

Research article

Prevalence of alcoholic and non-alcoholic fatty liver disease among different occupations and associated metabolic changes: A hospital-based study

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ABSTRACT

The fatty liver disease (FLD) considered as major health problem worldwide but its prevalence related to occupation and lifestyle habits is seldom assessed. This research study was conducted to find out the occurrence of FLD among occupation and associated metabolic changes. In this hospital-based study total 328 patients were enrolled. The anthropometric measurement, radiological & clinical examination and biochemical estimation were carried out in all enrolled subjects. On the basis of abdominal sonography; the patients were categorized into three groups such as Normal (without liver disease), non-alcoholic fatty liver disease (NAFLD) and alcoholic fatty liver disease (AFLD). For comparison of continuous variables, analysis of variance (ANOVA) was used to compare the means of study groups. A p -value <0.05 was considered as statistically significant. Mean BMI of NAFLD, AFLD and Normal subjects were 25.39 ± 0.38 , 20.13 ± 0.3 and 19.47 ± 0.25 respectively. AFLD group were found significantly higher ($p < 0.0001$) level of liver enzymes markers such as AST, ALT, ALP, GGT, total bilirubin compared to Normal and NAFLD groups. Majority of labour belongs to AFLD (58.2%); whereas, highest frequency of NAFLD was observed in salaried group occupation (49.5%). Based on physical work activity, highest frequency (54.3%) of NAFLD patients were observed in sedentary workers group followed by AFLD (48.3%) patients were heavy workers. The occurrence of metabolic syndrome was statistically significant in NAFLD patients compared to AFLD (40% vs 29%, $p = 0.001$). The occupation especially salaried & business class with sedentary lifestyle habits was increased risk to develop NAFLD; whereas, AFLD patients were majorly belongs to laborer occupation.

Keywords: Fatty liver disease, Alcoholic fatty liver disease, Non-alcoholic fatty liver disease, Occupation, Physical work activity.

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INTRODUCTION

The Fatty liver disease (FLD) with analogous pathogenesis and histological features has been categorized into two major types, alcoholic fatty liver disease (AFLD) and non-alcoholic fatty liver disease (NAFLD) based on significant consumption of alcohol^[1]. FLD comprised of diseases like hepatic steatosis to severe liver inflammation that leads to fibrosis, cirrhosis and hepatocellular carcinoma. NAFLD considered as a major health problem worldwide due to higher prevalence of overweight or obesity and type 2 diabetes among individuals^[1-3] including India and thus, NAFLD and AFLD are significantly linked with liver related morbidity and mortality^[4,5]. In general the prevalence of NAFLD was estimated between 15-40% in western countries; while, it was reported 9% to 40% in Asian countries^[6-8]. Several epidemiological studies from India had reported that the occurrence of NAFLD between 9% to 32% in general population, with higher incidence in those having obesity, diabetes or pre-diabetes history^[9-11].

The relationship between occupation and FLD was reported in a Chinese study in which they reported that factory workers, bank employees, civil servants and hospital staffs had higher prevalence, but the difference was statistically non-significant^[12]. Role of air pollution on occurrence of NAFLD showed that ambient particulate matter (PM) (2.5) exposure might be a noteworthy hazard factor for NAFLD development^[13]. There are two key common hazard factors for NAFLD i.e. obesity and air pollution, and both have broad hostile health effects, and reduction in their occurrence would help to lessen the grave health problems^[14]. Further, literature survey suggests that though the lifestyle and dietary habits play an important role in development of NAFLD. However, the role of occupation in progression and development of FLD need to be established through detailed study in Indian setup. The data on NAFLD with reference to occupation and life style habits is scanty. Therefore, this study was conducted to find out the changes in biochemical and haematological

markers, and association of occupation and lifestyle habits with occurrence of NAFLD and AFLD.

MATERIALS AND METHODS

Study design

The present cross-sectional study was conducted at the Medicine Department of Civil Hospital, Ahmedabad, India, between September 2016 and October 2019. The enrolled participants were further categorized into three groups (Normal, AFLD and NAFLD) according to their abdominal ultrasonography and consumption of alcohol.

