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Study of prevelance of Metabolic Associated Fatty Liver Disease (MAFLD) in Fayoum Governorate

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ABSTRACT

Background and aim; The liver affection in metabolic syndrome is called metabolic associated fatty liver diseases (MAFLD) which is associated with insulin resistance, obesity, diabetes mellitus (DM) type 2. This study aimed to identify prevalence of metabolically associated fatty liver disease (MAFLD) in Fayoum Governorate, Egypt. Patients and methods; Our cross sectional study was conducted on 1061 persons of simple random samples in Fayoum University Hospital. They were clinically assessed and investigated by laboratory tests including Liver enzymes, serum lipid profile, imaging i.e., abdominal ultrasound, transient elastography (fibroscan). Results; About two thirds of study participants 715/1061 (67.4%) were classified to have MAFLD. Patients with MAFLD were older than those without MAFLD, near one third of study participants319/1061 (30.1%) had normal weight, less than half 456/1061 (43.1%) were overweight, while 285/1061 (26.9%) were obese. Less than half of the study participants; 464/1061 (43.7%) and 492/1061 (46.4%) were diabetics and hypertensive. Conclusions; Our findings showed that the prevalence of MAFLD in the study population was high. Higher body mass index (BMI), waist circumference, triglyceride, cholesterol, fasting plasma glucose, were risk factors for MAFLD. Patients with MAFLD were older than those without MAFLD. Prevalence rate of MAFLD was found to be higher in females than males.

1. Introduction

Metabolically related fatty liver disease is frequently found, represents twenty-five percentage of population [1,2]. The etiologies of MAFLD are identified for accurate definitions and approval of drug therapy [3]. Development of inflammation of liver parenchyma is called metabolic associated steatohepatitis which is related to obesity,DM type 2, hyperlipidemia,simple steatosis is benign in progression,but steatohepatitis will lead to developmentofliverfibrosis, cirrhosis, HCC [4,5].

Diagnostic criteria and definition of groups MAFLD and non-MAFLD; MAFLD is diagnosed based on a radiologically diagnosed hepatic steatosis and the presence of any one of the following three conditions, namely overweight/obesity, presence of diabetes mellitus (DM), or evidence of metabolic dysregulation. Increased cardiometabolic and MAFLD risk defined as the presence of at least two ofthe following at-risk criteria:

- Waist circumference ≥102/88 cm in Caucasian men and women or ≥90/80 cm in Asian men and women).
- Blood pressure ≥130/85 mmHg or specific drug treatment
- Plasma triglycerides ≥150 mg/dl (≥1.70 mmol/L) or specific drug treatment
- Plasma HDL-cholesterol <40 mg/dl (<1.0 mmol/L) for men and <50 mg/dl (<1.3 mmol/L) forwomen or specific drug treatment.
- Prediabetes (i.e., fasting glucose levels 100 to 125 mg/dl [5.6 to 6.9 mmol/L], or 2-hourpost-load glucose levels 140 to 199 mg/dl [7.8 to 11.0 mmol] or HbA1c 5.7% to 6.4% [39 to47 mmol/mol]).
- Homeostasis model assessment of insulin resistance score ≥2.5.
- Plasma high-sensitivity C-reactive protein level >2 mg/L [6–8].

The non-MAFLD population referred to patients who do not meet the above conditions. According to alcoholic beverage consumption, MAFLD

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patients were further classified as MAFLD with alcohol intake and MAFLD without alcohol intake [7]. The aim of the study was to identify prevalence of metabolic associated fatty liver disease (MAFLD) in Fayoum Governorate.

2. Materials and method

A cross sectional study was conducted on 1061 subjects of simple random samples from Fayoum University Hospital, the study was conducted from September 2020 to September 2022. Ethical approval for the study was obtained from the Ethics Review Committee of the Faculty of Medicine, Fayoum University. Informed written consent was obtained from all participants.

