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Anthropometric Parameters Correlations with Non-Alcoholic Fatty Liver Disease

Kareem Essam[*1], Mohamed Gomaa[1], Manal Sadek[3], Mohamed Ahmed El Ghobary[1], Sara Essameldin[2], Sara Elkhateeb[2]*

[1]*Internal medicine department, Faculty of Medicine, Cairo University, Egypt.*

[2]*Clinical pathology department, Faculty of medicine, Cairo University, Egypt.*

[3]*Internal medicine department, Ahmed Maher teaching hospital, Cairo, Egypt.*

Abstract

Non-alcoholic fatty liver disease (NAFLD) has become more common in combination with the obesity pandemic during the last 30 years. The primary indication of liver transplantation worldwide is now considered NAFLD. The aim is studying the correlation of anthropometric parameters with liver steatosis for detection and monitoring progression of NAFLD. 100 NAFLD patients (diagnosed by ultrasound) collected from Kasr Alainy and Ahmed Maher teaching hospitals and 100 healthy subjects as a control group were subjected to full history taking, anthropometric assessment including body mass index (BMI), Waist Hib ration (WHR), waist circumference (WC), Hib circumference (HC), and abdominal Sonography (steatosis severity was graded according to degree of fatty infiltration (grade 1 ,2 and 3). In the NAFLD group, there were significant positive correlations between degree of liver steatosis and BMI (r=0.594), WC (r=0.361), hip circumference (r=0.433) compared to control group (p value < 0.001). The degree of liver steatosis in NAFLD group were (33% grade one, 51% grade 2, 16% grade 3) with no steatosis in the control group. The current study demonstrated a strong positive correlation between anthropometric measures and the presence, severity of NAFLD, which thought to be useful for early detection and monitoring progression of NAFLD.

Keywords: Anthropometric parameters, BMI, Fatty liver

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1. Introduction

Due to the obesity pandemic, the NAFLD prevalence, whose nomenclature changed into metabolic associated fatty liver disease (MAFLD) in 2020, has significantly increased during the past few decades. As NAFLD progresses naturally, end stage liver disease may develop, which currently thought to be a primary indicator for liver transplantation. [1]. in the pathophysiology of NAFLD, steatosis and inflammatory processes can progress to cirrhosis and fibrosis [2]. According to recent studies, NAFLD is currently the main cause of cryptogenic cirrhosis. [3]. Furthermore, there is still much to learn about the pathophysiology of NAFLD, with individual variations in the course, outcome, and development of HCC [4].

2. Materials and Methods

The current study is an observational case-control study for investigating the relationship between anthropometric parameters and degree of liver steatosis.

2.1 Characteristics of the study region

Participants were recruited from the Ahmed Maher Teaching Hospital, and Kasr Alainy internal medicine hospital.

2.2 Participants groups

Group 1: 100 subjects diagnosed with NAFLD after evaluation with abdominal ultrasonography.

Group 2: 100 healthy subjects as control. The study had obtained the Ethical approval from Kasr Alaini hospital, Cairo University, Institutional review board. An informed consent had obtained from all the study members.

2.3 Inclusion criteria

- Subjects between 30 and 60 years diagnosed with NAFLD after evaluation by abdominal ultrasonography.

2.4 Exclusion criteria

- Patients with cirrhosis.

- Patients using steatogenic drugs like amiodarone, methotrexate, tamoxifen and glucocorticoids
- Viral hepatitis.
- Autoimmune hepatitis.
- Wilson's disease.
- Kidney diseases.
- Alcohol consumption.
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2.5 Methods

All patients were subjected to:

- Full history including age, gender, alcohol consumption, drug history and presence of co-morbidities.
- Full clinical examination
- Anthropometric Measurements: Body mass index [BMI = body weight (kg)/height 2 (m2)], waist-to-hip ratio [WHR = waist circumference (cm)/hip circumference (cm)], waist circumference, and hip circumference.
- Laboratory data: Complete blood picture, full metabolic profile, viral markers, and autoimmune profile.
- Abdominal Sonography: steatosis severity graded according to degree of hepatic fatty infiltration into: (grade 1) minimal fatty infiltration, with mild increased echogenicity, (grade 2) moderate fatty infiltration, with obscured portal vessel walls, and (grade 3) dense infiltration.

