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RESEARCH ARTICLE

ESTIMATION OF LIPID PROFILE AND GLYCEMIC STATUS AND LIVER ENZYMES, AMONG PATIENTS WITH NON-ALCOHOLIC FATTY LIVER DISEASE

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Abstract

Aim: The aim of the study is mainly to evaluate the association of obesity, liver enzymes, lipid profile and glycemic status with Non - alcoholic Fatty Liver Disease (NAFLD).

Methods: This cross-sectional observational study

Results: This study shows that characteristics of studied population (n = 400) as control, The study population was categorized into three age groups viz. 18-35 yrs, 36-60 yrs and >60 yrs. Out of the 400 subjects studied more than 50% belonged to the age group 36-60 years, 27.5% to the age group18-35 years and the remainder to the group above 60 years. The genders wise distribution of study group is presented 53% of the subjects were females and 47% subjects were males. 59.5% of the subjects were obese according to the WHO's classification of BMI for Asians. 18.5% were overweight and the remaining 22% were normal. 25% of the subjects were diabetics and 20 % were hypertensives. The association between the prevalence of NAFLD and the age categories mentioned previously, gender, BMI & comorbidities was tested using Chi-Square test. There was a significant association with age, BMI, DM and HTN with a P-value of 0.003, 0.0.000, 0.000 and 0.000 respectively. No significant association was found with gender. The results of Chi-square tests performed to find out the association between NAFLD & serum levels of liver enzymes. There was no significant association between NAFLD and liver enzymes. The results of the Chi-square tests performed to find out the association between NAFLD & serum lipid levels. A significant association was found between the prevalence of NAFLD and total cholesterol, triglycerides, LDL-C and VLDL-C. No significant association was observed between NAFLD and HDL-C. The association between NAFLD and the glycemic status was tested. There was a significant association between plasma fasting glucose level and NAFLD. The percentage of subjects diagnosed with NAFLD in each of the various stages according to their Fibroscan results. Among the 75 NAFLD patients, 80 % of patients

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were in fatty liver stage, 17,3% had had progressed to NASH and 2.7% progressed to the fibrosis stage. None of the patients were found to have liver cirrhosis. There was a significant association between the HBA1c and the progression of NAFLD with a P-value of 0.001. A significant association was found to exist between the various stages of NAFLD and the plasma fasting glucose level. The P-value was 0.025. The results are summarized in different tables.

Conclusion: The Prevalence of NAFLD in the study population was 18.8%.The prevalence of NAFLD was higher among males. Age, BMI and co-morbidities like diabetes and hypertension were significantly associated with NAFLD. A significant association between NAFLD and total cholesterol, triglycerides, LDL-C, VLDL-C & fasting glucose was observed. There was a significant association between disease progression and glucose intolerance.

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Introduction:-

Non -alcoholic Fatty Liver Disease (NAFLD) is defined as accumulation of lipids in hepatocytes which exceeds 5% of the weight of the liver in the absence of alcohol consumption and without hepatitis B virus or hepatitis C virus infections.[1]NAFLD is a spectrum of diseases and comprises of Non-Alcoholic Fatty Liver (NAFL), Non -Alcoholic Steato Hepatitis (NASH), fibrosis and cirrhosis.[2] Hepatic Steatosis is the first recognizable stage. When hepatic inflammation occurs, it results in Non- Alcoholic Steato Hepatitis (NASH), which carries a higher risk of progression to fibrosis, cirrhosis or hepatocellular carcinoma. With a worldwide prevalence of approximately 24% among general population, NAFLD is now becoming a global burden. [3] The real burden of NAFLD is under-estimated due to lack of awareness among the people, long natural history for the development of fibrosis and mortality being not related to liver. It is predicted that NAFLD will be the leading cause of end stage liver disease by the year 2020.[4] Central obesity increases the risk of NAFLD and is a key determinant of its pathogenesis.[5] Central Obesity is a component of metabolic syndrome which is associated with increased risk for the development of Diabetes mellitus. NAFLD is considered as the hepatic component of the metabolic syndrome.[6] Liver enzymes like Alanine amino transferase (ALT), Aspartate amino transferase (AST) and Gamma glutamyl transferase (GGT), which act as markers of hepatocellular injury, have been shown to be elevated in NAFLD.[7] particularly, elevation of ALT, two to three times the normal limit is observed in NAFLD.

