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Diagnostic Accuracy of HOMA-IR in Detecting and Grading Nonalcoholic Fatty Liver Disease

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ABSTRACT

Background: The most frequent etiology of chronic liver illnesses globally is non-alcoholic fatty liver disease (NAFLD). To identify insulin resistance (IR) in NAFLD cases, the homeostasis model assessment estimate of IR (HOMA-IR) is being studied. **Objective:** To estimate the role of HOMA-IR in the context of NAFLD diagnosis. **Subjects and methods:** This retrospective cross-sectional study was conducted during the period from 2020 to 2021 in Benha University Hospitals, Egypt. It was conducted on 205 subjects; 102 NAFLD patients and 103 normal subjects. Entire subjects were assessed by complete history taking and physical examination. Liver function tests and lipid profile, fasting blood glucose (FBG), fasting insulin (FI) level and HOMA-IR were measured. Abdominal ultrasound (US) for diagnosis and grading of fatty liver was done for each subject. **Results:** In NAFLD patients, the mean age was 45.54 ± 9.56 years, 71.6% were females. Diabetes mellitus, hypertension, weight, and body mass index (BMI) were higher in NAFLD group. NAFLD cases had significantly higher FBG levels compared to those without NAFLD (107.40±5.34 mg/dl vs 85.10±0.71 mg/dl, p=0.047). Patients with NAFLD had significantly higher FI levels in comparison with those without NAFLD (4.62±0.86 µU/ml vs 4.39±0.56 µU/ml, p=0.026). Patients with NAFLD had significantly greater HOMA-IR in comparison with those without NAFLD (1.21±0.06 vs 0.92±0.01, p<0.001), with best cut off (>1.01), sensitivity (Sn) was 64.71% and specificity (Sp) was 82.52%. HOMA-IR showed ascending level with increased grade of fatty liver. **Conclusion:** FI, FBG and HOMA-IR are correlated with diagnosis of NAFLD. HOMA-IR is an biomarker of the degree of hepatic steatosis and can be used to identify individuals for further testing.

Keywords: Non-alcoholic fatty liver disease (NAFLD), Body mass index (BMI), Fasting blood glucose (FBG), Fasting insulin (FI), Homeostasis model assessment estimate of insulin resistance (HOMA-IR).

INTRODUCTION

Nonalcoholic fatty liver disease (NAFLD) represents the commonest cause of chronic liver disease globally. The estimated prevalence of NAFLD is estimated to be 25.2% all over the world [(1)], and in the Middle East and North Africa (MENA) is found to be 31.8% of all adults, this is one of the greatest NAFLD prevalence rates [(2)].

This condition is recognized as one of the leading contributors to liver disorder-related death [(3)]. It is a liver illness that develops without the use of large amounts of alcohol or any other secondary causes. It progresses through a range of stages with a poor prognosis. Steatosis, an excessively elevated fatty acid accumulation in hepatocytes, non-alcoholic steatohepatitis (NASH), fibrosis, cirrhosis, and ultimately hepatocellular carcinoma (HCC) are the first stages of the illness spectrum [(4)]. IR, obesity and type 2 diabetes mellitus (T2DM) were found to enhance NAFLD progression [(5)].

According to the definition of IR, this condition is characterized by a diminished biological response to the activities of insulin, which has an impact that is increased by obesity and leads to improper metabolism of glucose and fatty acids in human tissues, particularly fat, muscle, and liver. As it is strongly predictive of lipid deposition in the liver, the evaluation of IR using evaluation model index or the HOMA-IR is becoming a more relevant field of study [(6)].

Due to the ease of its measurement and computation, as well as its substantial association to glycemic clamp in non-diabetic individuals, HOMA-IR, which was developed by **Matthews *et al.*** [(7)], has been the most often used approach in clinical practice and epidemiological investigations. As a result, it has lately been used often in clinical investigations of NAFLD [(8)].

It has been proven by a previous study that even in the presence of experienced radiologists, ultrasound (US) is still not a valid objective method for grading steatosis, as different grades were given when same images were assessed by the same radiologist in two different settings one month apart. This sheds attention to the need for a more objective and quantitative technique for assessing the degree of fatty liver disease (FLD) that is both widely accessible and relevant for use in normal practice [(9)]. Therefore, we aimed to identify diagnostic accuracy of HOMA-IR in detecting and grading NAFLD.