2.6 Statistical analysis

SPSS version 20 for Windows 2010 is used for analysis of data, presenting the Numerical data as mean and standard deviation (SD) and considering P values <0.05 to have statistical significance.

3. Results and discussion

Table (1) shows the Anthropometric parameters of cases and controls. NAFLD group had significantly higher mean values for weight, BMI, waist-hip ratio, waist circumference and hip circumference (p-values <0.001) in comparison with the control non-steatotic group whose anthropometric parameters seen within normal range. Table (2) shows the gender and the grades of hepatic steatosis. Female predominance in the NAFLD group may be explained by the higher incidence of steatosis in the older post-menopausal women due to lack of estrogen protective effect. Nevertheless, NAFLD cases had significantly higher steatosis when compared to the control subjects (p-values <0.001). Table (3) shows the correlations of Anthropometric parameters with Degree of Hepatic Steatosis in the NAFLD group. A significant positive correlation is observed between weight, BMI, WC, HC with the degree of hepatic steatosis (p-values <0.001). (Figure 1, 2, 3 and 4). Table (4) shows the anthropometric parameters in both genders in NAFLD cases. NAFLD cases in both genders were obese with high anthropometric parameters. Females had higher BMI, HC, while males had higher WHR.

NAFLD is a common morbidity that affects 25% of individuals globally. It is often considered as the hepatic presentation of metabolic syndrome and is strongly related to type 2 diabetes and obesity. Although it has a strong correlation with liver-associated morbidity and death, its detrimental effects on the cardiovascular system are more pronounced. [5]. The term of "hepatic steatosis" means accumulation of more than 5% liver fat that isn't due to drugs, alcohol, viral infections, or other secondary causes. One of the subtypes of NAFLD is histologic evidence of hepatic steatosis or non-alcoholic steatohepatitis, which describes a condition of excess fat accumulation with lobular inflammation, +/- fibrosis. NAFLD prognosis can be used to predict the development of cirrhosis and hepatocellular carcinoma; however, the primary causes of morbidity in these patients are cardiac and metabolic in nature. [6]. Numerous anthropometric measures as BMI and WHR, have been linked to non-alcoholic fatty liver disease (NAFLD). On the other hand,some studies reported presence of 20% of lean NAFLD patients. Conversely, the physical measure most closely associated with nonalcoholic fatty liver disease (NAFLD) is waist circumference (WC).

Numerous studies with conflicting conclusions regarding the significance of anthropometric measurements as (NAFLD) risk factors have been published. [7-8]. The present study aimed to assess the correlations between anthropometric parameters like BMI, WHR, and WC and the grade of liver steatosis in NAFLD patients compared to controls. This observational case control study consisted of 100 NAFLD patients and 100 control subjects. The mean age in our study for cases was 49.47 years, while controls had lower mean age of 39.42 y. This is similar to Abdallah et al., [9] who reported that, NAFLD patients had significantly higher age than normal subjects ($p = 0.015$). In our study, out of the 100 NAFLD cases, females accounted for a majority, comprising 73%. Alternatively, there were 27% male cases of the total. The female predominance in the NAFLD group may be explained by the higher incidence of steatosis in older post-menopausal women owing to the deficiency of estrogen protective effect. In agreement, Barros et al., [10] found that, although not statistically significant, women made up 75% of NAFLD group and 55.4% of the group with normal liver. This went against what De Nucci et al., [6] found, which was that there was a male majority in NAFLD cases. In fact, the estrogens protective effect likely plays a role in the higher male susceptibility to abdominal obesity, which is directly associated with NAFLD.

