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Prospective cross-sectional study on role of lipid profile in assessment of severity of liver cirrhosis

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SUMMARY

Introduction

Cirrhosis has been reported to cause alterations in the lipoproteins structure and transfer through the blood, which leads to alterations to the serum lipid levels. Due to the high prevalence of chronic liver disease in India, the present study was conducted to find out the role of lipid profile in assessing the severity of liver cirrhosis.

Materials and methods

The present hospital based observational study with a cross sectional design was conducted at the department of General Medicine, Tirath Ram Shah General Hospital (TRSCH), New Delhi, with the objectives of assessing the lipid profile in patients with liver cirrhosis and finding the correlation of lipid levels with the severity of cirrhosis.The study was conducted among a sample of 72 consecutive patients, 18 years and above, with diagnosed cirrhosis attending the out/in patient departments of TRSCH. Data were collected in predesigned and pre tested proforma, without personal identifiers, and transferred to MS Excel for data cleaning, following which the data was analysed using IBM SPSS (Version 22).

Results

Most study participants were males (84.77%), between 50-59 years (36.1%) of age with a mean age of 47.1 years.Ascites was present in 23.6%, UGI bleeding in 23.6%, hepatic encephalopathy and Spontaneous Bacterial peritonitis in 22.2%, hepatorenal syndrome in 7% and hepatopulmonary syndrome in 2.8% of the patients included in the present study.Alcohol was the commonest (68.1%) aetiology of cirrhosis followed by NASH and unknown causes (6.9%), chronic hepatitis B infection (5.6%) and cryptogenic causes (4.2%). Other causes made up 8.3% of the study population. Severity of liver damage was assessed by the Child Pugh and MELD scores. According to the Child-Pugh score, the maximum patients in the study population belonged to the B category (37.5%), followed by category A (36.1%) and category C (26.4%). The in-hospital outcome of the present episode death in 6.9% of the patients.The median cholesterol, triglycerides, LDL, VLDL and HDL levels were highest in category A, followed by B and C. The median lipid values were similar based on the MELD scores.Significant decreases in all the lipid parameters can be seen with Child_pugh scores indicating hepatic damage. Significant decreases in all serum lipid parameters are also seen with increasing MELD score signifying greater liver damage. Significant negative correlations are marked between the MELD scores and the lipid parameters.

Conclusion

Significant changes were found in the lipid profile of patients with cirrhosis in the present study. There is significant reduction in levels of all lipid profile parameters like serum total cholesterol, LDL, VLDL, TG and HDL in patients with cirrhosis as the severity increases. Lipid profile monitoring is not a part of the routine management of such patients. However, with new evidence that lipid profile varies with the severity of liver disease, it should be considered in the management of such patients.

I. INTRODUCTION

Liver plays an essential role in lipid metabolism, several stages of lipid synthesis and transportation. Lipids are one of the necessary components which control cellular functions and homeostasis and liver is an important site for lipid metabolism. synthesis of lipoproteins predominantly occurs in the liver.**Error! Bookmark not defined.** Lipoproteins are large macromolecular complexes that transport hydrophobic lipids which consist of Triacylglycerol, Phospholipids, Cholesterol and Cholesteryl esters through body fluids. The Chylomicron is derived from intestinal absorption of TG and other lipids. The VLDL is derived from the liver for the export of TG. LDL represents the final stage in the catabolism of VLDL, whereas HDL is involved in cholesterol transport. TG is the

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predominant lipid in Chylomicron and VLDL, whereas Cholesterol and Phospholipids are the predominant lipids in LDL and HDL respectively. Approximately 70% of circulating LDL is cleared by LDL receptor mediated endocytosis in the liver.

Cirrhosis is the end result of a variety of liver diseases characterised by fibrosis and architectural distortion of the liver with the formation of regenerative nodules and can have varied clinical manifestation and complication. Multiple etiological factors contribute to the development of cirrhosis. Non-alcoholic fatty liver disease (NAFLD)is the most common cause was the commonest cause of chronic liver disease in the United States, as well as worldwide.The global prevalence of NAFLD is estimated to be as high as on billion. In the Unites States, NAFLD is estimated to affect between 80 and 100 million individuals. Other common causes are Chronic hepatitis B and hepatitis C viruses, regular(moderate) alcohol consumption in Alcoholic cirrhosis, Primary biliary cirrhosis, Primary sclerosing cholangitis and Budd-Chiari syndrome. The older age, obesity, insulin resistance/ type 2 diabetes, hypertension and hyperlipidaemia in NASH. Clinically cirrhosis is considered to progress through three stages that correlates with thickness of fibrous septa, compensated with varices and decompensated-ascites, variceal bleeding, encephalopathy, jaundice. Worldwide, cirrhosis is the 14th most common cause of death, but in Europe, it is the 4th most common cause of death. Many patients die from the disease in their fifth or sixth decade of life.**Error! Bookmark not defined.** According to Global Burden of Diseases 2017 on the burden of cirrhosis and its trend since 1990, death due to cirrhosis constituted 2.4% of total death globally in 2017 as compared with 1.9% in 1990.

Various hepatic parenchymal diseases result in alterations in the lipoproteins structure and transfer through the blood, which leads to low levels of triglycerides (TG) and cholesterol as observed in chronic liver disease. Decreased plasma levels of cholesterol from decreased synthesis and metabolism of cholesterol, are noted in chronic liver disease as the majority of endogenous cholesterol is synthesized in the hepatic microsomes. With further damage to the liver as in cirrhosis, severe metabolic impairment produces a worsening of the serum lipoprotein pattern. High-density lipoprotein (HDL) cholesterol and its major apolipoproteins have been shown to be reduced in cirrhosis, as also the serum levels of low-density lipoprotein (LDL) cholesterol.

Child Turcotte Pugh score (CTP) is used to assess the severity and prognosis of chronic liver disease, although it was originally used to predict the mortality during surgery now used to determine the necessity of liver transplantation along with MELD (Model for end stage Liver Disease) and MELD-Na score.

Due to the high prevalence of chronic liver disease in India, the present study was conducted to find out the role of lipid profile in assessing the severity of liver cirrhosis.

Objectives

1. To assess the lipid profile in patients with liver cirrhosis
2. To correlate with the severity of cirrhosis.

II. MATERIAL & METHODS

Study type and design

The present study was a hospital based observational study with a cross sectional design.

Study setting

The study was conducted at the department of General Medicine, Tirath Ram Shah General Hospital, a multi super speciality hospital in Delhi**. Inaugurated in 1955, i**t is a 200 bedded hospital with post graduate medical courses in medicine and other specialities.

Study period

The study was conducted between November 2020 to June 2022.

Study population

Patients diagnosed as cirrhosis attending the Inpatient (IPD) or outpatient (OPD) departments of General Medicine of TRSCH during the study period were included in the present study.

Inclusion criteria:

All consenting patients with age above 18 years diagnosed as a case of liver cirrhosis established by history, general examination, biochemical parameters, ultrasound of liver, CT abdomen and Upper GI endoscopy.

Exclusion criteria:

1. Patients taking lipid lowering agents
2. People living with HIV. Glucose tolerance abnormalities

Sample size:

The sample size was calculated based on the following assumptions

- Estimated number of OPD+ IPD attendees with cirrhosis (annual)-3000

- Hypothesized % frequency of outcome factor in the population (p)-5% ±5
- Confidence limits as % of 100(absolute +/-%) (d)-5%
- Confidence Level-95%
- Total Sample Size-72

Sampling technique:

Consecutive patients attending the OPD and getting admitted at the IPD were explained about the topic in detail. All consenting patients were included in the study if they fulfilled the inclusion criteria. If any patient meets exclusion criteria, then the next patient with cirrhosis was selected.

