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NON- ALCOHOLIC FATTY LIVER DISEASE: EXPLORING THE PREVALENCE AND RELATIONSHIP OF NAFLD WITH GENDER, SES AND BMI

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Abstract: Non-Alcoholic Fatty Liver Disease (NAFLD) is a chronic liver condition characterized by the accumulation of excess fat in the liver, excluding significant alcohol consumption. This study, conducted at Aligarh Muslim University, investigates the prevalence of NAFLD in relation to gender, SES, and BMI, aiming to understand the distribution of the disease across different demographics and to explore the socioeconomic factors influencing its prevalence. **Material and Method:** The study involved 105 patients of both genders, aged 20-60 years, with NAFLD diagnosed through ultrasonographic scans. **Result:** The prevalence of NAFLD was found to be slightly higher in males (54.28%) compared to females (45.71%), with gender playing a significant role in disease prevalence. Across different SES groups, the highest prevalence was observed in the upper middle class (46.67%), although the chi-square test revealed no statistically significant difference in NAFLD distribution across SES categories. BMI was significantly associated with NAFLD prevalence, with the highest incidence observed in the pre-obesity category (35.23%). The study underscores the critical role of obesity in NAFLD development. **Conclusion**, this research highlights the importance of addressing obesity and socioeconomic disparities in the management of NAFLD. It emphasizes the need for further studies on gender-specific risk factors, particularly the impact of menopause on fibrosis development in women, and calls for targeted public health interventions to mitigate the rising prevalence of NAFLD.

Keywords: NAFLD, Gender, SES, pre-obesity, BMI, Prevalence, Risk Factors, Obesity, Metabolic Syndrome

Introduction

Non-alcoholic fatty liver disease is a condition characterized by the accumulation of excess fat in the liver of individuals who consume little to no alcohol. It is one of the most common causes of chronic liver disease worldwide. NAFLD encompasses a spectrum of liver conditions, which include simple steatosis (non-alcoholic fatty liver or NAFL), where there is only accumulation of fat, and non-alcoholic steatohepatitis, where there is liver inflammation and damage in addition to fat accumulation, which can progress to cirrhosis and liver failure. (Mehta et al., 2002) (Tsai et al., 2017) The increasing prevalence of NAFLD is closely associated with the global epidemic of obesity and metabolic syndrome, which includes a cluster of conditions such as hypertension, diabetes, dyslipidemia, and central obesity. The pathogenesis of NAFLD includes a combination of genetic, demographic, clinical, and environmental factors. Currently, there is no standardized pharmacological treatment for NAFLD; the primary therapeutic

strategy consists of lifestyle modifications, including dietary changes and increased physical activity, aimed at weight loss and metabolic control (Iqbal et al., 2019) (Bender et al., 2017).

The global trends in the prevalence of NAFLD have been increasing, a phenomenon that is closely related to the surge in obesity and type 2 diabetes mellitus, especially in Western countries. It is projected that by 2025, NAFLD could become the leading cause for liver transplantation in the USA, highlighting its growing impact on healthcare systems (Duseja & Chalasani, 2013). The prevalence is varied, with some studies indicating that between 5-20% of the population in Asia may have NAFLD, subject to variations based on location, gender, race, and age (Butt et al., 2019).

When it comes to liver scarring, known as fibrosis, which can happen as NAFLD progresses, the research isn't clear if men or women are more affected. Some studies find no difference between the sexes, while others suggest that fibrosis might be more common in men, based on specific tests that measure liver damage, like the Fibrosis-4 index or liver stiffness. (Lonardo et al., 2019) Many of these studies, however, didn't take into account whether women had gone through menopause, which could significantly affect the development of fibrosis due to hormonal changes. This lack of consideration for menopausal status might partly be why the research shows conflicting results regarding whether men or women are more likely to develop fibrosis. (Ballestri et al., 2017) (Lonardo & Suzuki, 2020)

NAFLD is caused by physiological, genetic, environmental, and social factors. Social factors, which have a substantial effect on the nature, magnitude, and distribution of health in societies, have always been mentioned in relation to health. Various health studies have studied their impact on health outcomes. (Assimakopoulos et al., 2018) Some studies show that liver disease is a significant cause of health inequality. Poorer persons are particularly affected. A recent epidemiological research found that Iranians with NAFLD had higher SES (Sadeghianpour et al., 2023). Additionally, a 2020 Chinese cross-sectional research found that non-alcoholic fatty liver disease prevalence increased with wealth (Hu et al 2020)

Lower SES is associated with an increased risk of NAFLD. This suggests that individuals with lower SES may have higher exposure to risk factors for NAFLD or may have less access to resources that can help prevent the disease, emphasizing the influence of SES disparities on the risk of developing NAFLD. (Cho et al., 2021). On the contrary, there is insufficient data to support the opposite. The determinants of SES are wealth, employment, and education. Besides these three factors, composite measures of socioeconomic class are also often used because they give a more complete picture. There is still debate over the apparent relationship between socioeconomic status and nonalcoholic fatty liver disease (NAFLD). (Sadeghianpour et al., 2023)

Objectives:

As the NAFLD is a chronic liver disorder and has been associated with wide range of risk factors and complications. Also, there is lack of association of NAFLD with SES and gender this study was planned to estimate the prevalence of different grades of NAFLD along with its association with gender, SES, and BMI.