In our study, the results showed significantly higher mean values for, weight, BMI, WHR, WC, and HC in NAFLD cases compared to controls. This was expected given that higher insulin resistance in patients with abdominal obesity is a known risk factor for NAFLD. This is consistent with the research done by Kühn et al., [9], which investigated whether anthropometric measures might use to predict the onset of non-alcoholic fatty liver disease in overweight or obese people. This is in agreement with findings of De Nucci et al., [6], who found that the NAFLD subset had considerably higher waist circumference and BMI than the other subset. ($p < 0.01$; $p = 0.05$ respectively). According to the research of Naguib and Kassab [11], there is a substantial correlation between NAFLD and a high BMI. These results go in agreement with Masroor and Haque [12], who found that a higher BMI significantly correlated with NAFLD. Abdallah et al., [9] found that NAFLD patients had greater BMI, waist/hip ratio, and skinfold thicknesses compared to those with normal liver. This difference was highly statistically significant ($p < 0.05$). These results can also explained by the possibility that obesity causes an imbalance in the synthesis of adipokines that are pro- and anti-inflammatory, which aids in the development of NAFLD [13].

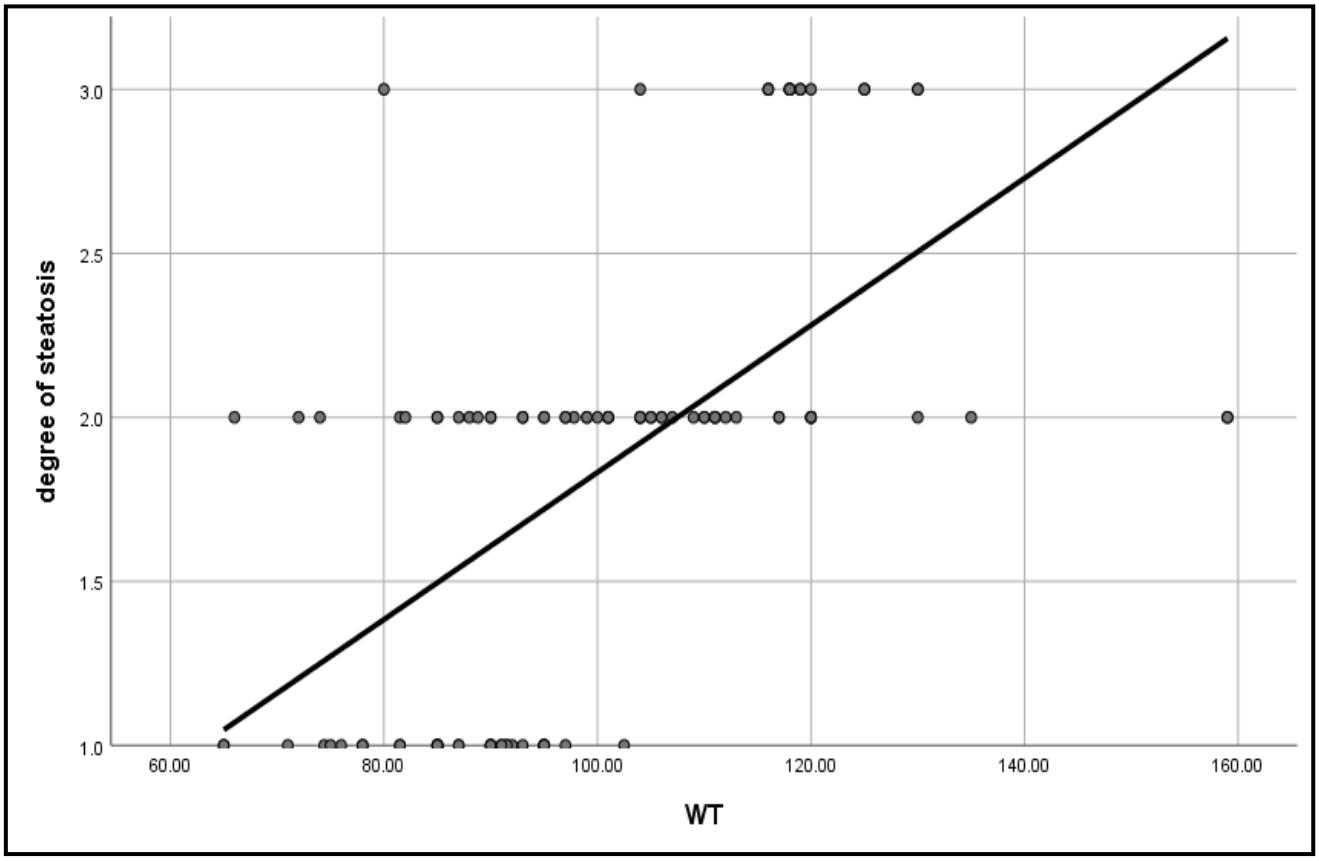

Figure (1): Correlations of Weight with Degree of Hepatic Steatosis

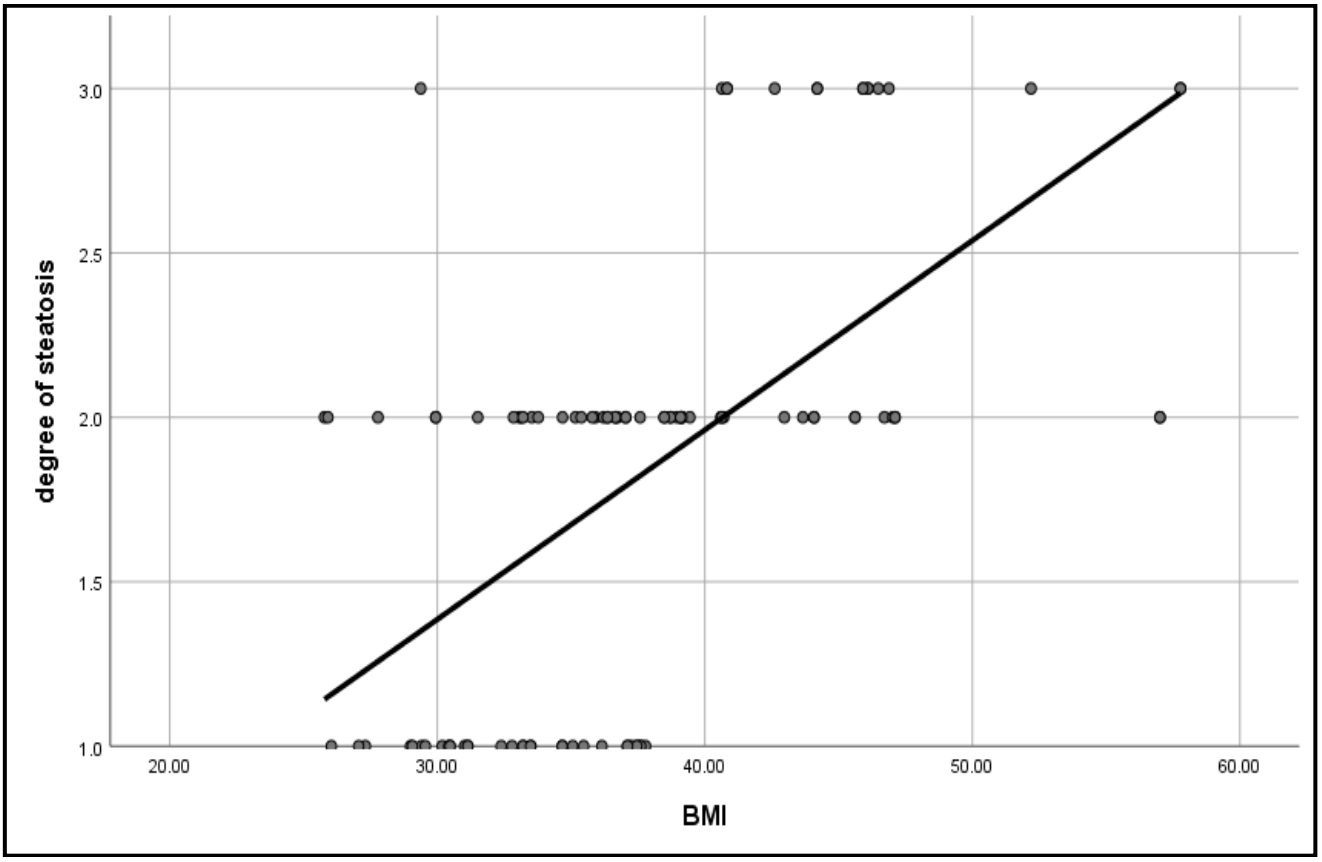

Figure (2): Correlations of BMI with Degree of Hepatic Steatosis

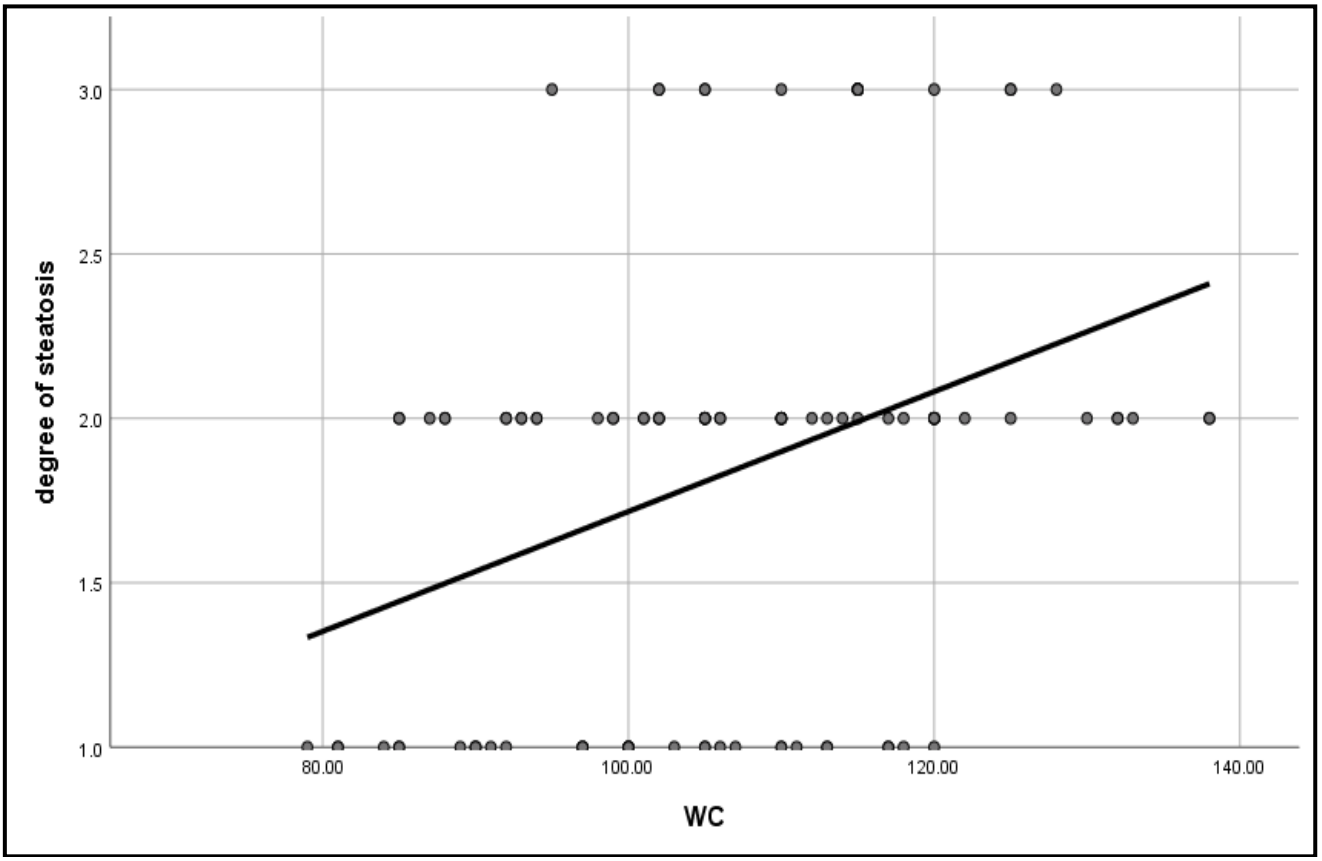

Figure (3): Correlations of WC with Degree of Hepatic Steatosis