Study tools and techniques

The study tools in the present study were
1) Case record proforma,
2) Hematologic investigations along with Lipid profile profile,

Variables used in the study

- Variables related to sociodemographic characteristics
  - Age
  - Sex
  - Occupation
  - Socioeconomic status
- Variables related to clinical signs and symptoms
  - Ascites
  - Upper GI bleeding
  - Encephalopathy
  - Spontaneous Bacterial Peritonitis (SBP)
  - Hepatorenal Syndrome
  - Hepatopulmonary syndrome
  - Etiology
- Variables related to clinical severity of disease
  - Child-Pugh scores
  - MELD scores
- Variables related to lipid profile
  - Total cholesterol
  - Total Triglycerides
  - LDL
  - VLDL
  - HDL
- Outcome

Operational definitions

Cirrhosis: The following patients were considered as having cirrhosis in the present study

- Patient with history of CLD with gastro-oesophageal varices, ascites or hepatic encephalopathy
- CLD patients without above mentioned complications, with physical finding of an enlarged left hepatic lobe with splenomegaly along with cutaneous stigmata of liver disease suggest cirrhosis especially in the setting of thrombocytopenia and impaired hepatic synthetic function. (e.g.hypoalbuminemia, increased PT/INR)
- In the absence of physical and laboratory parameters suggestive of cirrhosis, patients displaying the following on imaging study (small nodular liver with splenomegaly and intra abdominal collaterals and presence of ascites) were included as cirrhosis.
- Patients with a serum AST/ Platelet ratio index (APRI) of greater than 2 were also included as cirrhosis.

Hepato-renal syndrome: Rapid onset renal failure in a patient with cirrhosis

Hepato-pulmonary Syndrome: Development of shortness of breath and hypoxemia (low oxygen levels in the blood of the arteries of patients with cirrhosis.

Data collection methods

Patients attending in the OPD of General Medicine during the study period were subjected to undergo detailed history and general physical and systemic clinical examination. Patients who were diagnosed as having cirrhosis of the liver, were asked to participate in the study after informed consent. Blood samples were collected from consenting cirrhotics for analysis of Lipid profile parameters total cholesterol, triglyceride, LDL, VLDL and HDL. Data was recorded in a preformed case recording format.

III. STATISTICAL ANALYSIS

All data were entered into Microsoft Excel (Microsoft Inc) and double checked for correct entries. In this study, continuous variables will be represented in the form of mean ± standard deviation (SD) and categorical variables were expressed in the form of frequencies (percentage). In accordance with the objectives of the study, appropriate univariate, and bivariate statistical analysis were performed. The analysis included a detailed tabulation of the outcomes observed in the study sample. Descriptive summaries are presented, and Chi- square tests were used to assess differences between proportions. Continuous variables were compared using the student t test. P value. A P value of <0.05 was considered statistically significant. All analyses were

conducted using SPSS V.21.0. (SPSS Inc., Chicago, IL, USA).

Ethical considerations

Informed written consent will be obtained from each and every participant as per modified ICMR template. Confidentiality will be ensured while collecting and analysing the data and will be used for research purposes only. Application will be placed before the Institutional Ethics Committee of TRSCH for approval.

IV. RESULTS

Table 4: Distribution of study population based on Age groups (n=72)

Age groups (years)	Frequency	Percent
20-29	5	6.9
30-39	11	15.3
40-49	21	29.2
50-59	26	36.1
60-69	9	12.5
Total	72	100.0

Table 5: Descriptives of age in the study population (n=72)

Variable	Minimum	Maximum	Mean	Standard deviation
Age (years)	20	65	47.1	10.1

The most common age group in the study population was 50-59 years (36.1%) followed by 40-49 years (29.2%). The least common age group was 20-29 years (6.9%). The mean age of the study population was 47.1 years with a standard deviation of 10.1 years. The minimum age of the study participants was 20 years while the maximum age was 65 years.

Table 6: Distribution of study population based on sex (n=72)

Sex	Frequency	Percent
Female	11	15.3
Male	61	84.7
Total	72	100.0

Males comprised 84.7% while females comprised 15.3 % of the study population.

Table 7: Distribution of study population based on the presence of ascites (n=72)

Ascites	Frequency	Percent
Present	55	76.4
Absent	17	23.6

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Total	72	100.0

Ascites was present in 23.6% of the patients included in the present study.

Table 8: Distribution of study population based on upper gastro-intestinal bleeding (n=72)

UGI bleeding	Frequency	Percent
Present	20	27.8
Absent	52	72.2
Total	72	100.0

Upper gastrointestinal bleeding was present in 23.6% of the patients included in the present study

Table 9: Distribution of study population based on presence of encephalopathy (n=72)

Encephalopathy	Frequency	Percent
Present	16	22.2
Absent	56	77.8
Total	72	100.0

Hepatic encephalopathy was present in 22.2% of the study population.

Table 10: Distribution of study population based on presence of SBP (n=72)

SBP	Frequency	Percent
Present	11	15.3
Absent	61	84.7
Total	72	100.0

Spontaneous Bacterial Peritonitis (SBP) was present in 22.2% of the study population.

Table 11: Distribution of study population based on the presence of hepatorenal syndrome (n=72)

Hepatorenal syndrome	Frequency	Percent
Present	7	9.7
Absent	65	90.3
Total	72	100.0

Hepato-renal syndrome encephalopathy was present in 7% of the study population.

Table 12: Distribution of study population based on the presence of hepatopulmonary syndrome (n=72)

Hepatopulmonary syndrome	Frequency	Percent
Present	2	2.8

Absent	70	97.2
Total	72	100.0

Hepato-pulmonary syndrome was present in 2.8% of the study population.

Table13: Distribution of study population based on the Child-Pugh score

Child_pugh score	Frequency	Percent
A	26	36.1
B	27	37.5
C	19	26.4
Total	72	100.0

According to the Child-Pugh score, the maximum patients in the study population belonged to the B category (37.5%), followed by category A (36.1%) and category C (26.4%)

Table 14: Distribution of study population based on the MELD score (n=72)

MELD score	Frequency	Percent
<10	2	2.8
11-18	9	12.5
19-24	20	27.8
>24	41	56.9
Total	72	100.0

In the present study 56.9% of the study population had a MELD score greater than 24, 27.8% had a score between 19 -24, 12.5 had a score between 11-18 while 2.8% had a score less than 10.

Table 15: Descriptives of MELD scores in the study population (n=72)

Variable	Minimum	Maximum	Mean	Standard deviation
MELD score	5	48	26.5	8.7

The mean MELD score of the study population was 26.5 with a standard deviation of 8.7 years. the minimum score of the study participants was 5 years while the maximum age was 48.

Table 16: Distribution of study population based on the aetiology of cirrhosis (n=72)

Aetiology of cirrhosis	Frequency	Percent
Alcohol	49	68.1
Cryptogenic	3	4.2
Hepatitis B	4	5.6
Non-alcoholic steatohepatitis (NASH)	5	6.9

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Others	6	8.3
Unknown	5	6.9
Total	72	100

Others include auto-immune hepatitis, Budd-chiari syndrome, Extra Hepatic Portal Vein Obstruction, hepatocellular carcinoma, Primary Biliary Cirrhosis and Wilson's disease.