SUBJECTS AND METHODS

This retrospective cross-sectional study was conducted in the Hepatology, Gastroenterology and Infectious Diseases Department, Benha University Hospitals, Qalyubia Governorate, Egypt. The study was carried out from 2020 to 2021.

The study included 205 subjects aged between (27 to 60 years old), who consented to take part in the study. Subjects with history of different hepatic disorders (e.g., viral hepatitis, autoimmune-liver diseases, α1-antitrypsin deficiency, hemochromatosis, Wilson's disease and dugs) or history of alcohol intake and steatogenic drugs were ruled out from the study.

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According to US results, all study participants were divided into two groups:

Group A; 102 patients with NAFLD, and **Group B;** 103 subjects with normal liver.

All patients underwent a thorough physical examination with a focus on anthropometric measurements.

Venous blood specimens were acquired following fasting for 10 hours for evaluation of the following: fasting blood sugar, fasting insulin level, liver profile including alanine aminotransferase (ALT), aspartate aminotransferase (AST), γ-glutamyl transferase (GGT), alkaline phosphatase (ALP). In addition to, lipid profile comprising total cholesterol (TC), high density lipoprotein (HDL), low density lipoprotein (LDL), very low density lipoprotein (VLDL) and triglyceride (TG).

HOMA-IR test was assessed by utilizing the given mathematical equation: HOMA-IR = [plasma glucose (mg/dL) x plasma insulin (μU/mL)]/405 [(10)].

Abdominal US was performed for all participants after 8h overnight fasting, US grading of NAFLD severity was as follows: Grade 1 (mild) means a minor diffuse increase in hepatic echogenicity with normal visualization of the diaphragm and portal vein; grade 2 (moderate) means a moderate diffuse increase in hepatic echogenicity with a slight impairment of visualization of the diaphragm and portal vein; and grade 3 (severe) means a marked increase in hepatic echogenicity with poor visualization of the diaphragm and portal vein [(11)].

The sample size was calculated using STATA software, aiming to assess the validity of HOMA-IR for NAFLD prediction. By conducting sample size analysis for case-control study, the expected AUC is 0.807 for identifying NAFLD from non-NAFLD cases as reported by **Gutierrez-Buey *et al.*** [(12)]. The null hypothesis was considered as 0.7 to increase the test validity. The case to control ratio of 1:1 was used, the sample size was 84 in each group at a power of 80% and alpha error of 5%. We used 102 NAFLD patients and 103 non-NAFLD cases to increase the power of the study.

Ethical approval:

Benha Medical Ethics Committee of Benha Faculty of Medicine gave its approval to this study. All participants gave written consent after receiving all information. The Helsinki Declaration was followed throughout the study's conduct.

Statistical analysis

The help of IBM SPSS Statistics for Windows, V. 25.0, and the gathered data were examined. To assess the correlation between 2 qualitative variables, the Chi-Square test was carried out. Fisher exact test was also utilized in cases when the predicted count was below five in more than twenty percent of the cells. Regarding the quantitative data, the significance of the difference in parametric variable between the means of the 2 studied groups was assessed by utilizing the Student T test. The statistical significance of a difference in a non-parametric variable between 2 studied groups was assessed by utilizing the Mann Whitney Test. The ROC curve offers a practical method in the context of evaluating the sensitivity (Sn) and specificity (Sp) of quantitative diagnostic tools, which divide instances into two categories. The cut-off point which maximized the AUC value was considered to be the ideal one. The factors under investigation were correlated by utilizing Spearman's correlation. P values 0.05 were considered significant.

RESULTS

The current study was carried out on a total of 102 NAFLD patients. Their mean age was 45.54 ± 9.56 years. They were 28.4% males and 71.6% females. In addition to 103 non-NAFLD subjects of matched age and gender. NAFLD cases were significantly associated with higher incidence of DM, hypertension, higher weight and BMI when compared to non-NAFLD group **(Table 1).**