NAFLD has been found to be associated with dyslipidemia in 60 -70% of patients.[8] Imbalance between increased fatty acid synthesis and reduced delivery of fatty acids by VLDL results in steatosis. Impaired glucose tolerance and/or impaired fasting glucose are precursors for NAFLD and its further progression to fibrosis. T2DM is an independent risk factor for the development of NAFLD.[9] Risk of microvascular complications of DM like nephropathy, retinopathy gets increased in patients with NAFLD.[10] Glycated haemoglobin (HbA1c) level also gets increased with the progression of fibrosis.[11] On the other hand, the presence of NAFLD is associated with increased risk of development of DM. NAFLD can be diagnosed by clinical history, clinical examination, laboratory investigations and ultrasonogram (USG) abdomen.[12] Liver biopsy is the gold standard for assessing the stages of NAFLD. Transient Elastography (TE) – Fibroscan, a non-invasive method can also be used to assess the stages of hepatic fibrosis.[13] Studies on NAFLD among our population are lacking. Estimation of the prevalence will give an idea about the burden of the disease. Measurement of anthropometric measures and evaluation of various biochemical parameters among NAFLD patients will help in the identification of the risk factors, early diagnosis and treatment and helps to prevent progression.

Aim Of The Study:

To evaluate the association of obesity, liver enzymes, lipid profile and glycemic status with Non -alcoholic Fatty Liver Disease (NAFLD).

Objectives:-

1. To find the prevalence of NAFLD among our population.
2. To find out the association between Obesity and NAFLD.

3. To find out the association between Liver enzymes and NAFLD.
4. To find out the association between Lipid Profile and NAFLD.
5. To find out the association between Glycemic status and NAFLD.

To evaluate the stages of NAFLD by Fibroscore using Transient Elastography.

Materials And Methods:-

This cross-sectional observational study was carried out in the Department of Biochemistry, over a period of one year from June 2018 to May 2019. The study participants included both males and females of age ≥ 18 years, attending the outpatient department (OPD) with general complaints and without the history of alcoholism. The study was approved by the Institutional ethical committee. After registering the patient for this study, a brief history of presenting illness, past illness, co-morbidities like diabetes, hypertension, personal history such as smoking, substance abuse and treatment history were taken.

Examination:

The measurements like Height (cm), Weight (kg) and body mass index (BMI) was calculated by dividing weight in kg with height in meter square. Patients were grouped into following categories based on BMI.

1. Under Weight - <18.5kg/m^2
2. Normal Weight – 18.5 – 22.9kg/m^2
3. Over Weight -- 23 – 24.9 kg/m^2
4. Obese ≥ 25 kg/m^2

Pulse rate, blood pressure was recorded`. According to JNC-7 guidelines, subjects with BP ≥140/90 mmHg were considered as hypertensive patients along with the patients on anti-hypertensive drugs. Systemic examination - cardiovascular system, respiratory system, central nervous system and abdomen was done.

Strictly on aseptic precautions, 5 ml of venous blood was obtained after an overnight fasting for biochemical assessment of plasma glucose, lipid profile and liver enzymes in a clot activator tube and for HbA1c in EDTA tube. Samples were centrifuged immediately and assayed. All parameters were assayed using the fully automated analyser Mindray BS 420. HbA1c was assayed using the fully automated analyser Cobas C 311.

Ultrasonogram Abdomen:

USG - abdomen was done by using GE – Model LOGIQ P9 device. To identify normal echotexture or steatosis, a semi quantitative system of grading was used as Grade 1 to Grade 3.

Transient Elastography – Fibroscan:

Patients who were diagnosed as having NAFLD underwent transient elastography procedure for assessing the stages of fibrosis. FibroScan® (Echo Sens) –An ultrasound probe is placed on the skin above the liver area in the right mid-axillary line with the patient lying in supine posture. Vibration waves were generated on the skin whose velocities were measured and this gave the liver stiffness values. Every time when a vibration wave is generated by the probe, the patients felt a gentle 'flick'. It took 10 minutes for the performance of the test... FibroScan® results were interpreted from a guide developed by Echo Sens. Results ranged from 1 kPa to 75 kPa. About 95 % of healthy people without any liver pathology will have the liver stiffness value < 7 kPa.

F0 – F1	- < 7 kPa	- Fatty Liver
F -2	- 7.5 – 8.5 kPa	- NASH
F- 3	- 8.6 – 10.5kPa	- Fibrosis
F-4	- > 10.5 kPa	- Cirrhosis.

