFLD has become increasingly common worldwide, mirroring the growth in obesity rates, and now affects almost a quarter of the global population. Common risk factors encompass a lack of physical activity, unhealthy eating patterns, and a genetic inclination.[1,10]

Recently NAFLD as mentioned above has emerged as a significant public health concern all over the world. Additionally, a significant number of people who have type 2 diabetes mellitus (T2DM) been affected by this condition. Our study, which was carried out in Mogadishu, Somalia, aims to evaluate the prevalence of NAFLD among diabetic patients, as well as the risk factors and clinical implications associated with this particular condition. The demographic parameters of the population that we studied, such as the distribution of ages and genders, are consistent with the global epidemiological trends of nonalcoholic fatty liver disease NAFLD among diabetic patients. Similar studies that were carried out in a variety of populations have also found that older people have a greater prevalence rate, and there is a minor preference for females, which may be a reflection of hormonal and metabolic factors.[11,12]

In the presenting study the prevalence rate of NAFLD in our study was reported as 53.8%. There was a significant predominance in older age group, and the incidence was also somewhat higher in females, according to the findings. These findings are higher than the findings from around the world and indicates a high prevalence of NAFLD among diabetic populations in Somalia.[1,13]

NAFLD is considerably more prevalent in individuals with type 2 diabetes mellitus (T2DM) due to insulin resistance, which plays a critical role in its pathogenesis. Insulin resistance disrupts insulin signaling pathways that are essential for the regulation of lipid metabolism, thereby promoting hepatic lipid accumulation, as consistently demonstrated by research. This dysregulation results in the liver enduring higher triglyceride synthesis and reduced fatty acid oxidation, which exacerbates the progression of hepatosteatosis. It is essential to comprehend the relationship between the prevalence of NAFLD and insulin resistance in order to develop targeted therapeutic strategies that will reduce the incidence of liver complications in diabetic patients.[14,15]

In the presenting study, insulin resistance was found to be the most significant risk factor in our study, and individuals who were insulin-resistant demonstrated a considerably increased possibility of developing NAFLD. Several investigations conducted all over the world have consistently established a connection between insulin resistance and type 2 diabetes and the etiology of non-alcoholic fatty liver disease.[16,17] For example, a study conducted in Nigeria pointed out that central obesity (which is an indicator of insulin resistant) is a significant factor in determining the presence of non-alcoholic fatty liver disease (NAFLD) in diabetic individuals.[18]

The prevalence and severity of NAFLD are substantially influenced by hypertension, which is closely associated with the condition. Vascular remodeling and an increase in hepatic resistance are induced by hypertension, which exacerbates hepatic lipid accumulation and impairs liver blood flow. Studies consistently show that hypertension is a significant risk factor in the development of nonalcoholic fatty liver disease (NAFLD), especially among patients who have metabolic syndrome and insulin resistance.[19,20]

In our study, patients with hypertension exhibited a twentyfold greater risk of nonalcoholic fatty liver disease (NAFLD) in comparison to persons with normotensive blood pressure. Studies conducted in Asia and Europe[21] have shown that metabolic disorders and cardiovascular risk factors interact with one another in the evolution of liver disease. This discovery serves to highlight the interplay between these two factors.

In terms of hyperlipidemia, our research discovered that patients with raised lipid levels had a risk of non-alcoholic fatty liver disease that was twice as high. This study lends credence to the findings of worldwide studies that have demonstrated the influence of dyslipidemia on the buildup of fat in the liver and the development to more severe forms of non-alcoholic fatty liver disease.[22,23]

NAFLD is significantly influenced by hyperlipidemia, which is closely linked to its development and progression. Hepatic lipid accumulation is facilitated by higher levels of triglycerides and cholesterol, which exacerbate liver inflammation and fibrosis. Numerous studies have consistently demonstrated that hyperlipidemia is a significant risk factor for nonalcoholic fatty liver disease (NAFLD), particularly in patients who have concurrent metabolic disorders, such as obesity and insulin resistance.[24,25] The significance of lipid control in liver health is underscored by the necessity of managing hyperlipidemia through dietary interventions, lifestyle modifications, and pharmacotherapy in the prevention and management of NAFLD.

In our research, the distribution of NAFLD grades revealed that the majority of cases were within the mild to moderate range, with just a small number of instances moving to the severe stage. The findings of studies conducted in adjacent countries such as Kenya and Tanzania, which likewise indicated a predominance of mild hepatosteatosis among diabetic populations,[4,5] are in agreement with this finding. The fact that mild hepatosteatosis was the most common type of NAFLD in our study indicates that there is a potential for early intervention and changes in lifestyle to avoid the progression of the illness.

Limitation and Strength

The study addresses a critical gap in Somali healthcare data, focusing on NAFLD among diabetic populations. By highlighting prevalence and risk factors, it establishes a foundation for future research and public health policies, advancing diagnosis, management, and understanding of NAFLD in Somalia. However, its retrospective design, reliance on electronic medical records, and single-center setting limit generalizability and long-term evaluation. Challenges in Somalia's healthcare system further constrain data reliability and public health implications. Despite these limitations, the study's contribution to local epidemiological data represents a significant step toward improved healthcare outcomes in the region.

Conclusion

Our study emphasizes the substantial prevalence of NAFLD among diabetic patients in Mogadishu, Somalia, affecting 53.8% of participants. Insulin resistance, hypertension, and hyperlipidemia emerged as significant contributing factors. Our study findings underscore the pressing necessity for healthcare strategies and targeted interventions that are specifically designed to alleviate the burden of metabolic liver diseases in this region.

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Disclosure

The authors declare no competing interests in this study.

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