Table (1): Comparison of baseline characteristics data between both groups

		NAFLD N = 102	Non-NAFLD N = 103	P
Age (years)	Mean ± SD.	45.54 ± 9.56	45.13 ± 11.41	0.779
	Median (Min. – Max.)	49 (28 – 60)	49 (27 – 60)	
Male	N (%)	29 (28.4%)	26 (25.2%)	0.606
Female	N (%)	73 (71.6%)	77 (74.8%)	
DM	N (%)	20 (19.6%)	0 (0.0%)	<0.001*
HTN	N (%)	29 (28.4%)	4 (3.9%)	<0.001*
Weight (kg)	Mean ± SD.	87.37 ± 13.06	77.99 ± 11.22	<0.001*
	Median (Min. – Max.)	89 (55 – 117)	75 (57 – 100)	
Height (cm)	Mean ± SD.	166.71 ± 9.18	164.66 ± 7.29	0.079
	Median (Min. – Max.)	165 (150 – 186)	165 (150 – 188)	
BMI (kg/m^2)	Mean ± SD.	31.62 ± 5.31	28.84 ± 4.13	<0.001*
	Median (Min. – Max.)	30.4 (19 – 45.3)	27.5 (22.5 – 37.3)	

DM: Diabetes mellitus; HTN: Hypertension; BMI: Body mass index; n: number of patients. *: Significant.

NAFLD cases were significantly associated with higher GGT, TC, TG, LDL, VLDL, TC/HDL ratio, LDL/HDL ratio when compared to non-NAFLD group. On the other hand, NAFLD cases were significantly associated with lower HDL concentration. Otherwise, no significant differences were found between both groups as regards liver enzymes (ALT and AST) **(Table 2).**

Table (2): Comparison of laboratory data among NAFLD and non-NAFLD groups

		NAFLD N = 102	Non-NAFLD N = 103	p
ALT (U/L)	**Mean ± SD**	17.64 ± 0.75	17.43 ± 0.56	0.141
AST (U/L)	**Mean ± SD**	24.09 ± 6.21	22.74 ±6.67	0.135
ALP (U/L)	**Mean ± SD**	120.97 ± 4.54	139.32 ± 5.08	0.127
GGT (U/L)	**Mean ± SD**	21.68 ± 0.80	15.91 ± 1.28	<0.001*
TC (mg/dl)	**Median (Min. – Max.)**	180 (112 – 305)	144 (97 – 281)	<0.001*
TG (mg/dl)	**Median (Min. – Max.)**	112 (50 – 337)	77 (52 – 247)	<0.001*
LDL (mg/dl)	**Median (Min. – Max.)**	98.6 (17 – 247)	86.8 (17 – 207.6)	0.033*
HDL (mg/dl)	**Mean ± SD**	39.17 ± 12.22	44.3 ±13.6	0.005*
VLDL (mg/dl)	**Mean ± SD**	28.26 ± 1.65	19.63 ± 0.89	<0.001*
TC/HDL ratio	**Mean ± SD**	5.45 ± 0.32	4.20 ± 0.25	0.001*
LDL/HDL ratio	**Mean ± SD**	3.44 ± 0.27	2.71 ± 0.21	0.029*

ALT: Alanine transferase; AST: Aspartate aminotransferase; Alkaline phosphatase (ALP); GGT: Gamma-glutamyl transpeptidase; TC: Total cholesterol; TG: Triglyceride; HDL: High density lipoprotein; LDL: Low density lipoprotein; VLDL: Very low density lipoprotein; n: number of patients; Median, Min. – Max.: non parametric test. *: Significant.

Comparing NAFLD group to non-NAFLD group, NAFLD patients had significantly higher FBG, FI, and HOMA-IR levels in comparison with **(Table 3).**

Table (3): Comparison of FBG, FI levels and HOMA-IR among NAFLD and non-NAFLD groups

		NAFLD N = 102	Non-NAFLD N = 103	P
Fasting bl. glucose (mg/dl)	**Mean ± SD**	107.40 ± 5.34	85.10 ± 0.71	<0.047*
Fasting insulin (µU/mL)	**Mean ± SD**	4.62 ± 0.86	4.39 ± 0.56	0.026*
HOMA-IR test	**Mean ± SD**	1.21 ± 0.06	0.92 ± 0.01	<0.001*

HOMA-IR: Homeostasis model assessment-insulin resistance; n: Number of patients. *: Significant.