Methodology:-

Biochemical Investigations:

Estimated Parameters

Parameter	Method
Glucose	Glucose oxidase peroxidase
HbA1c	Turbidimetric Inhibition Immunoassay
Total Cholesterol	Cholesterol oxidase peroxidase
Triglycerides	GPO method- Trinder's reaction

High Density Lipoprotein-cholesterol (HDL-c)	Direct Immuno inhibition method
Low Density Lipoprotein-cholesterol (LDL-c)	Selective Direct Single Measurement
Aspartate aminotransferase (AST)	IFCC recommended procedure
Alanine aminotransferase (ALT)	IFCC recommended procedure
Alkaline phosphatase (ALP)	IFCC recommended procedure
Gamma glutamyl transferase (GGT)	Method according to Szasz/Persijn

Statistical Analysis

Data entry was done using Microsoft Excel and the statistical analysis was done using the software – Software package for Statistical Study (SPSS), version 21. Descriptive analysis was done to describe the distribution of age, gender, BMI and co- morbidities among the study population and expressed as percentage (%). Association between NAFLD and socio-demographic & biochemical parameters was analysed using Chi-Square test. P-value <0.05 was considered to be significant.

Results:-

This study shows that characteristics of studied population (n = 400) as control.

Table 1:- Characteristics of study population (n = 400).

Variables		No. of subjects	Percentage (n%)
Age	18 – 35 yrs	110	27.5 %
	36- 60 yrs	236	59.0%
	> 60 yrs	54	13.5 %
Sex	Male	188	47.0 %
	Female	212	53.0 %
BMI	18.5 – 22.5 kg/m^2	88	22.0 %
	23 – 24.9 kg/m^2	74	18.5 %
	>25 kg/m^2	238	59.5 %
DM	Yes	100	25.0 %
	No	300	75.0 %
HTN	Yes	80	20.0 %
	No	320	80.0 %

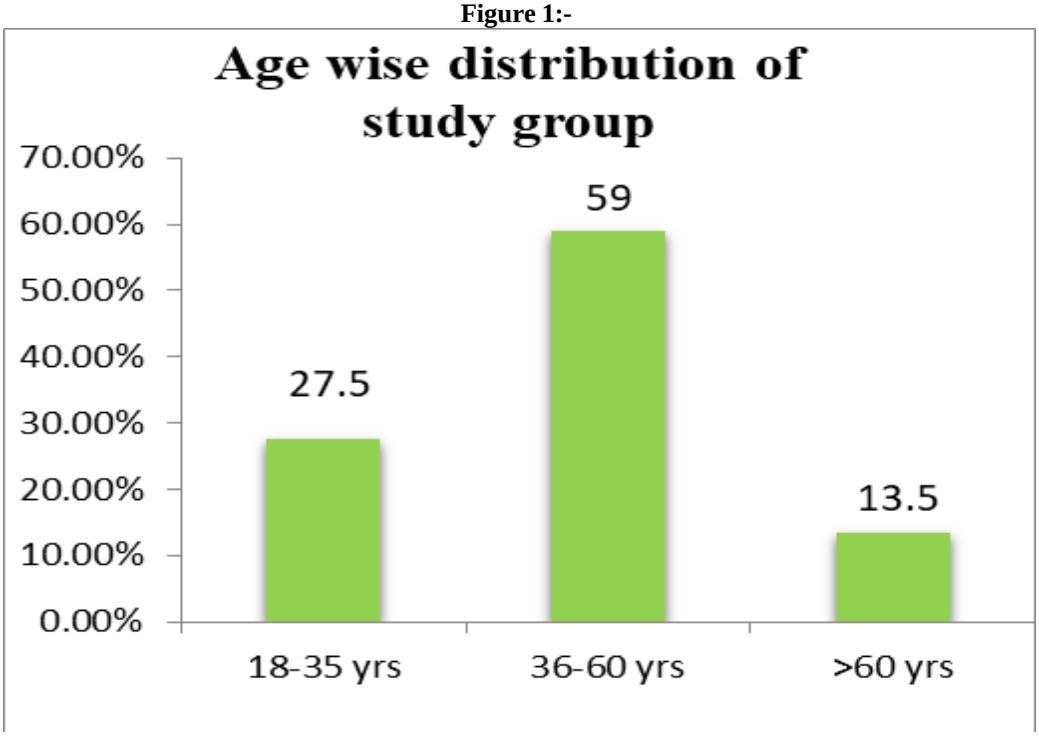
Table 2 shows association between NAFLD and the age groups, sex, BMI, liver enzymes, lipid profile and glycemic status based on chi-square test.