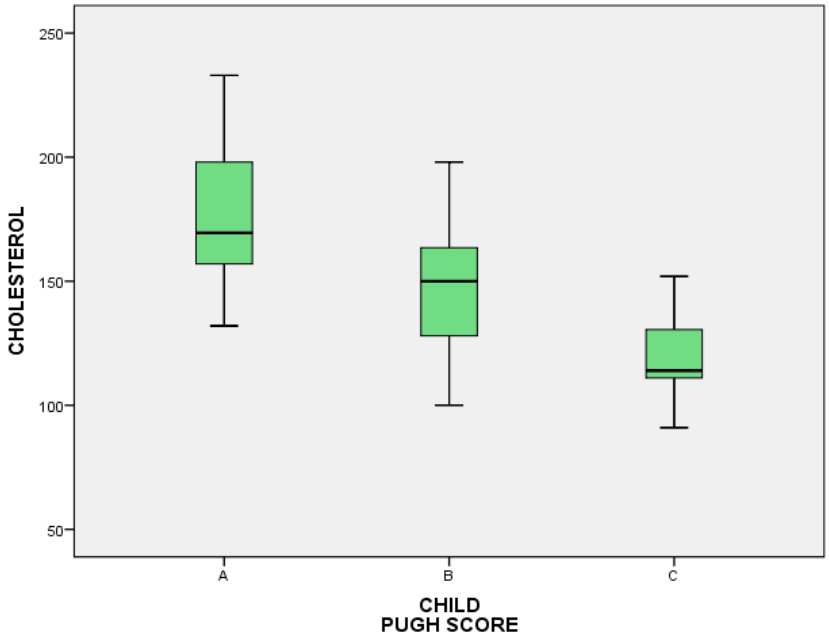
Alcohol was the commonest (68.1%) aetiology of cirrhosis for patents in the study population, followed by NASH and unknown causes (6.9%), chronic hepatitis B infection (5.6%) and cryptogenic causes (4.2%). Other causes made up 8.3% of the study population.

Table 17: Distribution of study population based on the treatment outcome (n=72)

Treatment outcome	Frequency	Percent
Death	3	4.2
Discharge	69	95.8
Total	72	100.0

The in-hospital outcome of the present episode death in 6.9% of the patients and discharge of 93.1% of the study population.

Figure 6: Box and whisker plot showing Total cholesterol levels based on Child Pugh score



The box and whisker plot shows the cholesterol levels of the study population based on Child Pugh score. It is evident that the median total cholesterol scores are highest in category A, followed by B and C.

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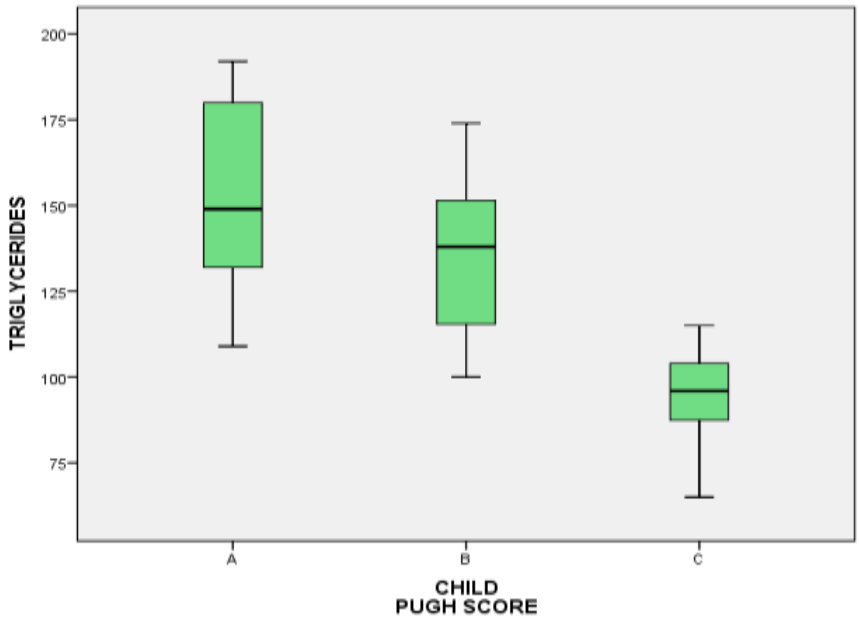
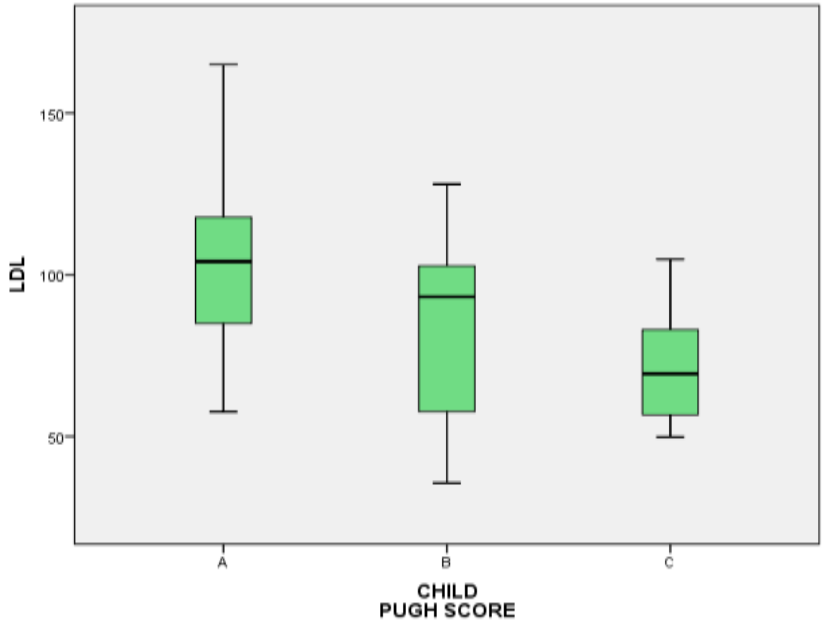
Figure 7: Box and whisker plot showing Triglycerides levels on child Pugh score



The box and whisker plot shows the triglycerides levels of the study population based on Child Pugh score. It is evident that the medical total cholesterol scores are highest in category A, followed by B and C.

Figure 8: Box and whisker plot showing LDL levels on child Pugh score



The box and whisker plot shows the LDL levels of the study population based on Child Pugh score. It is evident that the median total cholesterol scores are highest in category A, followed by B and C.