Material and Methods

This was a retrospective study conducted in the Department of Home Science A.M.U. in collaboration with the department of Medicine and Gastroenterology of J.N.M.C hospital A.M.U. Aligarh, U.P. total of 105 patients of either gender (male and female) of age between 20-60 yrs. The patient's ultrasonographic study verified the diagnosis of non-alcoholic fatty liver disease (NAFLD) and its grade. The patients were chosen based on inclusion and exclusion criteria in addition to the USG report. Written consent form was taken from all the patients.

All the patients had undergone complete history evaluation, anthropometric measurements and physical examination. Detail history including consumption of alcohol, duration of disease, to know about the socioeconomic status of the patient the SES score was calculated with the help of modified Kuppuswamy Scale (2019) by asking patient about education & occupation of head of the family along with total family income. Thus, calculating the socioeconomic status of the patient.

Anthropometric data included weight and height of the patient was recorded and then body mass index (BMI) was calculated of each patient by applying formula: BMI = weight (kg)/ height $(m)^2$ The value of BMI <24.99 $kg.m^2$ is considered as a risk factor.

The severity of disease is classified as the grade of NAFLD. Classification of NAFLD on the basis of Histology and ultrasonographic findings (Paul et al 2020) (See Table 1.1)

Table 1.1 Categorization of Grades of NAFLD

Grades of NAFLD	Histologolical findings	Ultrasonographic findings
Grade I	6-33% of hepatocytes contains fat	Hepatic echogenicity is more than the renal cortex
Grade II	34-66% of hepatocytes contains fat	Liver echogenicity obscures echogenic wall of portal venous branch
Grade III	>66% of hepatocytes contain fat	Diaphragmatic wall and portal venous wall are no visible dir to increased hepatic echogenicity

The inclusion criterion was: patient from JNMC hospital visiting Medicine and gastroenterology Department with Ultrasound report and diagnosis defined by the doctors along with the consent of the patient. The exclusion criterion was: alcohol consumption, patient suffering from any other auto-immune disease hepatitis and patients not consenting for the study.

Observation and Result

Table 1: Observation on Prevalence of NAFLD on the basis of Gender

Gender	Frequency	Percentage	Chi Square (χ^2)
Male	57	54.28	7.557 p = 0.006 df = 1
Female	48	45.71	

Prevalence on the basis of Gender: from Table 1 in the current study displays the prevalence of non-alcoholic fatty liver disease (NAFLD) among males and females. The results of the study indicate that males have a slightly higher prevalence of NAFLD (54.28%) compared to females (45.71%). Furthermore, the chi square analysis reveals that gender plays a significant role in the prevalence of NAFLD.

Table 2: Prevalence of NAFLD patients on the basis of Socio-economic Status (SES)

Socio Economic Status	Frequency	Percentage	Chi Square (χ^2)
Upper class	20	19.05	5.691 df = 8 p = 0.682
Upper Middle class	49	46.67	
Lower Middle class	20	19.05	
Upper Lower class	15	14.29	
Lower class	1	0.95	

The Prevalence of NAFLD patients on the basis of Socioeconomic Status: It can be stated from Table 2 that NAFLD is prevalent across all socioeconomic statuses, with the highest prevalence in the upper middle class (46.67%). Approximately 19.05% of the total NAFLD patients belong to the upper socioeconomic status. Nearly 46.67% of the total NAFLD patients belong to the upper middle socioeconomic status. About 19.05% of the total NAFLD patients come from a lower middle socioeconomic status. Almost 14.29% of the total NAFLD patients belong to the upper lower socioeconomic status. Only a small fraction, 0.95%, of the total NAFLD patients comes from a lower

socioeconomic status. The chi-square test results ($\chi^2 = 5.691$, $p = 0.682$, $df = 8$) indicate that there is no statistically significant difference in the distribution of NAFLD across different socioeconomic statuses.

Table 3: Prevalence of NAFLD patients according to the BMI Classification (WHO)

Prevalence of NAFLD patients according to the BMI: in the Table 3 we can see that the highest prevalence of NAFLD is observed in the pre-obesity category (30.47%). The lowest prevalence is observed in the underweight category (10.47%). The percentage of NAFLD patients in the normal category is 30.47%, while those in obesity class I and obesity class II constitute 12.28% and 7.6% respectively. The chi-square test results ($\chi^2 = 79.717$, $p = 0.000$, $df = 10$) indicate a statistically significant difference in the distribution of NAFLD across different BMI categories.