Variables		NAFLD status		□ 2(df)	P-Value
		Yes (n%)	No (n%)		
Age	18 – 35 yrs	9 (8.2)	101(91.8)	11.372(2)	0.003
	36 – 60 yrs	55(23.3)	181(76.7)		
	>60 yrs	11(20.4)	43(79.6)		
Sex	Male	39(20.7)	149(79.3)	0.926(1)	0.336
	Female	36(17)	176(83)		
BMI	< 18.5 kg/m^2	5(5.7)	83(94.3)	25.719(2)	0.000
	18.5 – 25 kg /m^2	6(8.1)	68(91.9)		
	>25 kg/ m^2	64(26.9)	174(73.1)		
DM	Yes	31(31)	69(69)	13.134(1)	0.000
	No	44(14.7)	256(85.3)		
SHT	Yes	27(33.8)	53(66.2)	14.769(1)	0.000
	No	48(15)	272(85)		
AST	Normal	72(18.6)	316(81.4)	0.317(1)	0.573
	High	3(25)	9(75)		
ALT	Normal	70(18.1)	317(81.9)	3.427(1)	0.064
	High	5(38.5)	8(61.5)		

ALP	Normal	72(18.7)	313(81.3)		0.899
	High	3(20)	12(80)	0.016(1)	
GGT	Normal	67(18.1)	304(81.9)		0.206
	High	8(27.6)	21(72.4)	1.602(1)	
TC	Normal	50(14.7)	289(85.3)		0.000
	High	25(41)	36(59)	23.355(1)	
TGL	Normal	53(15.6)	286(84.4)		0.000
	High	22(36.1)	39(63.9)	14.166(1)	
HDL-C	Normal	45(19.1)	190(80.9)		0.807
	High	30(18.2)	135(81.8)	0.060(1)	
LDL-C	Normal	58(16.8)	288(83.2)		0.010
	High	17(31.5)	37(68.5)	6.642(1)	
VLDL-C	Normal	37(14.4)	220(85.6)		0.003
	High	38(26.6)	105(73.4)	8.942(1)	
Fasting Glucose	Normal	29(12.7)	200(87.3)		0.001
	Impaired	25(28.1)	64(71.9)		
	Diabetic	21(25.6)	61(74.4)	13.197(2)	

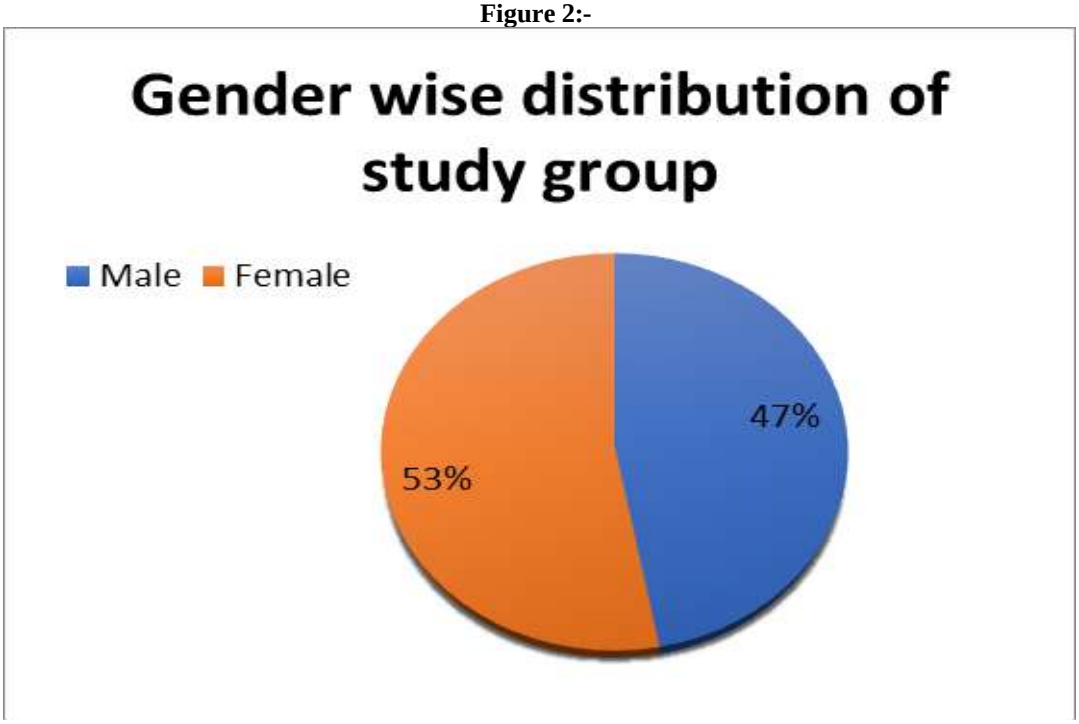
The study population was categorized into three age groups viz. 18-35 yrs, 36-60 yrs and >60 yrs. Out of the 400 subjects studied more than 50% belonged to the age group 36-60 years, 27.5% to the age group18-35 years and the remainder to the group above 60 years. This is represented by a bar diagram (Fig. 1)