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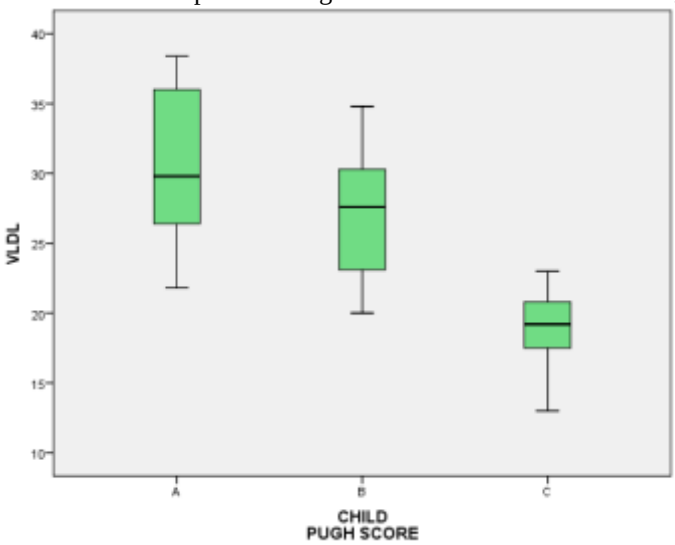
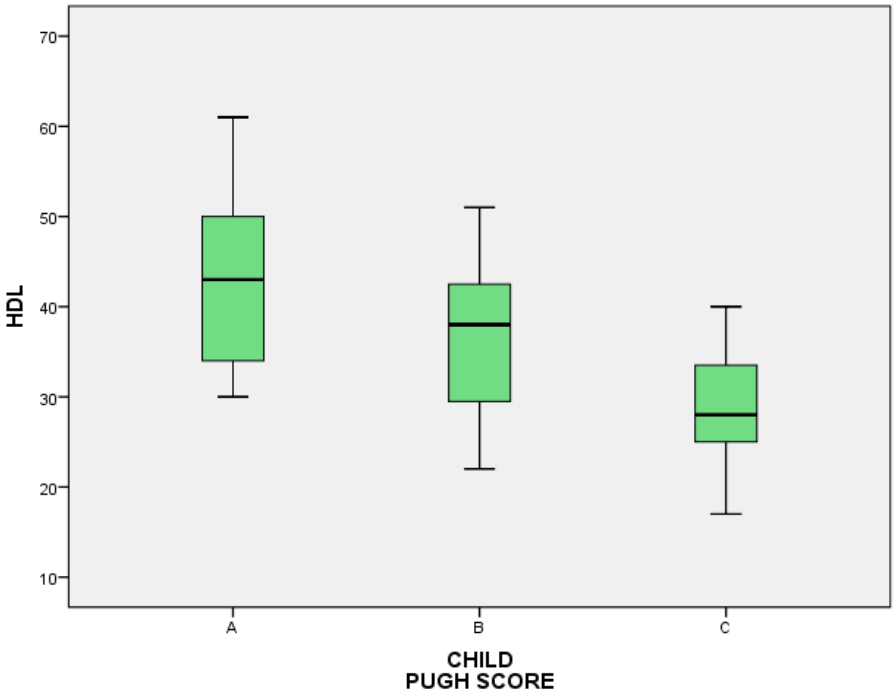
Figure 9: Box and whisker plot showing VLDL levels based on child Pugh score



The box and whisker plot shows the VLDL levels of the study population based on Child Pugh score. It is evident that the medical total cholesterol scores are highest in category A, followed by B and C.

Figure 10: Box and whisker plot showing HDL levels based on child Pugh score



The box and whisker plot shows the HDL levels of the study population based on Child Pugh score. It is evident that the median total cholesterol scores are highest in category A, followed by B and C.

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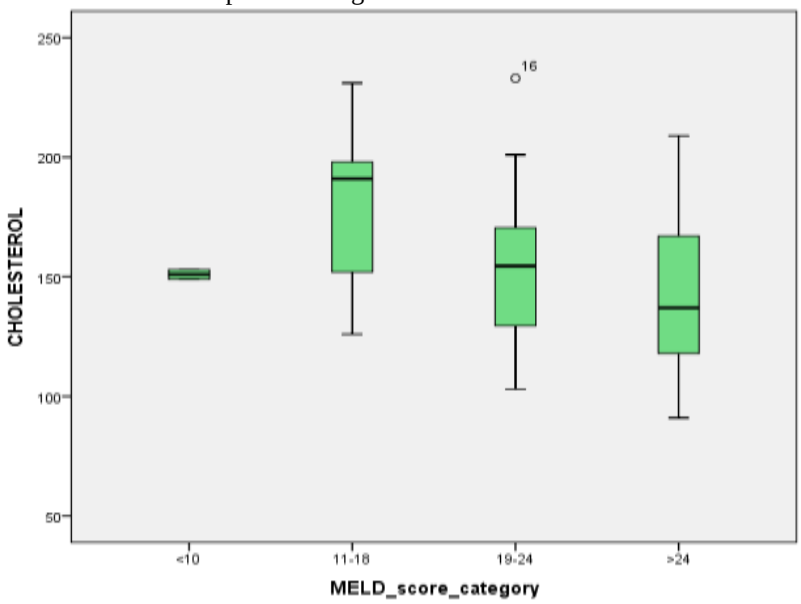
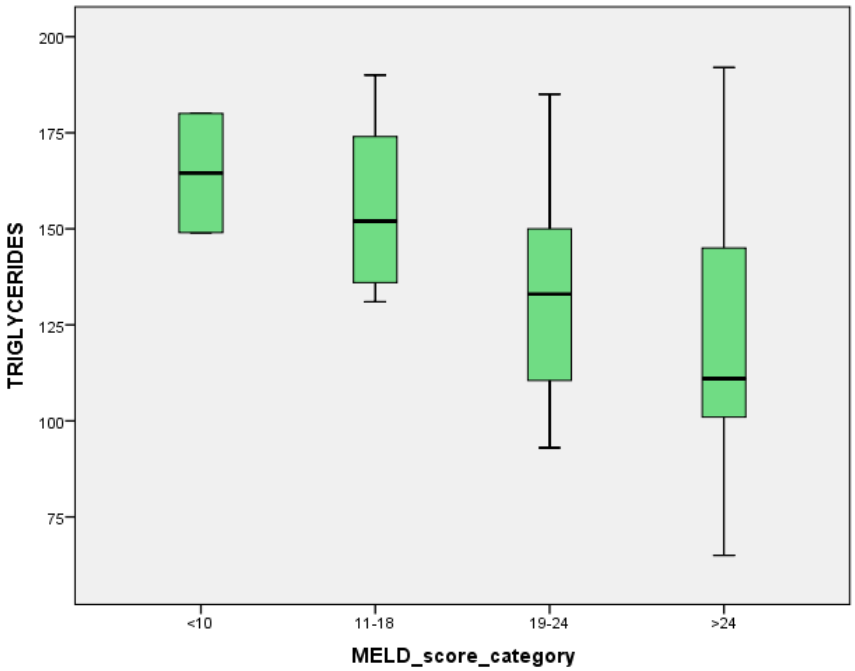
Figure 11: Box and whisker plot showing Total cholesterol levels based on MELD score



The box and whisker plot shows the Cholesterol levels of the study population based on the MELD score.

Figure 12: Box and whisker plot showing Triglyceride levels on MELD score



The box and whisker plot shows the Triglycerides levels of the study population based on the MELD score.