Ethics statement and subject enrolment

The study was ethically approved from the Institutional Ethical Committee of ICMR-National Institute of Occupational Health, Ahmedabad, India. A total 328 male participants were enrolled in the study and written consent was taken from each participant after explaining the aims & objectives of the present study. The data about personal demographic characteristics, occupation, personal habits such as tobacco chewing, smoking and alcohol abuse and medical history such as hypertension, diabetes, chronic liver diseases etc. were recorded through pre-tested questionnaire. The participant with alcohol intake >20 g/day (140g/week) were considered as alcoholic habits^[2,15].

Anthropometric measurement and clinical assessment

Height and weight were measured to the nearest of 0.5 cm and 0.1 kg, respectively and body mass index (BMI) was calculated by using formula kg/m^2 . The abdominal obesity was calculated as $\text{BMI} \geq 25 \text{ kg/m}^2$ according to WHO guidelines^[16]. Waist circumference was measured to the nearest 0.1cm at the midpoint between the bottom of the rib cage and the top of the iliac crest with the subjects standing position, their weight uniformly dispersed on both feet, their arms at their sides and head facing straight forward. Blood pressure (BP) was measured using a digital automated BP instrument (Omron HEM-7203, Kyoto, Japan), while patients were asked to sit in relaxed position with the arm supported at heart level. Total three readings were recorded from left arm at the intervals of five minutes, and the average of last two readings was considered for analysis. The hypertension was defined if systolic BP was $\geq 140 \text{ mm Hg}$ and or diastolic BP was $\geq 90 \text{ mm Hg}$.

Laboratory evaluation

5 to 6 ml of blood samples were drawn from each participant using vacutainer syringe from median cubital vein at least 10 hours of overnight fasting. The EDTA blood was used for hematological parameters by using 5-part auto differential cell counter (Mindray BC-5300, China) and serum samples were used for estimation of biochemical parameters such as fasting blood sugar (FBS), post prandial blood sugar (PPBS), random blood sugar (RBS), lipid profile such as total cholesterol (TC), triglycerides (TG), high-density lipoprotein cholesterol (HDL-C). The low-density lipoprotein

cholesterol (LDL-C) was calculated with the help of Friedewald's equation^[17], liver enzymes such as aspartate aminotransferase (AST), alkaline phosphatase (ALP), alanine aminotransferase (ALT), gamma-glutamyl transferase (GGT), total bilirubin and kidney function parameters like creatinine, uric acid and urea were estimated by using fully automatic biochemistry analyzer (Autoquant 100, Merilyzer, India). The commercially available enzymatic reagents and kits (Meril Diagnostic Kits, India) were used for the analysis of various biochemical analytes. Type 2 Diabetes Mellitus (T2DM) was defined by considering fasting blood sugar levels $\geq 126 \text{ mg/dL}$. The serological biomarkers of hepatitis such as hepatitis B virus (HBV) and hepatitis C virus (HCV) antibodies were tested in all patients to rule out viral hepatitis cases. HBV was tested using hepatitis B surface antigen (HBsAg) testing kit (Qualpro diagnostics, Goa, India) and HCV was tested using anti-hepatitis C virus testing kit (Qualpro diagnostics, Goa, India.).

Ultrasonography assessment

Abdominal sonography for detection of fatty liver was done in all participants in Radiology department at Civil Hospital, Ahmedabad, India. Radiological imaging was performed by using Toshiba Aplio 400 (MedCorp, USA) machine with 3.5 MHz transducer by an experienced radiologist who was blinded to all clinical and biochemical characteristics of patients. Fatty liver was confirmed with increased echogenicity of the liver in comparison to the right kidney and the spleen, blurring of intra-hepatic veins and diaphragm and attenuation of the ultrasound beam^[10,18].

Physical activity

Calorie deficit for each patient was considered by subtracting the calorie ingestion of a particular study subjects from his total calorie necessity (based on their age, sex, and nature of work, i.e. sedentary, moderate and heavy work). Physical activity was determined with ICMR classification of activities based on occupational history^[19].