Figure 1:-



The gender wise distribution of study group is presented by a pie chart (Figure 17). 53% of the subjects were females and 47% subjects were males.

Figure 2:-



59.5% of the subjects were obese according to the WHO's classification of BMI for Asians. 18.5% were overweight and the remaining 22% were normal. The distribution of study population according to their BMI is given in table 3.

Table 3:-

BMI (kg/m^2)		No of subjects	Percentage (%)
Normal	18.5 – 22.9 kg/m^2	88	22
Overweight	23-24.9 kg/m^2	74	18.5
Obese	$\geq$ 25 kg/m^2	238	59.5
Total		**400**	**100**

25% of the subjects were diabetics and 20 % were hypertensives. The distribution of study population with co-morbidities is given in table 4.

Table 4:-

Co - morbidities		No. of Subjects	Percentage (%)
DM	Yes	100	25
	No	300	75
HTN	Yes	80	20
	No	320	80

The association between the prevalence of NAFLD and the age categories mentioned previously, gender, BMI & comorbidities was tested using Chi-Square test. There was a significant association with age, BMI, DM and HTN with a P-value of 0.003, 0.0.000, 0.000 and 0.000 respectively. No significant association was found with gender. The results of this analysis were presented in table 5.

Table 5:-

Categories		No. of subjects	NAFLD	Non-NAFLD	Chi-Square Test
Total Subjects		400	75(18.8)	325(81.2)	**P -value**
Age	18 – 35 yrs	110	9(8.2)	101(91.8)	
	36- 60 yrs	236	55(23.3)	181(76.7)	

	>60 yrs	54	11(20.4)	43(79.6)	0.003
Sex	Male	188	39(20.7)	149(79.3)	
	Female	212	36(17)	176(83)	0.336
BMI	18.5 – 22.5	88	5(5.7)	83(94.3)	
	23 – 24.9	74	6(8.1)	68(91.9)	
(kg/m^2)	>25	238	64(26.9)	174(73.1)	0.000
DM	Yes	100	31(31)	69(69)	
	No	300	44(14.7)	256(85.3)	0.000
HTN	Yes	80	27(33.8)	53(66.2)	
	No	320	48(15)	272(85)	0.000

DM – Diabetes Mellitus, HTN - Hypertension

Table 6 gives the results of Chi-square tests performed to find out the association between NAFLD & serum levels of liver enzymes. There was no significant association between NAFLD and liver enzymes.

Table 6 :-

Liver Enzymes		**No.of subjects**	**NAFLD**	**Non NAFLD**	**Chi-Square test (P-value)**
AST	Normal	388	72(18.6)	316(81.4)	0.573
	High	12	3(25)	9(75)	
ALT	Normal	387	70(18.1)	317(81.9)	0.064
	High	13	5(38.5)	8(61.5)	
ALP	Normal	385	72(18.7)	313(81.3)	0.557
	High	15	3(20)	12(80)	
GGT	Normal	371	67(18.1)	304(81.9)	0.154
	High	29	8(27.6)	21(72.4)	

AST- Aspartate Aminotransferase, ALT- Alanine Aminotransferase ALP- Alkaline Phosphatase, GGT- Gamma Glutamyl Transferase

The results of the Chi-square tests performed to find out the association between NAFLD & serum lipid levels are shown in table 7. A significant association was found between the prevalence of NAFLD and total cholesterol, triglycerides, LDL-C and VLDL-C. No significant association was observed between NAFLD and HDL-C.