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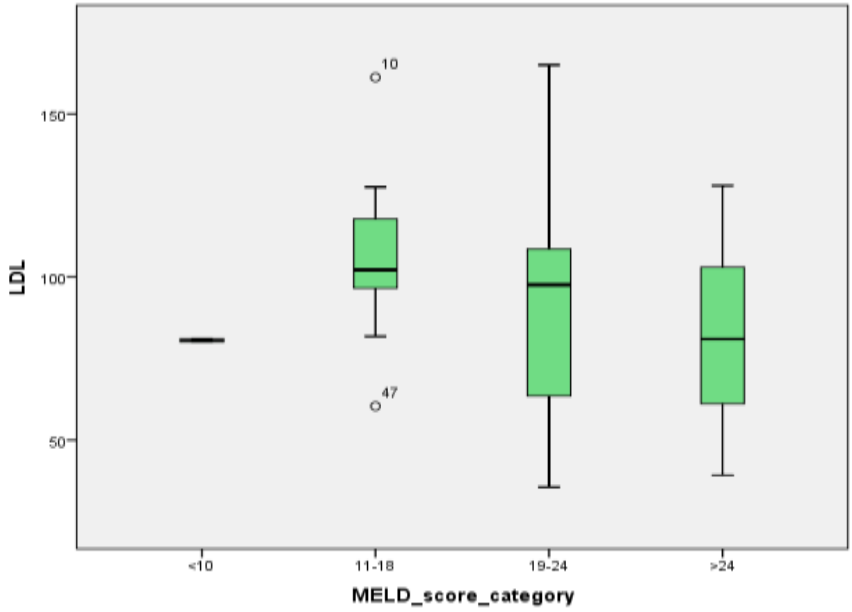
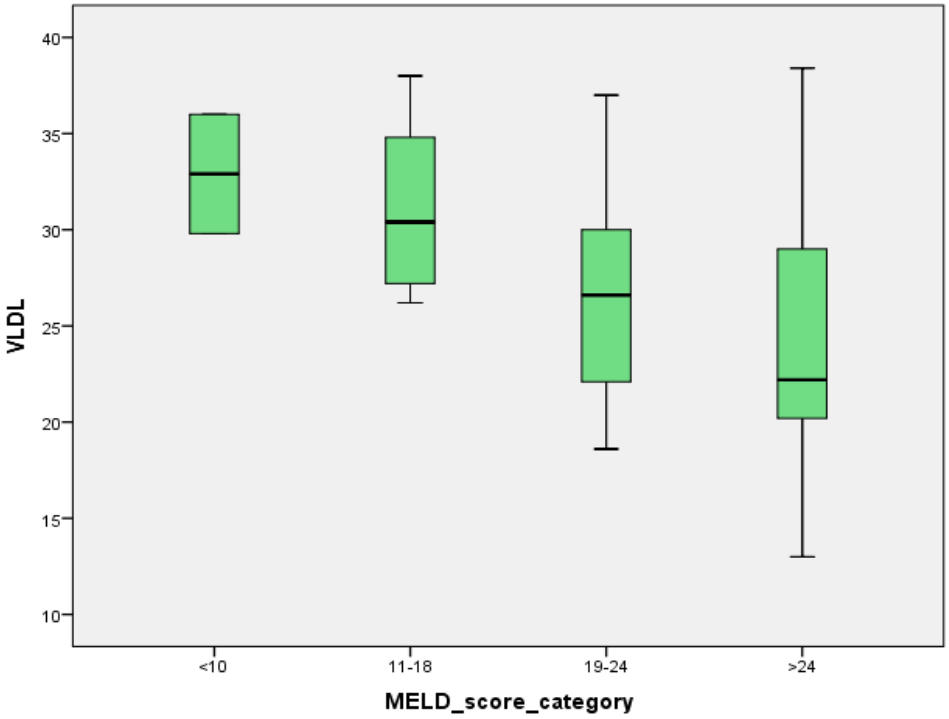
Figure 13: Box and whisker plot showing LDL levels on MELD score



The box and whisker plot shows the LDL levels of the study population based on the MELD score.

Figure 14: Box and whisker plot showing VLDL levels based on MELD score



The box and whisker plot shows the VLDL levels of the study population based on the MELD score.

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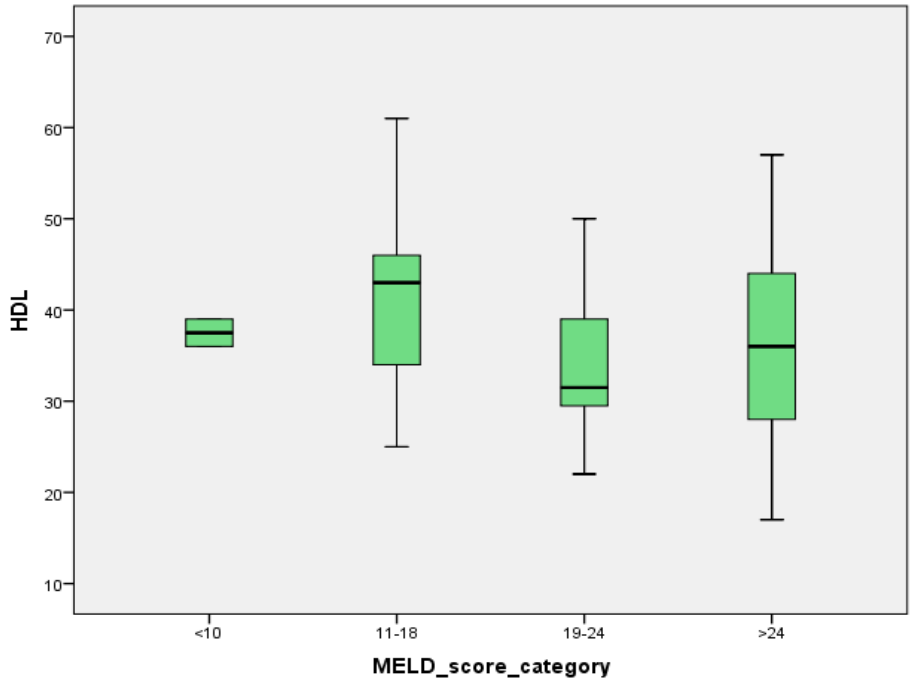
Figure 15: Box and whisker plot showing HDL levels based on MELD score



The box and whisker plot shows the HDL levels of the study population based on the MELD score.

Table 18: Association of mean lipid values with child Pugh score of the study population

Variable	Child-Pugh Score			p value
	A (n=26)	B (n=27)	C (n=19)	
Cholesterol (mg/dl)	175.9 ± 27.2	146.7 ± 26.1	120.1 ± 16.4	0.000*
Triglycerides (mg/dl)	151.9 ± 26.3	134.7 ± 21.6	94.7 ± 12.2	0.000*
LDL (mg/dl)	102.6 ± 26.9	82.7 ± 27.8	72.5 ± 17.4	0.000*
VLDL (mg/dl)	30.4 ± 5.3	26.9 ± 4.3	19 ± 2.4	0.000*
HDL (mg/dl)	42.9 ± 9.3	37 ± 8.4	28.6 ± 6	0.000*

*Statistically significant

The mean cholesterol levels were 175.9 ± 27.2 mg/dl, 146.7 ± 26.1 mg/dl and 120.1 ± 16.4 mg/dl in groups A, B and C respectively. The mean cholesterol levels are significantly lower in Child Pugh score C compared to Group A and Group B.

The mean triglycerides levels were 151.9 ± 26.3 mg/dl, 134.7 ± 21.6 mg/dl and 94.7 ± 12.2 mg/dl in groups A, B and C respectively. The mean triglyceride levels were significantly lower in Child Pugh score C compared to Group A and Group B.

The mean LDL levels were 102.6 ± 26.9 mg/dl, 82.7 ± 27.8 mg/dl and 72.5 ± 17.4 mg/dl in groups A, B and C respectively. The mean LDL levels were significantly lower in Child Pugh score C compared to Group A and Group B.

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The mean VLDL levels were 30.4 ± 5.3 mg/dl, 26.9 ± 4.3 mg/dl and 19 ± 2.4 mg/dl in groups A, B and C respectively. The mean VLDL levels were significantly lower in Child Pugh score C compared to Group A and Group B.

The mean HDL levels were 42.9 ± 9.3 mg/dl, 37 ± 8.4 mg/dl and 28.6 ± 6 mg/dl in groups A, B and C respectively. The mean HDL levels were significantly lower in Child Pugh score C compared to Group A and Group B.