Discussion

While common risk factors like obesity, metabolic syndrome, and insulin resistance are relevant to both genders, the impact and interaction with these factors can differ by gender, potentially influencing the development and progression of NAFLD (Lonardo & Suzuki, 2020) Studies about non-alcoholic fatty liver disease suggest that it is more common in men than in women. This trend is observed until around the age of 50-60 years, after which the rates of NAFLD in men and women become more similar. This change later in life is thought to be related to menopause in women, as the protective effects of female sex hormones, like estrogen, decrease. (Trojak, 2014)

BMI	Range	Frequency	Percentage	Chi Square (χ^2)
Underweight	Below – 18.5	11	10.47	79.717 p = 0.000 df = 10
Normal Weight	18.5 – 24.9	32	30.47	
Pre-Obesity	25.0 – 29.9	37	35.23	
Obesity Class I	30.0 – 24.9	13	12.38	
Obesity Class II	35.0 – 39.9	08	7.6	
Obesity Class III	Above 40	04	3.8	

The relationship between socioeconomic status and non-alcoholic fatty liver disease is not conclusive. Some studies have found an association between higher SES and increased NAFLD risk, potentially due to factors like unhealthy dietary habits and sedentary lifestyles among those with greater wealth. However, other research has suggested that lower SES may also be linked to a higher prevalence of NAFLD, possibly due to reduced access to healthcare and preventive resources. The complex interplay of social determinants and their impact on NAFLD development requires further investigation to fully understand this relationship.(Tang et al., 2023)(Jang & Kim, 2023)

Emerging research suggests that lower socioeconomic status is associated with an increased risk of non-alcoholic fatty liver disease. This indicates that individuals of lower SES may face greater exposure to risk factors for NAFLD, such as unhealthy dietary habits, sedentary lifestyles, and inadequate access to healthcare resources. Additionally, those with lower SES may have fewer opportunities to access preventive measures and interventions that could help mitigate the development and progression of NAFLD. These findings emphasize the significant influence of socioeconomic disparities on the risk of developing NAFLD, underscoring the need for targeted public health strategies to address these inequities and promote health equity in the management of this liver condition. (Cho et al., 2021)

Several studies have linked BMI to NAFLD. Global epidemiology and risk factors for NAFLD show a substantial link between BMI and NAFLD. Obesity and NAFLD, a hepatic symptom of metabolic syndrome, are linked. (Chowdhury & M. Younossi 2016) A cross-sectional study involving normal weight and obese individuals found that the prevalence of NAFLD was much higher in the obese group, regardless of age, gender, and other metabolic parameters. Specifically, the study reported that NAFLD affects up to 90% of obese individuals, underscoring the critical role of obesity in the development of this liver condition. (Akshintala et al., 2019) (Obika & Noguchi, 2012) This alarmingly high prevalence

among the obese population indicates that excess body weight is a major contributing factor to the onset and progression of non-alcoholic fatty liver disease.

Additionally, data from various sources suggests that the prevalence of NAFLD in the general adult population ranges from 10% to 24% globally, but this rate can reach as high as 57.5% to 74% in individuals who are obese. (Alkhouri & Feldstein, 2016) This stark difference highlights the significant impact of obesity on the risk of developing NAFLD. Further research has indicated that between 40-50% of obese individuals have NAFLD, and this percentage can increase to around 70% in those with concomitant type 2 diabetes.(Jang & Kim, 2023) The coexistence of obesity and diabetes appears to exacerbate the risk of NAFLD, underscoring the importance of managing both conditions to mitigate the development and progression of this liver disease. These findings collectively emphasize the strong association between higher body mass index and an increased risk of developing non-alcoholic fatty liver disease. (Imanzadeh et al., 2023)

Conclusion

This study has explored the relationship between Non-Alcoholic Fatty Liver Disease (NAFLD) and various demographic and socioeconomic factors, including gender, socioeconomic status (SES), and body mass index (BMI). The findings indicate that males have a slightly higher prevalence of NAFLD compared to females, suggesting a potential gender disparity in the disease's prevalence. However, the role of menopausal status in women and its impact on NAFLD progression, particularly with regard to liver fibrosis, remains an area for further research. Socioeconomic status was found to be a complex factor in the prevalence of NAFLD. While some studies have suggested that lower SES individuals may be at increased risk due to limited access to healthcare and unhealthy lifestyles, our study observed the highest prevalence in the upper middle class. This indicates that the relationship between SES and NAFLD is not straightforward and may involve multiple interacting factors. The most significant association observed was between BMI and NAFLD prevalence, with the highest rates found in the pre-obesity category. This confirms the well-established link between obesity and NAFLD, highlighting the importance of weight management and metabolic control in the prevention and treatment of this condition.
In conclusion, the study underscores the multifaceted nature of NAFLD and the need for a comprehensive approach to its management. Public health strategies should target obesity and address socioeconomic disparities to effectively combat the rising prevalence of NAFLD. Further research is warranted to better understand the gender-specific determinants of NAFLD, particularly the influence of hormonal changes in women, to develop more targeted interventions for this growing healthcare concern.

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