2.1. Inclusion and exclusion criteria

Inclusion criteria were (a) male or female patients and (b) patients with age more than 18 years old. While exclusion criteria were (a) patients with end stage liver disease, (b) patients aged less than 18years, and (c)refusal of consent informs. All patients weresubjected toa questionnaire (demographic, personal data, past history, present, medical history then examination and anthropometric measures).

2.2. Laboratory investigations

Laboratory investigations i.e., complete blood count,fasting blood glucose, serum lipid profile,hemoglobin A1C (HBA1C), homeostatic model assessment for insulin resistance (HOMA IR), andC-reactive protein (CRP) tests. Measurements of liver enzymes;serumaspartate aminotransferase (AST) and alanine transaminase (ALT) were also performed.

2.3. Non –invasive measures of hepatic steatosis

Abdominal ultrasonography,usually, “Steatohepatitis” is identifiedusing abdominal ultrasound (USG) when the appearance of liver shows bright echogenicity with liver parenchyma more bright than kidney with high specificity and sensitivity. All patients underwent abdominal ultrasonography using SONOSCAPE ultrasound using prope C 362.

2.4. Transient elastography

Transient elastographyis an ultrasound-based study and also known as vibration-controlled transient elastography or Fibroscan which can measure controlled attenuation parameter (CAP). CAP values from 100 to 400 decibels per meter (dB/m) identify steatosis significantly. But less in detection of grade of steatosis. The perfect cut-off results of CAP for detection of hepatic steatosis levels such as S1, S2, and S3 are ≥263dB/m, ≥ 281dB/m and ≥ 283dB/m respectively. Values of hepatic steatosis depending on CAP value into S1 ≥ 238 dB/m, S2 ≥260 dB/m, and S3 ≥293 dB/m [8]. Transient Elastogrphy is used for assessment of controlled attenuation parameter by vibration-controlled transient elastography (Fibro touch 502).

2.5. Statistical analyses

Values were presented as mean ± standard deviation, median, and interquartile range for descriptive statistics, whereapplicable. The non-parametric Manny-Whitney test was employed to determine significance.*P*-values and frequency (%) were used to display data for categorical variables.

3. Results

This cross-sectional study has included 1061 persons. More than half of study participants 581/1061 (54.8%) were males. Mean ± SD of their age was 48.9 ± 14.1 (Table 1).

Table 1: Socio-demographics

	Mean	SD
Age	48.9	14.1
	N	%
Sex		
Male	581	54.8%
Female	480	45.2%

SD; standard deviasion, N; number

Regarding body mass index, Table (2) showed the following; near one third of study participants 319/1061 (30.1%) had normal weight, less than half 456/1061 (43.1%) were overweight, while 285/1061 (26.9%) were obese. Mean ± SD of BMIwas27.4 ± 3.6.Cutoff values of BMI are: Normal weight - BMI greater than or equal to 18.5 to 24.9 kg/m^2. Overweight – BMI greater than or equal to 25 to 29.9 kg/m^2.Obesity – BMI greater than or equal to 30 kg/m^2.

Table 2: Body mass index

	Mean	SD
Body mass index (BMI)	27.4	3.6
	N	%
BMI		
Normal	319	30.1%
Overweight	457	43.1%
Obese	285	26.9%

SD; standard deviasion and N; number

Less than half of the study participants; 464/1061 (43.7%) and 492/1061 (46.4%) were diabetics and hypertensive, as shown in Table (3). As regards liver enzymes, mean ± SD of AST and ALT were 44.6 ± 12.8 and 44.8 ± 12.9 (Table 4).

As regards FIB-4, patients with level less than 1.45 were 47.9%, patients with level between 1.45and 3.25 were 19.9%and patients with level more than 3.25 were 5.1% (Table 5).

Table 3: Co-morbidities

	N	%
D.M		
Present	464	43.7%
Not present	597	56.3%
HTN		
Present	492	46.4%
Not present	569	53.6%

D.M; Diabetus Mellitus, N; number, and HTN; Hypertension

Table 4: Liver enzymes

	Mean	SD
AST	44.6	12.8
ALT	44.8	12.9

AST; Aspartate aminotransferase, ALT; Alanine aminotransferase and SD; standard deviasion.