Metabolic syndrome

The metabolic syndrome (MS) was considered at least presence of 3 or more factors out of the following 5 risk factors according to National cholesterol Education Program Adult Treatment Panel III criteria (NCEP- ATP III)^[20]. (1) Class I obesity as $\text{BMI} \geq 25 \text{ kg/m}^2$ but $< 30 \text{ kg/m}^2$ and class II obesity as $\text{BMI} \geq 30 \text{ kg/m}^2$. (2) Serum triglyceride $> 150 \text{ mg/dL}$. (3) Serum HDL cholesterol $< 40 \text{ mg/dL}$ for men and $< 50 \text{ mg/dL}$ for women. (4) Systolic/diastolic blood pressure $> 130/85 \text{ mmHg}$ or known hypertensive. (5) Fasting blood glucose $> 110 \text{ mg/dL}$ or known diabetic.

Statistical analysis

The results were expressed in Mean $\pm$ standard error of mean (SEM) and statistical analysis was performed using R 3.4.3 for Windows (R Project for Statistical Computing). Mean and SEM was

used for continuous variables whereas frequency and percentages were used for discrete data. Chi-Square test was used to compare the frequencies between groups and for continuous variables; ANOVA (analysis of variance) was used to compare the means of individual groups. A p -value <0.05 was considered as statistically significant.

RESULTS AND DISCUSSION

Total 328 subjects were enrolled in the study and categorized into three groups viz. Normal, AFLD and NAFLD based on abdominal ultrasonography and alcoholic history of participants. Mean age of the study participants was comparable among three study groups. The participants in NAFLD group had significantly higher weight followed by AFLD and Normal group participants. Height of participants between the groups was comparable; however, there was substantial difference in BMI and waist circumference (WC) of subjects between the study groups. Mean BMI of NAFLD, AFLD and Normal subjects were 25.39 ± 0.38 , 20.13 ± 0.3 and 19.47 ± 0.25 respectively. Similarly, WC was also proportionate as NAFLD patients had 89.76 ± 0.8 cm, AFLD had 77.09 ± 0.77 cm and Normal subjects had 78.03 ± 0.72 cm waist size. There was considerable difference observed in BMI and WC of patients between the three study groups. The systolic and diastolic blood pressures were significantly higher ($p < 0.05$) in AFLD and NAFLD patients compared to Normal subjects. The pulse rate of NAFLD patients

were higher ($p < 0.05$) than Normal subjects but it was comparable between AFLD and Normal subjects. The work exposures were comparable among the study groups as shown in table 1.

Table 1: Baseline characteristic of clinical and anthropometric parameters of Normal, AFLD and NAFLD subjects

Variables	Normal (N=117)	AFLD (N=99)	NAFLD (N=112)
Age (Years)	44.6 $\pm$ 0.9	43.4 $\pm$ 0.9	45.8 $\pm$ 1.0
Weight (Kg)	51.7 $\pm$ 0.8	52.8 $\pm$ 0.9	66.9 $\pm$ 1.0 ^{b,c}
Height (M)	162.8 $\pm$ 0.6	161.8 $\pm$ 0.7	162.7 $\pm$ 0.7
BMI (Kg/ M ²)	19.5 $\pm$ 0.2	20.1 $\pm$ 0.3	25.4 $\pm$ 0.4 ^{b,c}
Waist Circumference (cm)	77.8 $\pm$ 0.7	79.1 $\pm$ 0.8	88.7 $\pm$ 0.8 ^{b,c}
Systolic BP (mmHg)	119.2 $\pm$ 1.9	124.7 $\pm$ 2.0 ^a	134.7 $\pm$ 2.6 ^{b,c}
Diastolic BP (mmHg)	75.4 $\pm$ 1.0	79.6 $\pm$ 1.3 ^a	84.9 $\pm$ 1.5 ^{b,c}
Pulse (beat/min)	78.5 $\pm$ 0.8	77.9 $\pm$ 0.9	82.4 $\pm$ 1.0 ^{b,c}
Work exposure (Years)	14.7 $\pm$ 0.7	15.1 $\pm$ 0.7	15.3 $\pm$ 0.8

Data expressed as Mean $\pm$ SEM; Level of Significance $p \leq 0.05$, (^{a,b} $p \leq 0.05$ Vs Normal, ^c $p \leq 0.05$ Vs AFLD)

Normal, Without Fatty Liver Disease; AFLD, Alcoholic Fatty Liver Disease; NAFLD, Non-alcoholic Fatty Liver Disease.