Table 7:-

Lipid Profile		**No. of subjects**	**NAFLD**	**Non NAFLD**	**Chi-Square test (P-value)**
Total Cholesterol	Normal	339	50(14.7)	289(85.3)	
	High	61	25(41)	36(59)	0.000
Triglycerides	Normal	339	53(15.6)	286(84.4)	
	High	61	22(36.1)	39(63.9)	0.000
HDL-C	Normal	235	45(19.1)	190(80.9)	
	Low	165	30(18.2)	135(81.8)	0.807
LDL-C	Normal	346	58(16.8)	288(83.8)	
	High	54	17(31.5)	37(68.5)	0.010
VLDL-C	Normal	257	37(14.4)	220(85.6)	
	High	143	38(26.6)	105(73.4)	0.003

HDL-C – High density lipoprotein-cholesterol LDL-C Low density lipoprotein-cholesterol
VLDL-C – Very low- density lipoprotein -cholesterol

The association between NAFLD and the glycemic status was tested, and the results are shown in table 8. There was a significant association between plasma fasting glucose level and NAFLD.

Table 8:-

Fasting glucose	No.of subjects	NAFLD	Non NAFLD	Chi-Square test (P-value)
Normal	229	29(12.7)	200(87.3)	
Impaired	89	25(28.1)	64(71.9)	
Diabetic	82	21(25.6)	61(74.4)	0.001

Table 33 gives the percentage of subjects diagnosed with NAFLD in each of the various stages according to their Fibroscan results. Among the 75 NAFLD patients, 80 % of patients were in fatty liver stage, 17,3% had had progressed to NASH and 2.7% progressed to the fibrosis stage. None of the patients were found to have liver cirrhosis.

Table 9:-

Fibroscan Stages	Findings	Liver Stiffness (kPa)	No.of NAFLD	Percentage (%)
F0 – F1	Fatty Liver	< 7	60	80
F2	NASH	7 – 8.5	13	17.3
F3	Fibrosis	8.6-10.5	2	2.7
F4	Cirrhosis	>10.5	0	0

The percentage of subjects in various stages of NAFLD according to their HbA1c values and association between them is represented in table 10. There was a significant association between the HBA1c and the progression of NAFLD with a P-value of 0.001.

Figure 10:-

HbA1c (%)		NAFLD	Percentage (%)	Stages of fibrosis			Chi-Square test (P-value)
				F0-F1	F2	F3	
4 – 5.6	Normal	26	34.7	22	4	0	
5.7 – 6.4	Impaired	16	21.3	11	5	0	
≥ 6.5	Diabetes	33	44	27	5	1	0.001

A significant association was found to exist between the various stages of NAFLD and the plasma fasting glucose level. The P-value was 0.025. The results are summarized in Table.11

Table 11:-

Plasma fasting glucose	NAFLD	F0 – F1	F2	F3	Chi-Square P-Value
Normal	26	23 (88.5%)	3 (11.5%)	---	
Impaired	16	16 (100%)	---	---	0.025
Diabetes	33	21 (63.6%)	10 (30.3%)	2 (6.1%)	

Discussion:-

In our study, we studied about the prevalence of NAFLD among the adults who attended the out- patient department in Jagannath Gupta Institute of Medical Sciences & Hospital. We also evaluated biochemical parameters like liver enzymes, lipid profile and glycemic status among NAFLD patients. We assessed the stages of fibrosis in NAFLD patients by fibroscan.

The prevalence of NAFLD among adult population in this study was found to be 18.8% Majumdar. A et al had conducted a population- based study on rural population of Haryana and found a prevalence of 30.7%.[14] In another study conducted by Kapoor.A et.al among adults of age ≥ 30 years in a rural people of Jammu got a prevalence of 37.2% [15]. The lower prevalence in our study compared to the prevalence made out by the first two studies carried out in the northern states of India may be due to the differences in diet. Amarakpur D et.al got a prevalence of 16.6 % among the general population in Mumbai[16] which is almost similar to the prevalence in our study. This may be due to Mumbai city being cosmopolitan in nature.

In our study, NAFLD was more prevalent among the age group 36-60 years followed by >60 years A population-based study conducted in India by Amarakpur D et.al showed a higher prevalence of NAFLD among 40 – 60 years of

age.[15] Alam S et.al in a cross -sectional study conducted in Bangladesh stated that midlife adults aged 45-54 years had the highest prevalence (55.38%).[17] Young people of age less than 24 years showed the least prevalence in that study. This matched with our study findings of least prevalence among the age group 18-35 years (8.2%).