Table 5:FIB-4

FIB-4	N	%
<1.45	795	74.9%
1.45-3.25	212	19.9%
>3.25	54	5.1%

N; number

Concerning lipid profile; more than one third of study participants398/1061 (37.5%) haddesirable level of blood cholesterol, less than half 466/1061 (43.9%) had borderline level, while 197/1061 (18.6%) had high level. Cutoff values of blood cholesterol are: Normal: Less than 200 mg/dL. Borderline high: 200 to 239 mg/dL. High: At or above 240 mg/dL. On the other hand, about one quarter of study participants271/1061 (25.5%) hadnormal level of blood triglycerides, near on fifth 243/1061 (22.9%) had borderline level, while more than half 547/1061 (51.6%) had high level. Cutoff values of blood triglycerides are: Normal — Less than 150 milligrams per deciliter (mg/dL), or less than 1.7 millimoles per liter (mmol/L) Borderline high — 150 to 199 mg/dL (1.8 to 2.2 mmol/L) High — 200 to 499 mg/dL (2.3 to 5.6 mmol/L). Mean ± SD of blood cholesterol and triglycerides were213.4 ± 23 and 194.9 ± 48.3, respectively as demonstrated in Table (6).

Table (7) demonstrated the U/S and fibro-scan findings. In about one third of study participants 346/1061 (32.6%), U.S was normal. While in near half 525/1061 (49.5%), U.S showed mild steatosis. Moderate and severe steatosis was found in 150/1061 (14.1%) and 40/1061 (3.8%), respectively. By the same manner, about one third of study participants 344/1061 (32.4%), had S0 by fibro-scan. While in less than half 509/1061 (48.0%), fibro-scan revealed S1. S3, S4 were found in 163/1061 (15.4%) and 45/1061 (4.2%), respectively.

Table 6: Lipid profile

	Mean	SD
Cholesterol	213.4	23
Triglyceride	194.9	48.3
	N	%
Hypercholesterolemia		
Desirable	398	37.5%
Borderline	466	43.9%
High	197	18.6%
Hypertriglyceridemia		
Normal	271	25.5%
Borderline	243	22.9%
High	547	51.6%

N; number

Table 7: U/S and fibro-scan findings

	N	%
Ultrasound		
Normal	346	32.6%
Mild steatosis	525	49.5%
Moderate steatosis	150	14.1%
Severe steatosis	40	3.8%
Fibro-scan		
S0	344	32.4%
S1	509	48.0%
S2	163	15.4%
S3	45	4.2%
F0-F1	258	24.4%
F2	318	29.9%
F2-F3	265	24.9%
F3-F4	159	14.9%
F4	62	5.8%

N; number

Compared to patients without MAFLD, those with MAFLD were older (mean ± SD= 49.5 ± 13.7 vs. 47.5 ± 14.8), which was a statistically significant, p=0.033. Prevalence rate of MAFLD was found to be higher in females (72.5 %) than males (63.2%) (OR =1.537, 95% CI =1.183–1.997, p=0.001) as demonstrated in Table (8).

Table 8: Relation between socio-demographics and prevalence of MAFLD

	MAFLD (N=715)		No MAFLD (N=346)		Mean Difference (95% CI)	P-value
	Mean	SD	Mean	SD		
Age	49.5	13.7	47.5	14.8	2.022 (0.167-3.877)	0.033*
	N	%	N	%	Odds ratio (95% CI)	P-value
Sex						
Male	367	63.2%	214	36.8%	R	
Female	348	72.5%	132	27.5%	1.537 (1.183-1.997)	0.001*

SD; standard deviation, MAFLD; metabolic associated fatty liver disease.

Table (9) indicated that patients with MAFLD had a statistically significant higher BMI and waist circumference than patients without MAFLD (mean ± SD= 28.4 ± 3.7 vs. 25.3 ± 2.5), p<0.001, (mean ± SD = 102.2 ± 13.7), p-value 0.17.