Table 19: Association of mean lipid values with MELD score of the study population (n=72)

Variable	Child-Pugh Score				p value
	<10 (n=2)	11-18 (n=9)	19-24 (n=20)	>24 (n=41)	
Cholesterol (mg/dl)	151 ± 2.8	180.9 ± 32.3	152.9 ± 33.9	142.1 ± 29.5	0.012*
Triglycerides (mg/dl)	164.5 ± 21.9	154.8 ± 22.6	131.3 ± 25.3	122.8 ± 32.4	0.013*
LDL (mg/dl)	80.6 ± 0.6	106.7 ± 28.4	92.1 ± 31.7	80.8 ± 24.1	0.058
VLDL (mg/dl)	32.9 ± 4.4	31.0 ± 4.5	26.3 ± 5.1	24.6 ± 6.5	0.013*
HDL (mg/dl)	37.5 ± 2.1	43.2 ± 11.7	34.5 ± 8	36.7 ± 10.2	0.181

*Statistically significant

The mean cholesterol levels were 151 ± 2.8 mg/dl, 180.9 ± 32.3 mg/dl, 152.9 ± 33.9 mg/dl and 142.1 ± 29.5 mg/dl in groups <10, 11-18, 19-24 and >24 groups. The mean cholesterol levels are significantly lower with increasing MELD scores.

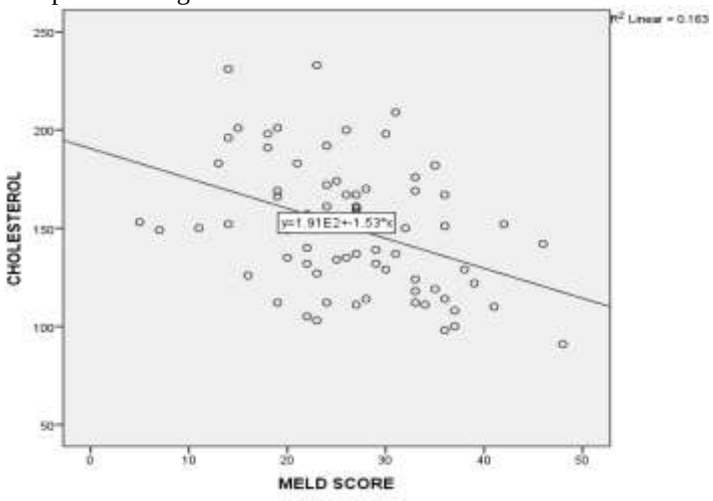
The mean triglyceride levels were 164.5 ± 21.9 mg/dl, 154.8 ± 22.6 mg/dl, 131.3 ± 25.3 mg/dl and 122.8 ± 32.4 mg/dl in groups <10, 11-18, 19-24 and >24 groups. The mean triglyceride levels are significantly lower with increasing MELD scores.

The mean LDL levels were 80.6 ± 0.6 mg/dl, 106.7 ± 28.4 mg/dl, 92.1 ± 31.7 mg/dl and 80.8 ± 24.1in groups <10, 11-18, 19-24 and >24 groups. The mean LDL levels were not significantly different with increasing MELD scores.

The mean VLDL levels were 32.9 ± 4.4 mg/dl, 31.0 ± 4.5 mg/dl, 26.3 ± 5.1 mg/dl and 72.5 ± 17.4 mg/dl in groups <10, 11-18, 19-24 and >24 groups. The mean 24.6 ± 6.5LDL levels were significantly lower with increasing MELD scores.

The mean HDL levels were 37.5 ± 2.1 mg/dl, 43.2 ± 11.7 mg/dl, 34.5 ± 8 mg/dl and 36.7 ± 10.2 mg/dl in groups <10, 11-18, 19-24 and >24 groups. The mean HDL levels were not significantly different with increasing MELD scores.

Figure 16: Scatter plot showing the correlation between MELD score and Cholesterol values



The scatter plot shows a weak negative correlation (r= -0.40, p=0.000) correlation between cholesterol levels and MELD score. This means that there is a decrease in the cholesterol levels with progressive deterioration of the liver function. The correlation is, however, statistically significant.

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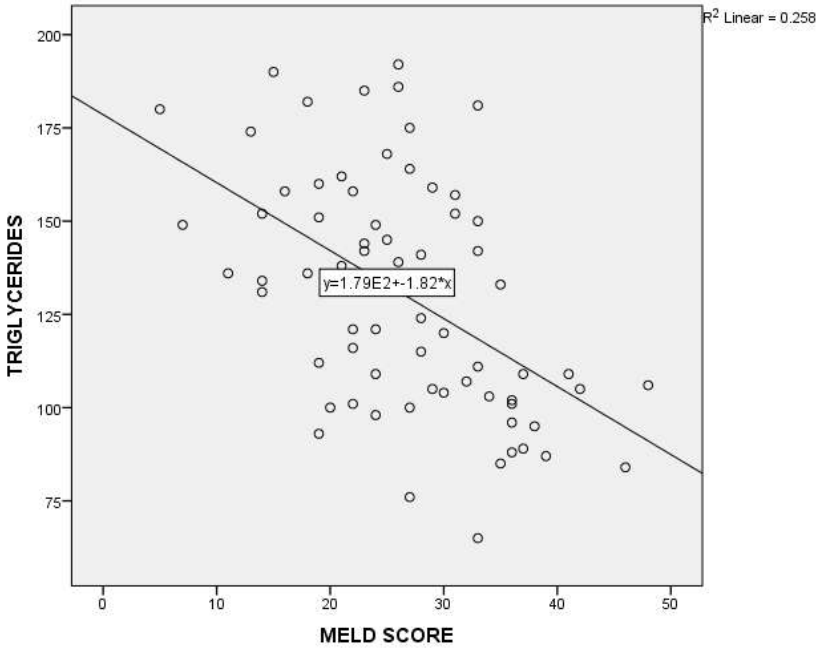
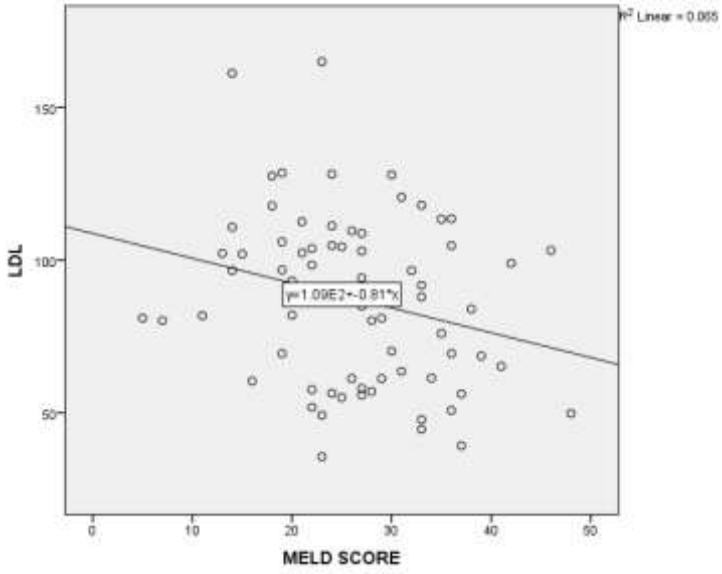
Figure 17: Correlation between MELD score and Triglyceride values



The scatter plot shows a moderate negative correlation (r= -0.50, p=0.000) correlation between triglyceride levels and MELD score. This means that there is a decrease in the triglyceride levels with progressive deterioration of the liver function. The correlation is, however, statistically significant.

Figure 18: Correlation between MELD score and LDL values



The scatter plot shows a weak negative correlation (r= - .25, p=0.031) correlation between LDL levels and MELD score. This means that there is a decrease in the LDL levels with progressive deterioration of the liver function. The correlation is, however, statistically significant.