Though males (20%) were affected more frequently than females (17.1%) in the present study the p-value was insignificant between sex category and NAFLD (Table 26). Pan J.J and Fallon M.B who studied about gender and racial differences in NAFLD in US population documented the male preponderance in their study.[18] Similar findings of male preponderance had been observed in various studies like a large Dutch cohort study by van den Berg E.H et.al,[19] a multicenter large retrospective study conducted in Japan by Eguchi Y et.al.[20] On the contrary a population-based cross-sectional study conducted in Thailand by Summart U documented a female preponderance in all age groups, but large difference was observed between 56-60 yrs.[21]

Higher prevalence of NAFLD among obese individuals (26.9%) was observed in our study compared to normal weight (5.7%) and overweight individuals (8.1%). There was a positive correlation between BMI and NAFLD with significant P-value of 0.000 (Table 26). This is in line with the findings of Eguchi Y et.al [19]Alam s et.al [16] In their study, 14.47% with normal BMI had NAFLD compared to 5.7% in the present study. The prevalence of NAFLD increases with BMI. This is consistent with BMI being a risk factor for the development of NAFLD.

In our study the prevalence of NAFLD among the diabetic population was almost twice than that of the non-diabetic population and the association is statistically significant (Table 26). Among NAFLD patients 41.3% had diabetes. A hospital based cross sectional study conducted by Mathew T et.al in Karnataka documented a 52.7% prevalence of NAFLD among pre-diabetes and 30.7% among diabetes.[22] A meta-analysis on prevalence of NAFLD among T2DM done by Dai W et.al documented 73.2% of prevalence in Italy according to Targher et.al, 42.6% by Williamson et.al in UK and 29.6% by Li et.al in China.[23] Impaired glycemic status is an established risk factor for the development of NAFLD and our findings are also in agreement with it.

Hypertensive patients also showed a similar trend like DM patients with twice the prevalence rate of NAFLD than non-hypertensives, the association being statistically significant (Table 26). This is similar to the findings of a study conducted by Donati G et.al in Italy which documented significantly higher prevalence of NAFLD among hypertensives with the prevalence of 30.9% against 12.7% among non-hypertensives with P value of < 0.04.[24] This was due to high Insulin levels and insulin resistance observed among the hypertensives.

In the present study, one fourth of the study population with an elevated aspartate aminotransferase (AST) had NAFLD while the prevalence among those without AST elevation was found to be lower. Similarly, the prevalence of NAFLD among people with elevated alanine aminotransferase (ALT) levels was higher compared to those without an elevation in AST level. But the association was not statistically significant. In the NHANES III study conducted among US population, 6% of patients with elevated ALT had 41% prevalence of NAFLD and 5.6 % of elevated AST with 33.8% prevalence of NAFLD.[25] ALT elevation was more common among NAFLD patients than AST elevation.

NAFLD was present in one fifth of the individuals with elevated alkaline phosphatase (ALP) levels and in roughly one fourth of those with elevated gamma-glutamyl transferase (GGT) levels. But there was no significant association (Table 27). A cross sectional study conducted by Sanyal et.al in eastern India documented a significant association between elevated GGT values and NAFLD and no association between ALP and NAFLD.[26] This could be due to differences in the methods used.

More than 90 % of NAFLD patients had normal levels of liver enzymes in the present study. This finding was similar to a study conducted by Browning et.al in among urban population in US with 78% of patients with normal liver enzymes.[28]

In our study people with elevated serum lipids had a statistically significant association with NAFLD (Table 28). Among NAFLD patients, elevated total cholesterol values were observed in roughly one third of patients which is only half the people in the study of Lizardi-cervera J et.al conducted in Mexico.[29] This could be due to genetic, ethnic differences as well due to the diet consumed. A statistically significant percentage of NAFLD patients had elevated triglycerides and this is in line with the findings of Clark et.al

[127] among the people of USA and Leite NC et.al [28]in Brazil population. An earlier Indian study done by Sathiaraj et.al[129] also documented elevated total cholesterol and triglycerides levels in NAFLD patients. Approximately half and one fourth of the subjects had elevated VLDL-cholesterol & LDL- Cholesterol respectively.[30] A study by Sen A et.al in North India had found also elevated levels of total cholesterol, triglycerides, LDL-C and VLDL-C.[31]

The association between Low HDL-Cholesterol & NAFLD prevalence in the current study was statistically insignificant (Table 28) which is concurrent with the finding obtained by Tanwani et.al. [32]This is in contrast to the findings of Majumdar et.al whose study had revealed a statistically different association.