Table 9: Difference in BMI and waist circumference according to MAFLD

	MAFLD (N=715)		No MAFLD (N=346)		Mean Difference (95% CI)	P-value
	Mean	SD	Mean	SD		
BMI	28.4	3.7	25.3	2.5	3.060 (2.684-3.436)	<0.001*
	N	%	N	%	Odds ratio (95% CI)	P-value
BMI						
Normal	121	37.9%	198	62.1%	R	
Overweight	336	73.5%	121	26.5%	4.544 (3.342-6.178)	<0.001*
Obese	258	90.5%	27	9.5%	15.636 (9.906-24.681)	<0.001*
Waist circumference (cm)						
	MAFLD		No MAFLD			P-value
	102.2 ± 13.7		103.3 ± 11.4			0.17

BMI; Body mass index, SD; Standard deviation, Values of Waist circumference are mean± SD. MAFLD; metabolic associated fatty liver disease.

According to Table (10), individuals with MAFLD had statistically substantially higher blood levels of triglycerides and cholesterol than patients without MAFLD (mean ± SD= 219 ± 23.5 vs. 200 ± 14.5 for cholesterol and 214.7 ± 44.7 vs. 153.9 ± 22.9 for triglycerides, p<0.001). As compared to desirable level of blood cholesterol, increasing levels was a statistically significantly associated with increasing risk of MAFLD: for borderline level, OR = 3.073 (95% CI: 2.315-4.081, p<0.001) and for high level, OR = 36.651 (95% CI: 15.884-84.572, p<0.001). Likewise, increasing levels of blood triglycerides was a statistically significantly associated with increasing risk of MAFLD as follow; for borderline level, OR = 20.210 (95% CI: 12.634-32.587, p<0.001) and for high level, OR = 149.650 (95% CI: 87.409-255.905, p<0.001).

Table 10: Association between Lipid profile and MAFLD

	MAFLD (N=715)		No MAFLD (N=346)		Mean Difference (95% CI)	P-value
	Mean	SD	Mean	SD		
Cholesterol	219.9	23.5	200	14.5	19.838 (17.531-22.144)	<0.001*
Triglyceride	214.7	44.7	153.9	22.9	60.791 (56.719-64.863)	<0.001*
	N	%	N	%	Odds ratio (95% CI)	P-value
Hypercholesterolemia						
Desirable	185	46.5%	213	53.5%	R	
Borderline	339	72.7%	127	27.3%	3.073 (2.315-4.081)	<0.001*
High	191	97.0%	6	3.0%	36.651 (15.884-84.572)	<0.001*
Hypertriglyceridemia						
Normal	28	10.3%	243	89.7%	R	
Borderline	170	70.0%	73	30.0%	20.210 (12.634-32.587)	<0.001*
High	517	94.5%	30	5.5%	149.650 (87.409-255.905)	<0.001*
	Mean±SD		Mean±SD			
HDL-cholesterol (mg/dL)	44 ± 11		45 ± 11			0.4
LDL-cholesterol (mg/dL)	122 ± 68		149 ± 73			0

SD; standard deviation and MAFLD; metabolic associated fatty liver disease

According to Table (11) the HOMA-IR, HBA1C andFPG were found to be are significantly higher in patients with MAFLD. According to Table (12) patients with MAFLD had statistically substantially higher levels of AST and ALT than patients without MAFLD (mean ± SD= 48.9 ± 11.7 vs. 35.7 ± 10.4 for AST and 49.1 ± 11.6 vs. 36.0 ± 10.6 for ALT, p<0.001). while, acording to Table (13) high percentages of patients with MAFLD were diabetics and hypertensives than non–MAFLD patients.About two thirds of study participants 715/1061 (67.4%) were classified to have MAFLD.