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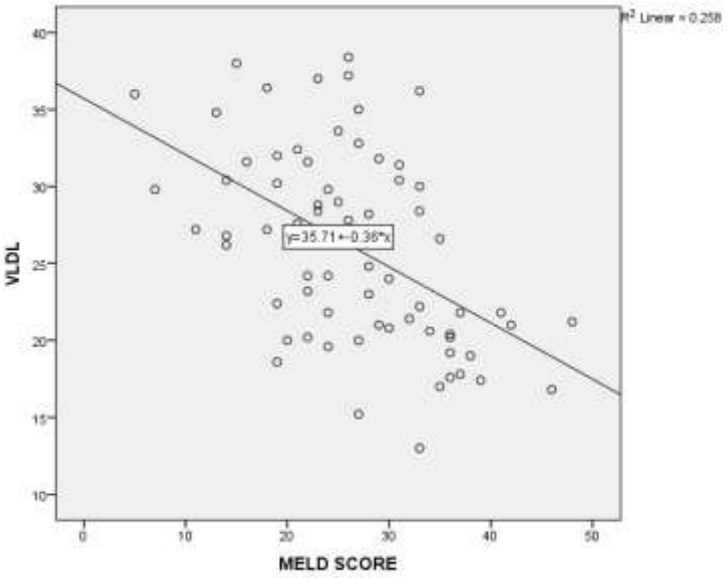
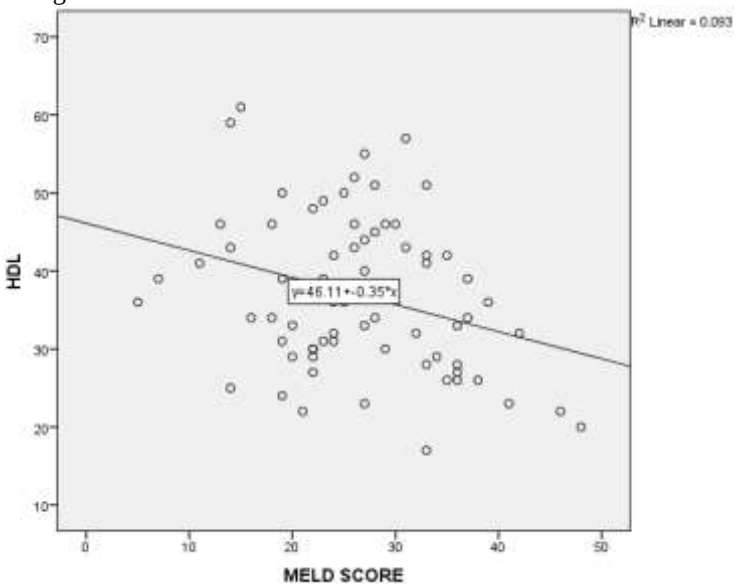
Figure 19: Correlation between MELD score and VLDL values



The scatter plot shows a moderate negative correlation (r= -0.50, p=0.000) correlation between VLDL levels and MELD score. This means that there is a decrease in the VLDL levels with progressive deterioration of the liver function. The correlation is, however, statistically significant.

Figure 20: Correlation between MELD score and HDL values



The scatter plot shows a moderate negative correlation (r= -0.30, p=0.000) correlation between HDL levels and MELD score. This means that there is a decrease in the HDL levels with progressive deterioration of the liver function. The correlation is, however, statistically significant.

V. DISCUSSION

Liver injury persisting six months or more is a manifestation of CLD, which can be caused by infection, inflammation, toxic, or congenital predisposition. Dyslipidemia is one of the systemic effects produced by CLD. Liver impairment causes disturbed protein anabolism, excretion of bilirubin, and lipid metabolism. Such patients should be managed to improve liver metabolism. Lipid

profile monitoring is not a part of the routine management, however, recent studies showed that lipid profile varies with the severity of disease and should be considered in the management of such patients.

Patients with cirrhosis of the liver have shown low levels of HDL apolipoproteins, lipoproteins and activities of hepatic lipase and lecithin cholesterol acyl transference in their plasma. This results in a significant decline in the serum total cholesterol and TG levels that has been confirmed earlier in other studies.**Error! Bookmark not defined.**Decreased levels of VLDL, total cholesterol, HDL-cholesterol were found in these patients and Intermediate density lipoproteins were not detectable.**Error! Bookmark not defined.** The present study showed that patients with cirrhosis had lower lipid levels (total cholesterol, TG, LDL, VLDL and HDL) with increasing liver damage (as measured by Child Pugh and MELD scores).

The most common age group in the study population was 40-59 years (65.3%). The mean age (sd) of the study population was 47.1 (10.1) years. The minimum age of the study participants was 20 years while the maximum age was 65 years. In the study by Yamuna J, on a similar cohort of patients, mean age of the participants was 47.3 years with the standard deviation of 9.1 years, which ranged from 20-65 years. Most participants were in the age range of 40-60 years of age, a finding similar to the present study. In their study on 74 cirrhosis patients in Kanpur, Singh M et al,**Error! Bookmark not defined.** reported that the mean age of patients was 48.27 ± 11.12 years. The lowest age was 30 years and highest was 72 years. Most of the patients were in 40-60 years of age group, also similar to the present study. Another study from Pakistan reported a mean age of 39.65 ± 12.45 years, in their study cohort of cirrhotics.**Error! Bookmark not defined.** The mean age of cirrhotics, recruited from 11 tertiary care centres throughout India, showed a mean age of 43 years and a male proportion of 75%.**Error! Bookmark not defined.** Cirrhosis is believed to occur much less frequently in young adults than in older patients. Cirrhosis can occur at any age and often causes prolonged morbidity. A number of reports from the West and Japan, it was found that less than 5% of cirrhosis was under 30-35 years of age.**Error! Bookmark not defined.** Males were 59.7% of the study population, again similar to the sex distribution reported by Yamuna J, who reported 76% males and Singh M et al who reported 75.6% males.**Error! Bookmark not defined.**,**Error! Bookmark not defined.**.

Cirrhosis and its complications represent the end in the spectrum of chronic liver diseases with encephalopathy, varices, and peritonitis complications. In their study from Nepal, Maskey et al reported that the commonest signs were ascites (100%), similar to the present study, followed by icterus.**Error! Bookmark not defined.** Hepatic encephalopathy and Spontaneous Bacterial Peritonitis (SBP) were seen in 22.2% of the study population, slightly higher than the 19% reported by Yamuna J in her study on 120 patients with cirrhosis from a tertiary care hospital in Coimbatore.**Error! Bookmark not defined.** Upper gastrointestinal bleeding (23.6%), and hepato-renal syndrome (7%) were lower than the 29%, 11% reported by Yamuna J. A slightly higher proportion (11%) was reported by Yamuna J.**Error! Bookmark not defined.** Hepatopulmonary syndrome was reported in 2.8% of the present and 2% of the cohort studied by Yamuna J.**Error! Bookmark not defined.**

The **Child–Pugh score** and MELD scores are used to assess the prognosis of chronic liver disease, mainly cirrhosis. Based on the Child-Pugh score, the maximum number of patients in the present study cohort belonged to the B category (37.5%), followed by category A (36.1%) and category C (26.4%). Yamuna J, in her study, divided 120 patients with cirrhosis under category A (36.7%), category B (41.7%) and category C (21.7%), similar to the proportion of patients in the present study.**Error! Bookmark not defined.** In the present study, 56.9% of the study population had a MELD score greater than 24, 27.8% had a score between 19 -24, 12.5 had a score between 11-18 while 2.8% had a score less than 10, the mean being 26.5 with a standard deviation of 8.7. The minimum score of the study participants was 5 while the maximum score was 48. Yamuna et al reported a MELD score of 26.1 with the SD of 8.4, with a range of 10-50.**Error! Bookmark not defined.**