The ROC curve, conducted for discrimination between NAFLD and non-NAFLD groups, showed moderate accuracy AUC at best cut off (>1.01) **(Table 4).**

Table (4): Validity of HOMA-IR for discrimination between NAFLD and non-NAFLD groups

HOMA-IR test								
AUC	**95% CI**	**P**	**Cut off**	**Sensitivity (%)**	**Specificity (%)**	**PPV (%)**	**NPV (%)**	**Accuracy (%)**
0.702	0.609 – 0.763	<0.001*	>1.01	64.71	82.52	78.6	70.2	73.66

AUC: Area under ROC curve; CI: Confidence interval; PPV: Positive predictive value.
NPV: Negative predictive value. *: P value Significant <0.05.

Regarding ultrasound finding, all 102 NAFLD subjects had fatty liver on ultrasound. The most common grade was grade II. Among non-NAFLD subjects, 100% had normal liver ultrasound **(Table 5)**. HOMA-IR showed ascending level with higher grades of fatty liver **(Table 6).**

Table (5): Ultrasound among NAFLD and non-NAFLD groups

US liver	NAFLD (N = 102)	Non-NAFLD (N = 103)	P
	No. (%)	No. (%)	
Normal	0 (0.0%)	103 (100.0%)	<0.001*
Fatty (Grade I)	18 (17.6%)	0 (0.0%)	
Fatty (Grade II)	49 (48.0%)	0 (0.0%)	
Fatty (Grade III)	35 (34.3%)	0 (0.0%)	

Table (6): Comparison of HOMA-IR according to ultrasound among NAFLD and non-NAFLD subjects

Group	US liver	HOMA IR			P
		Mean±SD	Median	Minimum-maximum	
Non-NAFLD	Normal (Grade 0)	0.92±0.01	0.95	0.64-1.18	<0.001
NAFLD	Fatty (Grade I)	0.94±0.09	1.01	0.40-1.45	
	Fatty (Grade II)	1.00±0.02	1.04	0.78-1.15	
	Fatty (Grade III)	1.64±0.14	1.60	0.58-3.25	

HOMA-IR had a significant positive correlation with the following; BMI, FBG, FI level, GGT and lipid profile **(Table 7).**

Table (7): Correlation of HOMA-IR with other parameters among all studied subjects

	HOMA-IR	
	Rs	P
BMI (kg/m^2)	0.360	<0.001*
Fasting bl. glucose (mg/dl)	0.713	<0.001*
Fasting Insulin (µU/mL)	0.512	<0.001*
ALT (U/L)	0.136	0.151
AST (U/L)	0.169	0.127
ALP (U/L)	-0.102	0.144
GGT (U/L)	0.193	0.006*
TC (mg/dl)	0.856	<0.001*
TG (mg/dl)	0.920	<0.001*
LDL (mg/dl)	0.834	<0.001*
HDL (mg/dl)	-0.804	<0.001*
VLDL (mg/dl)	0.920	<0.001*
Cholesterol/HDL Ratio	0.862	<0.001*
LDL/HDL Ratio	0.855	<0.001*

BMI: Body mass index; ALT: Alanine transferase; AST: Aspartate aminotransferase; ALP: Alkaline phosphatase; GGT: Gamma-glutamyl transpeptidase; TC: Total cholesterol; TG: Triglyceride; LDL: Low density lipoprotein; HDL: High density lipoprotein; VLDL: Very low density lipoprotein; rs, Spearman' s correlation coefficient.