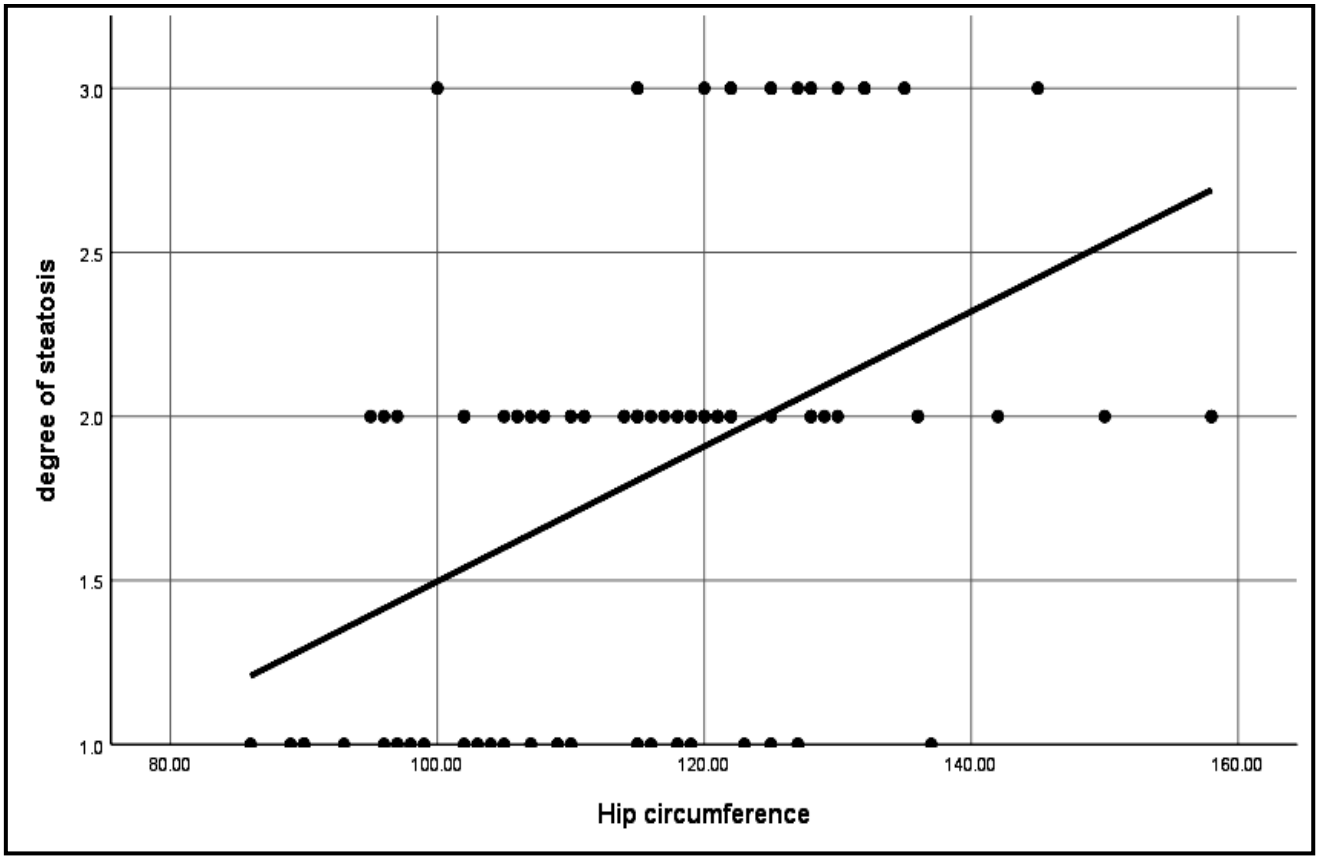

Figure (4): Correlations of Hip circumference with Degree of Hepatic Steatosis

Table (1): Anthropometric parameters of cases and controls

	CASES		CONTROL		P value
	Mean	SD	Mean	SD	
Age (year)	49.47	7.76	39.42	7.93	< 0.001
Weight (kg)	99.89	18.21	68.82	9.95	< 0.001
Height (cm)	162.97	8.05	162.94	9.34	0.981
BMI (Kg/m2)	37.71	7.04	25.97	3.47	< 0.001
WC (cm)	106.21	13.51	79.44	11.09	< 0.001
Hip circumference (cm)	116.19	14.36	89.32	2.26	< 0.001
Waist to hip ratio	0.92	0.06	0.8	0.05	< 0.001