Table11: Association between labs and MAFLD

	MAFLD (N=715)		No MAFLD (N=346)		P-value
	Mean	SD	Mean	SD	
Platelet count (109/L)	259	76	278	83	0.04
Hemoglobin (g/dL)	13	1.8	13	1.7	0.9
HBA1c (%)	9	1.4	7.2	1.4	0.71
FPG	73	18	97	23	0.02
HOMA-IR score	8.64	9.48	27	9.5%	0.1

SD; Standard deviation, MAFLD; metabolic associated fatty liver disease, and HOMA IR; Homeostasis Model Assessment of insulin Resistance.

Table 12: Difference between patients with MAFLD and those without as regards Liver enzymes

	MAFLD (N=715)		No MAFLD (N=346)		Mean Difference	P-value
	Mean	SD	Mean	SD	(95% CI)	
AST	48.9	11.7	35.7	10.4	13.178 (11.788-14.569)	<0.001*
ALT	49.1	11.6	36	10.6	13.072 (11.662-14.482)	<0.001*

SD; Standard deviation, AST; Aspartate aminotransferase, ALT; Alanine aminotransferase, and MAFLD; metabolic associated fatty liver disease.

Table 13: Co-morbidities in relation to MAFLD

	MAFLD (N=715)		No MAFLD (N=346)		Odds ratio	P-value
	N	%	N	%	(95% CI)	
			D.M			
Not present	390	65.3%	207	34.7%	R	
Present	325	70.0%	139	30.0%	1.241 (0.956-1.610)	0.104
			HTN			
Not present	372	65.4%	197	34.6%	R	
Present	343	69.7%	149	30.3%	1.219 (0.941-1.579)	0.133

N; Number, MAFLD; metabolic associated fatty liver disease, D.M; Diabetus Mellitus,HTN Hypertension.

4. Discussion

In 2020, a new definition known as MAFLD was discovered. MAFLD has extremelychangeable criteria from NAFLD. Two differences between MAFLD and NAFLD are, there are two distinctions between MAFLD and NAFLD: the former does not need the exclusion of alcohol consumption or other chronic liver illnesses, and the latter is identified by the appearance of metabolic dysregulation [9]. MAFLD is identifieddepending on a radiological diagnosis of hepatic steatosis and the presence of three diseases, which are overweight/obesity, metabolic dysregulation or DM [10].

In obese individuals, the percentage of MAFLD is 80-90% in diabetic patients, it is 30-50% and in hyperlipidemic patients, it can reach 90%. Between children, MAFLD incidence ranges from 3-10%, with obesity–affected children experiencing an increase to 40-70%. MAFLD in children increased from about 3% to 5% today, male-to-female percentage of 2:1. The prevalence of MAFLD is not fully understood, but it is known that the most of people with MAFLD do not have MASH. The prevalence of MAFLD is generally increasing in Western fields, associated with lifestyles [11].

This study enrolled a total of 1061 patients from Fayoum Governorate, about two thirds of study participants 715/1061 (67.4%) were classified to have MAFLD.In our current study, patients with MAFLD were older than those without MAFLD (mean ± SD= 49.5 ± 13.7 vs. 47.5 ± 14.8), which was a statistically significant, *p*=0.033.This was in agreement with Eslam, et al. [9] who reported that the mean age of patients with MAFLD was 48.39+15 years while mean age of Non MAFLD patients was 35.13+ 13 years.Also this was in agreement with Fouad et al. [10] who reported that the mean age of the MAFLD patients was 46.81+15 years, while mean age of Non MAFLD patients was 44.9+ 13 years.

In our study, prevalence rate of MAFLD was found to be higher in females (72.5 %) than males (63.2%) (OR =1.537, 95% CI =1.183–1.997, p=0.001.This was in agreement with Lin et al., [12] who reported that prevalence of MAFLD in males was 44.13%, while prevalence of Non MAFLD male patients was 35.06%.the prevalence of MAFLD in females was 55.87%,while prevalence of Non MAFLD female patients was 64.94%.