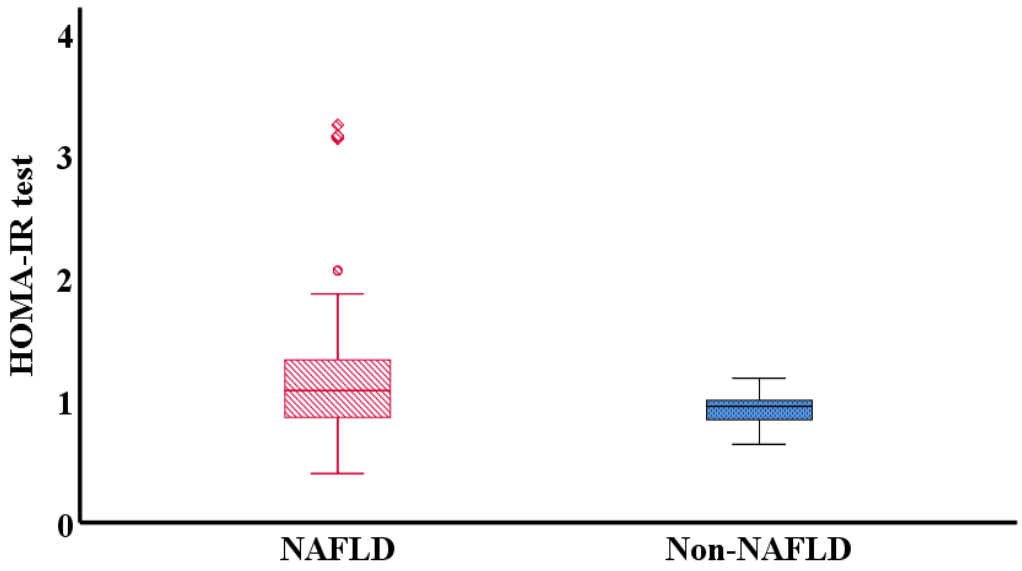

Figure (1): Boxplot chart for HOMA-IR test among NAFLD and non-NAFLD groups

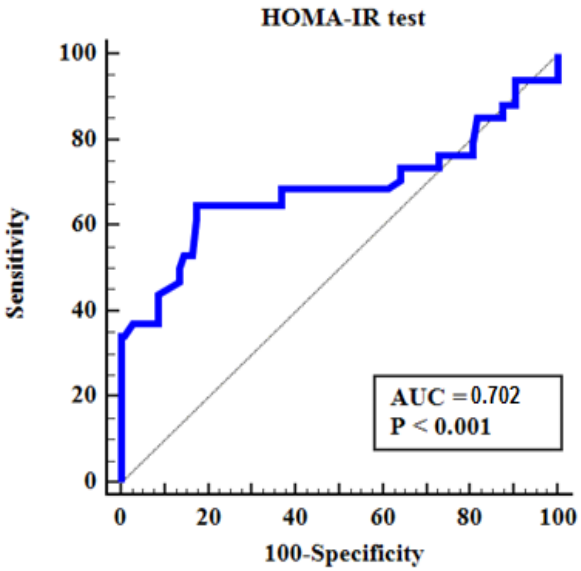

Figure (2): ROC Curve for HOMA-IR test among for discrimination between NAFLD and non-NAFLD groups.

DISCUSSION

Insulin resistance (IR) is the primary pathogenic mechanism of NAFLD because it has a crucial role in both the establishment of steatosis and its development into more severe disease states such as NASH, fibrosis, and liver-related mortality [(13)].

In this study, between both groups, there was no significant difference (NAFLD and non-NAFLD) regarding age with mean (45.54 ± 9.56 vs 45.13 ± 11.41 years, respectively) and this was agreed with a study, where age was slightly higher in NAFLD compared to NAFLD free one with mean (45.74±12.71 vs 42.28 ± 13.41 years, respectively), but not statistically significant [(14)]. On the other hand, a study assessing the risk factors of NAFLD found a significant difference between NAFLD and non-NAFLD groups regarding age, as the mean age was (52.3 ± 15 years vs 36.7 ± 15.7 years, respectively), p < 0.001 [(15)]. Although there was a correlation between age and both the prevalence of NAFLD and the stages of liver disease [(16)], one study hypothesized that the association between age and increased prevalence of NAFLD, and the greater degree of fibrosis and progression to cirrhosis in NAFLD, could be associated with disease duration instead of the patient's age [(17)].

There was no statistically significant difference between NAFLD and non-NAFLD groups as regard sex in the present study, overall females constituted the dominant portion of NAFLD group (73 patients) representing 71.6%, while males (29 patients) represented 28.4%. This goes in agreement with two other studies, where the number of female to male patients was (53/32 respectively) in one of them [(18)], and (44/22 respectively) in the other one [(19)]. This rules out female sex as a protective factor of NAFLD, as it seems that the prevalence increases in females with increasing age [(20)].

With regard to history of DM, there was significant difference between NAFLD group and NAFLD free one, (20 Patients (19.6%)) with NAFLD has history of DM vs (0 subjects (0.0%)) in non-NAFLD group (P=<0.001). That agreed with a study, which found that only 39 patients (5.2%) in the non-NAFLD group and 108 patients (41.5%) in the NAFLD group (p 0.001) (15) had diabetes. Additionally, a number of population-based studies revealed that people with T2DM have a greater incidence of NAFLD development [(21)].