Haemoglobin (Hb) level, RBC count, haematocrit (HCT), lymphocyte count and platelet count were significantly decreased and MCV, MCH and MPV were significantly increased in AFLD group compared to Normal and NAFLD groups. Whereas, Hb level, RBC count, MPV, RDWCV and ESR were significantly increased in NAFLD patients compared to Normal while WBC, hematocrit, MCV, MCH, MCHC and platelets were statistically insignificant as shown in table 2.

Table 2: Comparison of hematological indices of AFLD and NAFLD with Normal subjects

Variables	Normal ^a (N=117)	AFLD ^b (N=99)	NAFLD ^c (N=112)	p value		
				a vs. b	a vs. c	b vs. c
Hb (g/dl)	12.03 $\pm$ 0.14	11.17 $\pm$ 0.13	13.11 $\pm$ 0.16	<0.0001	<0.0001	<0.0001
WBC ($\times 10^3$ /cmm)	7.04 $\pm$ 0.24	8.87 $\pm$ 0.22	7.69 $\pm$ 0.27	<0.0001	0.072	0.001
RBC ($\times 10^6$ /cmm)	4.70 $\pm$ 0.05	3.93 $\pm$ 0.08	4.94 $\pm$ 0.07	<0.0001	0.006	<0.0001
Haematocrit (%)	38.99 $\pm$ 0.50	34.70 $\pm$ 0.52	40.11 $\pm$ 0.48	<0.0001	0.105	<0.0001
MCV (fl)	84.68 $\pm$ 0.69	89.26 $\pm$ 0.55	86.23 $\pm$ 0.63	<0.0001	0.099	<0.0001
MCH (pg)	28.09 $\pm$ 0.30	30.68 $\pm$ 0.28	28.63 $\pm$ 0.27	<0.0001	0.185	<0.0001
MCHC (g/dl)	32.66 $\pm$ 0.14	33.70 $\pm$ 0.24	32.46 $\pm$ 0.16	<0.0001	0.35	<0.0001
MPV (fL)	8.01 $\pm$ 0.11	9.15 $\pm$ 0.12	8.72 $\pm$ 0.14	<0.0001	<0.0001	0.021
RDWCV (%)	14.55 $\pm$ 0.21	16.55 $\pm$ 0.32	15.43 $\pm$ 0.27	<0.0001	0.009	0.008
Platelets ($\times 10^3$ /cmm)	254.81 $\pm$ 7.33	183.87 $\pm$ 5.35	235.37 $\pm$ 7.16	<0.0001	0.059	<0.0001
ESR (after one hour)	15.26 $\pm$ 1.97	47.45 $\pm$ 3.64	23.63 $\pm$ 2.10	<0.0001	0.004	<0.0001

Data expressed as Mean $\pm$ SEM; Level of Significance $p \leq 0.05$;

Normal, Without Fatty Liver Disease; AFLD, Alcoholic Fatty Liver Disease; NAFLD, Non-alcoholic Fatty Liver Disease. Hb, Hemoglobin; WBC, White Blood Cell; RBC, Red Blood Cell; MCV, Mean Corpuscular Volume; MCH, Mean Corpuscular Hemoglobin; MCHC, Mean Corpuscular Hemoglobin Concentration; MPV, Mean Platelet Volume; RDWCV, Red Blood Cell Distribution Width; ESR, erythrocyte sedimentation rate.