Regarding body mass index, show the following; near one third of study participants319/1061 (30.1%) had normal weight, less than half 456/1061 (43.1%) were overweight, while 285/1061 (26.9%) were obese. Mean ± SD of BMIwas27.4 ± 3.6. BMI was a statistically significantly higher in patients with MAFLD than those without MAFLD (mean ± SD= 28.4 ± 3.7 vs. 25.3 ± 2.5), p<0.001.Compared with normal body weight, increasing levels of obesity was associated with increasing odds of MAFLD: for overweight, OR = 4.544 (95% CI: 3.342-6.178, with a statistical significant p<0.001) and for obese, OR = 15.636 (95% CI: 9.906-24.681, p<0.001).This was in agreement with Eslam et al. [9] who reported that despite the close relationship between obesity and liver steatosis, not all obese people also have MAFLD. Obesity is classified into metabolicallyhealthy (MHO) andmetabolically unhealthy can be distinguished by higher BMI and metabolically unhealthy obesity (MUO).Also this was in agreement with Jongraksaket al. [13] who reported that mean BMI in patients with MAFLD was 28.89+ 2.92 while mean BMI in Non MAFLD patients was 24.30+ 3.17. Also this was in agreement with Siddiqui et al. [15] who reported that diseases with metabolic syndrome and DM type 2 are identified in many circumstances by low-level inflammation of adipose tissue.

In our study; 464/1061 (43.7%) of patients were diabetics and 492/1061 (46.4%) were hypertensive.This was in agreement withAbdelmaleket al.[16] who reported that 30% of the patients with MAFLD were diabetics and 41.3% were hypertensive, while 8.98% of Non MAFLD patients were diabetics and 19.9% of Non MAFLD patients were hypertensive. Beringer and Thaler examined the liver histology of 465 T2DM patients finding that 75% of these patients had liver steatosis and 2.6% had liver cirrhosis,compared to 0.84% in the general population.

ALT and AST were a statistically significantly higher in all patients with MAFLD than those without MAFLD (mean ± SD= 48.9 ± 11.7 vs. 35.7 ± 10.4 for AST and 49.1 ± 11.6 vs. 36.0 ± 10.6 for ALT, p<0.001). It was in agreement with Lin et al. [12] whoreported that ALT (U/L) was higherin patients with MAFLD than Non MAFLD patients.

This study has a number of drawbacks. Firstly, the cross- sectional design makes it impossible to determine a causal link between the contributing factors and MAFLD.secondely, ultrasonography techniques were employed to diagnose MAFLD rather than histology evaluations, nonetheless ultrasonography techniques are frequently employed in population-based research.

5. Conclusions

Our results demonstrated that there was a high prevalence of MAFLD in the studied population in the Fayoum governorate. Patients with MAFLD were older than those without MAFLD. It was discovered that women had a higher prevalence of MAFLD than men. Individuals with MAFLD had a statistically significant greater BMI than individuals without MAFLD. High percentages of patients with MAFLD were diabetics and hypertensives. Multiple forward stepwise logistic regression analysis identifies female sex, high cholesterol level, and high triglycerides level to be statistically significant predictors for MAFLD.

Author Contributions

Conceptualization, A. A. Gomaa , E. A. Hassan and M. Tawfic; Methodology, Y. Fouad and A. A. Gomaa ; Validation, E. A. Hassan; Formal analysis, M. Massoud; Investigation, A. A. Gomaa, Y. Fouad; Data curation, A. A. Gomaa, E. A. Hassan and Y. Fouad; Writing—original draft preparation, E.G.Fouad, M. Tawfic, Y. Fouad, and A. A. Gomaa; Writing—review and editing, E. G. Fouad, M. Tawfic, Y. Fouad, and A. A. Gomaa; Visualization, E. A. Hassan and E. Fares; Supervision, A. A. Gomaa, E. A. Hassan, M. Tawfic, and M. Massoud; Project administration, A. A. Gomaa, E. A. Hassan, Y. Fouad and M. Massoud; Funding acquisition, A. A. Gomaa, E. G. Fouad, and M. Massoud. All authors have read and agreed to the published version of the manuscript.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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