Given that the prevalence of history of hypertension was greater in NAFLD compared to NAFLD free one, there was a significant difference between both groups (28.4% vs 3.9%), P=<0.001. This agreed with two other studies, as one found that hypertension was present in 43.08% vs 17.50% in NAFLD and non-NAFLD groups respectively, p= 0.001 [(22)], and the other found hypertension in 51.5% vs 15.6% in NAFLD and non-NAFLD groups respectively, p < 0.001 [(15)].

Regarding BMI, this study revealed a significant difference between both groups, with the NAFLD group experiencing a larger level compared to NAFLD free group with mean BMI of (31.62±5.31 vs 28.84±4.13 kg/m^2, respectively), P< 0.001. In the same line, significant differences between NAFLD and non-NAFLD group subjects were noticed as regard BMI in other studies, with mean BMI (30.05 ± 0.51 kg/m^2 vs 20.41 ± 0.31 kg/m^2, respectively), P<0.001 [(23)], and mean BMI (29.6 ± 4.0 vs 25.5 ± 2.2 kg/m^2, correspondingly), p < 0.001 [(15)]. This is consistent with the fact that overweight is a main predisposing factor in the context of NAFLD and that the prevalence of the disease grows as BMI climbs [(24)].

Regarding liver enzymes, there was no statistically significant difference in ALT between the NAFLD and non-NAFLD groups in this study with a mean of (17.64±0.75 vs 17.43±0.56 IU/L, respectively). This was in contrary to another study who stated that NAFLD patients had statistically significant higher ALT compared to NAFLD free patients with a mean of (31.2 ± 27.2 vs 20.0 ± 11.8 IU/L, respectively), p<0.001 [(15)]. Moreover, according to the present study, there was no significant difference in AST between both groups, however it was marginally greater in the NAFLD group in comparison with NAFLD free one, with a mean of (24.09±6.21 vs 22.74±6.67 IU/L respectively). This was consistent with another study, as AST was higher in NAFLD group in comparison with NAFLD free one with a mean of (65.01 ± 12.8 and 29.45 ± 9.8 IU/L, respectively), P= 0.97 [(22)].

Generally, when there is a shift in aminotransferases, the ALT level often rises while the AST level stays the same or very slightly rises. However, the ALT levels of around 80% of patients

are normal [25, 26]. This was found in previous studies where serum ALT levels has been argued that it cannot be used to h-predict NASH or to differentiate between simple steatosis and NASH [27]. Also, it is well known that liver enzymes are poor indicators of NAFLD and hence could not be relied upon for NAFLD diagnosis or grading [25,26,28].

In the context of lipid profile, there were statistically significant differences between both groups (NAFLD and non-NAFLD groups), as TC, TG, LDL, VLDL were significantly higher and HDL was significantly lower in NAFLD group in comparison with non-NAFLD group. This has been also proven in previous studies [15,29]. This may be based on that the lipid buildup in hepatocytes is the pathological characteristic of NAFLD, indicating a direct connection between improper lipid metabolism and NAFLD [30].

The current study demonstrated that, FBG was significantly elevated in NAFLD group in comparison with NAFLD free one with a mean of (107.40 ± 5.34 vs 85.10 ± 0.71 mg/dl), P=0.047. This was in agreement with another study where FBG was similarly greater in NAFLD group compared to NAFLD free one with a mean of (168.20 ± 61.19 vs 140.72 ± 39.58 mg/dl, respectively), P= 0.009 [10]. The correlation between dysglycaemia and fatty liver disease is well recorded. In particular, increased FBG values was found to raise the possibility FLD [31].

Additionally, FI was significantly elevated in NAFLD group in comparison with NAFLD free one with a mean of (4.62 ± 0.86 μU/mL vs 4.39 ± 0.56 μU/mL, respectively), P=0.026. This was in agreement with two other studies, where FI in one of them was significantly higher in NAFLD group in comparison with NAFLD free one with a mean of (15.7 ± 7.6 mU/L vs 6.00 ± 2.8 mU/L, respectively), p<0.01 [14,22]. This has been clarified by reduction in insulin sensitivity among cases with NAFLD [10].