Table 3 shown elevated level of hepatic enzymes like AST, ALT, ALP, GGT and total bilirubin in AFLD group compared to Normal and NAFLD groups except ALT in NAFLD ($p < 0.0001$). The results showed AST/ALT ratio was 1.32 ± 0.02 in AFLD patients which was statistically significant ($p < 0.0001$) compared to Normal (0.85 ± 0.03); whereas, this ratio was 0.73 ± 0.01 in NAFLD patients, significantly lower ($p = 0.002$) compared to Normal subjects. The serum cholesterol, triglycerides, LDL-C and VLDL of NAFLD group was higher compared to Normal and AFLD groups and it was statistically significant ($p < 0.0001$); however, HDL-C also known as good cholesterol was significantly decreased ($p < 0.0001$) in AFLD

(26.71 ± 0.32) and NAFLD (34.13 ± 0.24) compared to Normal (41.87 ± 0.29). The participants with Normal, AFLD and NAFLD showed comparable results for total protein, albumin. There were statistical differences in FBS, PPBS, creatinine and uric acid among these three groups.

The figure 1 showed distribution of fatty liver disease among various occupational groups. Labour class had highest number of AFLD (58.2%); whereas, highest frequency of NAFLD was reported in salaried class (49.5%) followed by business class (38.7%) occupations. Based on physical work activity highest frequency (54.3%) of NAFLD was observed in sedentary workers and lowest

(17.0%) was found in heavy workers, while higher frequency (48.3%) of AFLD was observed in heavy workers and lower was found in sedentary workers. These differences were statistically highly significant among AFLD and NAFLD patients in comparison to Normal subjects as shown in figure 2. The result indicates that the

occurrence of MS among Normal, AFLD and NAFLD patients which was 17%, 29% and 40% respectively and highest prevalence of MS was found in NAFLD followed by AFLD patients as shown in figure 3 which was statistically significant.

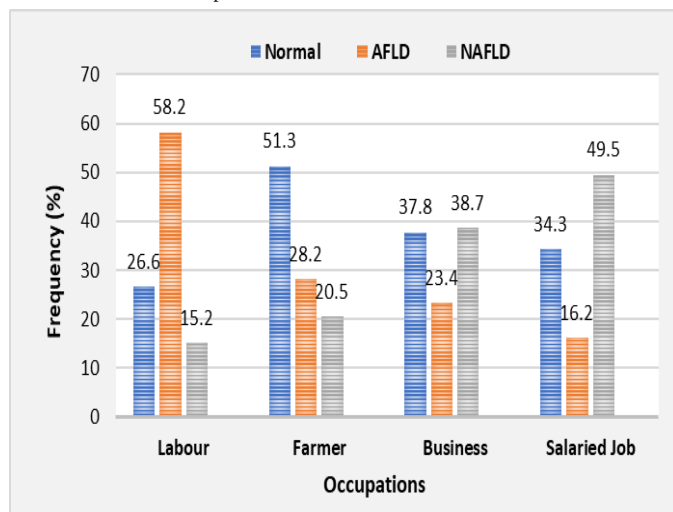
Table 3: Comparison of biochemical parameters of AFLD and NAFLD with Normal subjects

Variables	Normal ^a (N=117)	AFLD ^b (N=99)	NAFLD ^c (N=112)	p value		
				a vs. b	a vs. c	b vs. c
AST (IU/L)	26.51±1.31	84.46±2.83	55.5±1.47	<0.0001	<0.0001	<0.0001
ALT (IU/L)	33.35±1.54	64.14±1.85	76.99±1.82	<0.0001	<0.0001	<0.0001
AST /ALT Ratio	0.85±0.03	1.32±0.02	0.73±0.01	<0.0001	0.002	<0.0001
ALP (IU/L)	65.88±1.70	106.38±2.46	87.02±3.20	<0.0001	<0.0001	<0.0001
GGT (IU/L)	25.2±1.80	62.82±2.25	45.89±1.54	<0.0001	<0.0001	<0.0001
T Bil (mg/dl)	0.94±0.14	4.95±0.70	2.12±0.45	<0.0001	0.011	0.001
Total Cholesterol (mg/dl)	150.32±3.51	173.49±4.03	209.94±4.62	<0.0001	<0.0001	<0.0001
Triglyceride (mg/dl)	119.73±5.09	142.58±3.79	179.02±4.90	<0.0001	<0.0001	<0.0001
HDL-C (mg/dl)	41.87±0.29	26.71±0.32	34.13±0.24	<0.0001	<0.0001	<0.0001
LDL-C (mg/dl)	86.72±2.49	120.12±2.92	142.04±3.78	<0.0001	<0.0001	<0.0001
VLDL (mg/dl)	23.94±1.02	28.52±0.76	35.8±0.98	0.004	<0.0001	<0.0001
RBS (mg/dl)	107.3±4.79	109.2±3.53	131.63±3.73	0.757	<0.0001	<0.0001
FBS (mg/dl)	78.85±2.05	83.3±1.82	104.51±2.62	0.112	<0.0001	<0.0001
PPBS (mg/dl)	101.73±2.76	104.77±2.49	149.4±4.43	0.422	<0.0001	<0.0001
TP (mg/dl)	6.95±0.06	6.65±0.08	7.01±0.07	0.002	0.556	0.001
Albumin (mg/dl)	3.94±0.04	3.49±0.05	3.96±0.06	<0.0001	0.754	<0.0001
Serum Creatinine (mg/dl)	0.74±0.01	0.83±0.01	1.04±0.02	<0.0001	<0.0001	<0.0001
Serum Urea (mg/dl)	20.42±0.43	19.24±0.36	22.23±0.46	0.042	0.005	<0.0001
Serum Uric Acid (mg/dl)	4.31±0.15	5.00±0.09	4.49±0.11	<0.0001	0.327	0.001