A prospective, multicentric study to delineate the aetiology and clinical profile of chronic liver from different parts of India reported that alcoholism (34.3%) was the commonest cause of cirrhosis in India.**Error! Bookmark not defined.** In the present study also the commonest cause of cirrhosis was alcohol (68.1%) although the percentage was much higher. This can be attributed to the regional differences in alcohol consumption. Higher proportion of patients with alcoholic

cirrhosis has been reported from South India in the study by Yamuna J.**Error! Bookmark not defined.** Another study from Nepal among cirrhotics attending outpatient and inpatient departments in a tertiary care centre in Nepal, 85.7% of the cases were attributed to alcohol.**Error! Bookmark not defined.** The other common causes of cirrhosis are NASH and cirrhosis of unknown causes (6.9%), chronic hepatitis B infection (5.6%) and cryptogenic causes (4.2%). Other causes made up 8.3% of the study population, findings similar to other studies. In the present episode, death occurred in 6.9% of the patients, a similar proportion (4.2%) to that reported by Yamuna J.**Error! Bookmark not defined.**

The mean cholesterol levels were 175.9 ± 27.2 mg/dl, 146.7 ± 26.1 mg/dl and 120.1 ± 16.4 mg/dl in groups A, B and C respectively. The mean cholesterol levels are significantly lower in Child Pugh score C compared to Group A and Group B. In her dissertation, Yamuna J reported that the cholesterol level was lowest in child pugh category C when compared to child pugh score B then to A, with the mean value of 176.9±12 in group A, 148.6 ±11.8 in group B and 121.4 ± 9.5 in group C. The differences were found to be statistically significant.**Error! Bookmark not defined.** Another study reported that serum cholesterol level in Child Pugh class A was 167.1±15.07, class B 141.30±20.33 and in class C134.67±14.93. serum cholesterol level decreases as severity of cirrhosis progresses.**Error! Bookmark not defined.**This decrease in cholesterol level with progression of cirrhosis was found statistically significant. In a similar study, it was found that the serum total cholesterol in cirrhotic patients was significantly lower than in healthy persons.**Error! Bookmark not defined.**,**Error! Bookmark not defined.**Significant decline was observed in total cholesterol levels in cirrhotic patients compared to controls in a study performed by Cicognanic.**Error! Bookmark not defined.** Several diseases may act as confounders to the hypocholesterolaemia, like malabsorption, malignancy hyperthyroidism, malnutrition and immunoglobulin disorders. Hence, the study excludes all such concomitant illness from inclusion in the sample.**Error! Bookmark not defined.**Cicognani C et al reported an obvious decline in total cholesterol level in patients with chronic liver disease in comparison with controls.**Error! Bookmark not defined.** Ghadir MR et al reported a significant difference between patients and a healthy matched normolipidemic comparison group in total cholesterol levels and a significant correlation between liver damage and total cholesterol levels.**Error! Bookmark not defined.**Abbas et al found that hypocholesterolemia was common in decompensated chronic liver disease and was significantly associated with the Child-Pugh class. As the severity of liver dysfunction increased the cholesterol levels decreased proportionately.

The mean serum triglycerides of the study population were 151.9 ± 26.3 mg/dl, 134.7 ± 21.6 mg/dl and 94.7 ± 12.2 mg/dl in Child Pugh groups A, B and C respectively. The mean triglyceride levels were significantly lower in Child Pugh score C compared to Group A and Group B. Yamuna J found triglyceride values to be statistically significant with mean value of 152+9 in group A, 130+8.6 in group B and 92.7+9.9 in group C, very similar to the present study.**Error! Bookmark not defined.** Significantly lower values of serum triglyceride were observed in cirrhotics as compared to non-cirrhotics, and with increasing hepatic damage as measured by the Child Pugh scores, in another study in Pakistan.**Error! Bookmark not defined.** In contrast, Singh et al, observed that serum triglyceride levels were non significantly elevated with progression of cirrhosis., while Ghadir et al reported that no correlation was observed between the serum TG level and the extent of liver damage, assessed either by the Child-Pugh or the MELD scores.**Error! Bookmark not defined.** Ghadir et al also did not find any correlation between serum Triglyceride levels and the extent of liver damage assessed by both the scores.**Error! Bookmark not defined.**

The mean LDL levels in the present study were 102.6 ± 26.9 mg/dl, 82.7 ± 27.8 mg/dl and 72.5 ± 17.4 mg/dl in Child Pugh groups A, B and C respectively, with LDL levels being significantly lower in Child Pugh score C compared to Group A and Group B. Mean values of 101.5+12.4 in group A, 86.6+10.9 in group B and 74+10.3 in group C, in LDL levels were found by Yamuna J and the differences between the groups were statistically significant.**Error! Bookmark not defined.** In the study by Singh et al, the authors found that serum LDL cholesterol in cirrhotic patients was significantly decreased as severity of cirrhosis increases. In a similar study, LDL cholesterol in cirrhotic patients was found to be significantly lower than in healthy controls.**Error! Bookmark not defined.**,**Error! Bookmark not defined.**

Variations in serum VLDL have been observed, with progression of liver damage, in the

study from Punjab, by Singh et al.**Error! Bookmark not defined.** However, the differences were not statistically significant. The findings of the study are in contrast to the present study and the study by Yamuna J which show a significant decrease in the VLDL levels with increasing hepatic damage.**Error! Bookmark not defined.**

In the present study, the mean HDL levels were significantly lower in Child Pugh score C compared to Group A and Group B, similar to the findings reported by Singh et al and Yamuna J.**Error! Bookmark not defined.** **Error! Bookmark not defined.** Thus, decreasing HDL levels suggest progression of cirrhosis.**Error! Bookmark not defined.** Significantly lower HDL levels were also detected in cirrhotics when compared to non-cirrhotics in some other studies.**Error! Bookmark not defined.** **Error! Bookmark not defined.**Jármay K et al, showed that with increasing hepatic parenchymal damage, there is a decrease in total cholesterol, HDL and LDL but not with TG levels. Salimoghlou observed in a study that HDL level is lower in Child-Pugh B than Child-Pugh A patients, indicating that it is the severity of liver function that causes HDL levels to decline.

Farooque et al reported that the mean serum values of total cholesterol (174.20±17.33 vs. 164.00±17.82 vs. 128.64±24.73 mg/dl; p-value 0.001), triglycerides (127.15±8.98 vs. 100.84±27.12 vs. 93.36±25.56 mg/dl; p-value 0.001) LDL (113.15±14.08 vs. 95.58±14.25 vs. 53.46±5.90 mg/dl; p-value 0.001) and HDL (50.60±3.19 vs. 40.70±2.95 vs. 35.40±3.88 mg/dl; p-value 0.001) decreased significantly with increasing severity of disease, findings mimicking that of the present study. Yamuna J, also reported that the mean values of serum total cholesterol, triglycerides, LDL, VLDL and HDL were found progressively decreased as the MELD score increases. This was found to be statistically significant.**Error! Bookmark not defined.**

Cirrhosis is a highly prevalent disease in the present setting. Alterations in the lipid components also contribute to its morbidity and mortality as commonly observed in them. In a study conducted by EL-Khabbany ZA, it was concluded that dyslipidemia was a frequent finding in a patient with chronic liver disease, which worsened with increased severity of CLD. Further studies on a larger scale in different settings will help generate data for better generalisation.

The study was undertaken in a single centre with a small sample. Further studies with a larger population are needed to determine more accurate predictive values of lipid profile for estimating the extent of liver damage in cirrhotic patients. The pathogenesis of cirrhosis involves various aetiologies and the lipid profile could be different among them given the different pathways of hepatic injury. The present study did not look into the differences in lipid profiles based on the aetiology of the cirrhosis.

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