This study revealed that there was a significant difference between both groups with regard to HOMA-IR level, with a mean of greater in the NAFLD group in comparison with NAFLD free one (1.21±0.06 Vs 0.92±0.01) with the optimal cut off point ≥1.01, Sn of 64.71% and Sp of 82.52%, with total accuracy of 73.66%, p<0.001. This was consistent with earlier research, the **Farag Allah *et al.*** [10] study revealed a statistically significant correlation (p 0.0001) between the mean value of HOMA-IR and the existence of NAFLD. The best sensitivity, Sp, and overall accuracy scores were found with a HOMA-IR value of 4.2 (72%, 68% and 70%, respectively).

In the same line, **Motamed *et al.*** [14] study showed that the HOMA-IR in the NAFLD group was significantly greater than the nonalcoholic group, p <0.001, with a Sn of 87.0% and a Sp of 81.5%, the greatest positive point for the aforementioned index was 1.75.

Also **Novaković *et al.*** [22] found that HOMA-IR index > 3 was established in the group with NAFLD, with average value of 3.9 ± 2.8 vs 1.2 ±0.6 which was statistically significant in the control group. This study's cut off value differs from that of other research' due to a variety of reasons, including methodological variations, instruments used, patient characteristics, and ethnicity.

It was recommended that the fact that NAFLD is regarded the hepatic component of the metabolic syndrome and IR represents its pathophysiological signature explains the strong correlation between HOMA-IR and the existence of NAFLD. Reduction in body, hepatic, and adipose tissue insulin sensitivity are the hallmarks of IR in NAFLD. Hepatic steatosis and IR are considered to be parts of a vicious cycle, both being the cause and effect of the other [28].

HOMA-IR showed ascending level with increasing grade of fatty liver, with a mean of (0.92 ± 0.01) in Grade 0, (0.94 ± 0.09) in Grade I, (1.00 ± 0.02) in Grade II and (1.64 ± 0.14) in Grade III, P<0.001. This was also concluded in previous reports where significant differences between NAFLD grades and the control group were revealed by the HOMA-IR score. In one study, entire NAFLD cases in all grades had HOMA-IR index values > 1.5, with a mean of (1.33 ± 0.05) in Grade 0, (1.99 ± 0.14) in Grade I, (2.5 ± 0.24) in Grade II and (2.82 ± 0.28) in Grade III [32]. In another report, the HOMA-IR index was statistically linked to the progression of the grades of hepatic steatosis with a mean of (1.88 - 3.58) in Grade I, (2.04 - 5.23) in Grade II and (4.2 - 27.2) in Grade III, p=0.008 [7]. Another study has revealed a significant correlation between hepatic fat and IR as determined by HOMA-IR [33].

This might be owing to IR causing de novo lipogenesis and increasing free fatty acid (FFA) inflow in hepatocytes as a result of excessive adipose tissue lipolysis, which then causes intra-hepatocyte fat buildup and dysregulation of the lipid metabolism [34]. The HOMA-IR index is a crucial instrument that aids in the analysis of NAFLD and could foretell the development of more severe forms [6].

On the other hand, **Motamed *et al.*** [14] study found the limited sample size (108 people, 54 NAFLD and 54 non-NAFLD), as well as the various ethnicities of the patients included in their research, may have contributed to the extremely weak positive non-significant connection between the degree of steatosis and the HOMA-IR score (P=0.251) [14].

The use of ultrasonography to diagnose NAFLD and its grades as opposed to liver biopsy, which has traditionally considered the best approach in the context of FLD diagnosis, is one of the study's shortcomings. However, because of its invasiveness, potential for problems, and expensive expense, it is not advised for the general public. Contrarily, abdominal ultrasonography is a simple, inexpensive, low-risk, noninvasive, and widely accessible technology.

Second, the sample size was inadequate, and a larger sample size is advised [21, 34]. Additionally, we advise that the HOMA-IR index be generated separately for each distinct geographic location to assess the impact of ethnic and genetic variables.

CONCLUSION

The independent relationship between HOMA-IR and the presence of NAFLD in adult patients suggests that it might be used in clinical practice as a screening tool for the disease, subsequently referring patients for further evaluation, also it may be used to differentiate between different grades of NAFLD.

- **Sponsoring financially:** Nil.
- **Competing interests:** Nil.

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