Data expressed as Mean±SEM; Level of Significance $p \leq 0.05$;

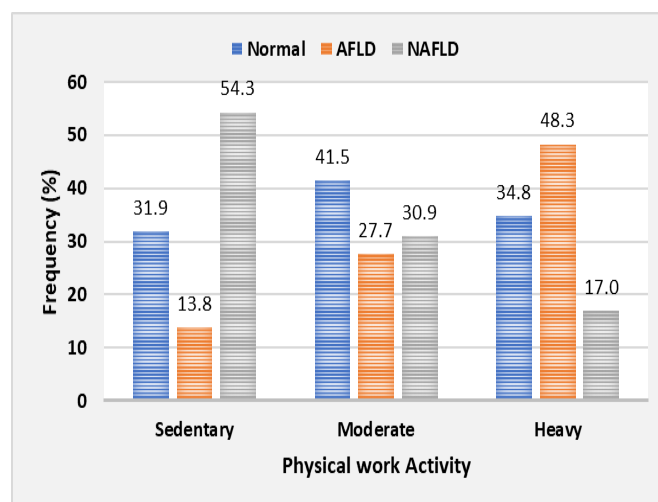
Normal, Without Fatty Liver Disease; AFLD, Alcoholic Fatty Liver Disease; NAFLD, Non-alcoholic Fatty Liver Disease. AST, aspartate aminotransferase; ALT, alanine aminotransferase; ALP, alkaline phosphatase; GGT, gamma glutamyl transferase; T Bil, total bilirubin; TP, total protein; LDL, low-density lipoprotein; HDL, high-density lipoprotein; VLDL, very low-density lipoprotein; RBS, random blood sugar; FBS, fasting blood sugar; PPBS, postprandial blood sugar.

Figure 1: Frequency distribution of Normal, AFLD and NAFLD among various occupations



The objective of study was to find out the alteration in biological biomarkers and association between occupation and lifestyle habits with incidence of NAFLD and AFLD. The findings supported the strong association of incidence of NAFLD cases among salaried and business class occupations. This may be due to their low physical work as seen in our study which demonstrates that sedentary physical work activity had higher prevalence of NAFLD compare to moderate and heavy physical work activity.