In our study nearly 62 % of NAFLD patients had abnormal plasma glucose values. Other studies by Mathew T et.al in Karnataka, Ortiz-Lopez et.al [33]and Singh et.al[34] also documented higher prevalence of glucose intolerance among NAFLD patients. Transient Elastography (TE) was done for the patients diagnosed with NAFLD. About 80% of NAFLD patients were in the fatty liver stage, 17.3% in the inflammatory stage (NASH) and 2.7% in the fibrosis stage. The disease was in a more advanced stage with increased plasma glucose levels. Since 4/5th of NAFLD patients had not undergone any inflammatory changes, this might be the reason for the insignificant association of liver enzymes and NAFLD in the present study.

We also found out a statistically significant association between HbA1c values and progression of NAFLD (Table 31). Insulin resistance and oxidative stress could be the most important causes for higher values of HbA1C among NAFLD patients. A study by Ma H et.al in elderly Chinese population also documented increased prevalence of NAFLD patients with increased HbA1C values.[35] In the present study, high plasma glucose levels were associated with associated (P-Value-0.025) with more advanced stages of NAFLD as made out by fibroscan. Approximately a three-fold increase was observed in the progression of NAFLD to NASH in diabetics when compared with subjects with normal plasma glucose levels. Haukeland et.al proposed that diabetes and pre -diabetes are the predictors of progression of NAFLD to NASH and fibrosis.[36]

Summary

This cross- sectional study was conducted among the adult population who had attended out- patient department in a tertiary care hospital. About 400 non-alcoholic subjects of both sexes who underwent ultrasonogram abdomen were included in the study to find out the prevalence of NAFLD and to evaluate the association between elevated liver enzymes, lipid profile and glycemic status with NAFLD.

The prevalence of NAFLD obtained in this study was about 18.8%. NAFLD was more prevalent among the age group 36-60 years (23.3%), among male sex (20.7%), among obese individuals (26.9%), among diabetics (31%) and among hypertensives (33.8%). There was a significant association between NAFLD and age, BMI, co-morbidities like diabetes and hypertension with P-value < 0.05. An insignificant association between NAFLD and Sex was observed in this study.

No significant association was made out between elevated liver enzymes and NAFLD.

About 41% of people with NAFLD had elevated total cholesterol values, 36.1% with elevated triglycerides, 31.5% with elevated LDL-C and 26.6% with elevated VLDL-C and there was a significant association between the above said parameters and NAFLD. About 40 % of NAFLD patients had low HDL-C levels which was not statistically significant.

On studying glycemic status among NAFLD patients, 33.3% had impaired fasting glucose and 28% had diabetes. There was a significant association between fasting plasma glucose and NAFLD with P-value of < 0.001. About 28.1% of patients with NAFLD had impaired level of HbA1c values and 25.6% had diabetic values of HbA1c.

Patients who were diagnosed with NAFLD underwent transient elastography for staging the disease. About 80% of NAFLD patients were at the stage of F0-F1 (Fatty Liver), 17.3% were at F2 stage (NASH) and 2.7 % were at F3 Stage (Fibrosis). There was a significant association between disease progression and the glycemic status. Higher prevalence of disease progression was observed among patients who had higher HbA1c values.

Conclusion:-

The Prevalence of NAFLD in the study population was 18.8%. The prevalence of NAFLD was higher among males.

Age, BMI and co-morbidities like diabetes and hypertension were significantly associated with NAFLD. A significant association between NAFLD and total cholesterol, triglycerides, LDL-C, VLDL-C & fasting glucose was observed. There was a significant association between disease progression and glucose intolerance. From this study, it is suggested that diabetic patients should be screened for NAFLD and vice versa for early diagnosis and treatment, so that we can prevent further complications like end stage liver disease.

Limitations

1. This was a hospital-based study. Hence the prevalence found out may not be reflective of the true prevalence in the community.
2. Diagnosis of NAFLD was based on ultrasonogram which may underestimate the prevalence.
3. Hepatitis infections were not ruled out by laboratory investigations.

Declarations
Funding:
Nil.

Conflict of interest:
Nil.

Ethical Approval:
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