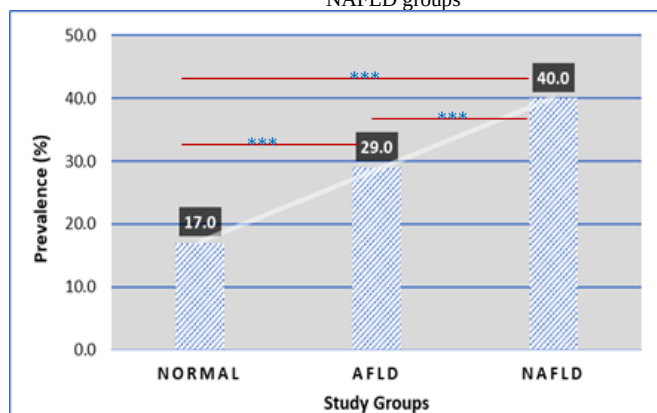
Figure 2: Frequency distribution of Normal, AFLD and NAFLD with respect to physical work activity



There are some studies which reported an association between NAFLD and sedentary physical activities^[21-23]. A study from China revealed that FLD was higher among administrative and white collar workers followed laborers and monks^[24,25]. The job stress, lifestyle habits, eating habits, working pattern and sedentary physical work are the major contributor of major health issues^[26,27], which supports our study results showing high prevalence of NAFLD in sedentary lifestyle, salaried and businessmen.

Generally, it was reported that alteration in hematological and biochemical indicators amongst patients suffering with chronic and acute liver diseases. Another study shown that the subjects with chronic alcoholic liver disease (ALD) related with significant decrease in hematological indices like hemoglobin level, RBC count, HCT and platelets^[28]; whereas, WBC, MCV, MCH, RDWCV^[29] and ESR were significantly increased as compared to Normal and NAFLD patients and this findings are similar to our results. Further, it was observed that the substantial increase in ESR, an inflammatory marker, among AFLD patients may be due to its high consumption of alcohol which resulted liver inflammation and was similar to earlier finding of reports of hepatic injury due to high alcohol abuse^[30]. In ideal state, the lifespan of platelets is about 10 days and it occurs in latent form with stable structure of surface membrane. At the time of cell injury or inflammation, wounded blood vessels stucked by circulating platelets and adhere to expose endothelial tissues^[31].

Figure 3: Prevalence of metabolic syndrome among Normal, AFLD and NAFLD groups



Liver enzymes of NAFLD patients indicate mild liver inflammation compared to Normal subjects as shown in table 3. Previous report suggest that the AST/ ALT ratio is typically <1 in other causes of steatohepatitis rather than alcohol^[32, 33]. High level of AST in relation to ALT level has been anticipated as an indicator of alcohol induced liver damage and it was also established that alcohol is main cause of liver injury or inflammation if AST/ALT ratio is >1.5^[34]. Elevated GGT enzymes linked with an increase in alkaline phosphatase as origin of hepatic enzymes^[35] and elevation in GGT enzymes of alcoholic patients may be due to induction in hepatic microsomal enzyme by alcohol abuse^[36]. This comparison in our study provides information that the patients of AFLD can be differentiated from NAFLD patients based on biochemical parameters like AST/ALT ratio, GGT and ALP.

The indicators of kidney function test of present study have shown to be within normal range among all three groups (table 3). However, serum creatinine and urea of NAFLD patients were significantly higher compare to other groups. Similarly, uric acids of AFLD patients were also higher in comparison to Normal and

NAFLD patients which was in support to the conclusions of Das and Vasudevan^[37].

The MS was a common health problem worldwide and contributed severe health issues in Asia including India because of modification in lifestyle habits and lack of physical exercise. Present study reported about 40% of patients with NAFLD had metabolic syndrome, which was considerably higher than the subjects in Normal group (17%). Some of the differences in clinical features may not be of a clinically significant but the changes in BMI, triglyceride levels, liver enzymes profiles, fasting blood sugar level, etc. of patients with and without FLD should be considered as clinically relevant. Another study reported that even similar prevalence of the MS in AFLD and NAFLD groups, the NAFLD group had significantly higher HDL-C and triglycerides than the AFLD group^[38]. Our results also revealed that elevated level of serum triglycerides, known as dyslipidemia, play a decisive role in contribution and progression of liver inflammation specially NAFLD and this findings are in agreement with earlier studies which supported the crucial role of serum triglyceride in comparison to serum cholesterol in causation of NAFLD and metabolic syndrome^[39, 40].

CONCLUSIONS

The findings of the study conclude the high prevalence of NAFLD among salaried and business class occupations and associated with alteration in hematological and biochemical markers in study population.

Conflict of interests: None declared.

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