Table (2): Gender and grades of steatosis

		CASES		CONTROL		P value
		Count	%	Count	%	
Gender	**F**	73	73.0%	76	76.0%	0.626
	M	27	27.0%	24	24.0%	
Liver steatosis on ultrasound	**Grade 1**	33	33.0%	0	0.0%	< 0.001
	Grade 2	51	51.0%	0	0.0%	
	Grade 3	16	16.0%	0	0.0%	
	Normal	0	0.0%	100	100.0%	

Table (3): Correlations of Anthropometric parameters with Degree of Hepatic Steatosis in the NAFLD group (N=100)

		Degree of steatosis
Age	**R**	-0.015-
	P value	0.880
Weight	**R**	0.598
	P value	< 0.001
Height	**R**	0.017
	P value	0.863
BMI	**R**	0.594
	P value	< 0.001
WC	**R**	0.361
	P value	< 0.001
Hip circumference	**R**	0.433
	P value	< 0.001
WHR	**R**	-0.138-
	P value	0.172

Table (4): Anthropometric parameters in both genders in NAFLD cases

CASES	Gender				P value
	F		M		
	Mean	Standard Deviation	Mean	Standard Deviation	
BMI (kg/m2)	39.19	7.06	33.72	5.31	< 0.001
WC (cm)	104.97	13.13	109.56	14.22	0.133
Hip circumference (cm)	116.95	14.00	114.15	15.39	0.390
WHR	0.90	0.04	0.96	0.06	< 0.001

In our study, all NAFLD cases had some degree of liver steatosis on evaluation with ultrasonography (33% grade 1, 51% grade 2, 16% grade 3) while all controls had normal liver. The positive associations noted between anthropometric measures and the grade of steatosis support previous reports of Young et al., [14]. Tantanavipas et al., [15] found that NASH might be distinguished from mild NAFLD with significant accuracy using both general and abdominal obesity parameters. In our study, in the NAFLD group, there were significant positive correlations between degree of liver steatosis and anthropometric measures like BMI (r=0.594), WC (r=0.361), hip circumference (r=0.433). The detection of hepatic steatosis at the bedside using ultrasonography has received a lot of attention lately [16]. Numerous pharmacological trials, some of which have reached phase IV, have increased the requirements for non-invasive instruments and biomarkers. It is not practical to follow up on these cases with repeated biopsies. Ultrasonography fatty liver indicator has been demonstrated to be able to detect mild steatosis, which correlates with metabolic parameters and severity-related histology abnormalities. Consistently, anthropometric parameters and grades of steatosis correlates significantly, according to Masroor and Haque's [12].

In both genders, there was a greater association between severity grades of steatosis and BMI and WC than with WHR among the body parameters. This is in line with Kühn et al., [17] who reported that, liver fat has positive correlations with the waist circumference. The anthropometric parameters of NAFLD patients in our study is similar to other studies which reported mean BMI ~27-40 kg/m2, WC ~90-110 cm in similar NAFLD group [18]. In our study, there was statistically non-significant difference between gender and WC. In contrast, Masroor and Haque, [12] found that females had higher WC in NAFLD group. This is also in contrary to Dai et al., [19] who found a higher WC in NAFLD patients. The gender disparities in BMI and waist-hip ratio that we observed in our study within the NAFLD group also support some previous research's that suggest men may exhibit poorer metabolic risk profiles than women at similar stages of NAFLD [20-22]. Masroor and Haque [12], found significantly higher BMI ($p<0.001$) in the presence of NAFLD in males and females, while WHR was significantly higher only in males ($p<0.001$). This may indicate that abdominal obesity is strongly associated with presence of NAFLD. Even in patients who are lean, the can develop fatty liver if they have central obesity. This is in agreement with Dai et al., [19] who found significant increase in BMI in NAFLD patients. From the above findings, we can consider anthropometric measures as useful tool in monitoring hepatic steatosis.

4. Conclusions

The present study demonstrated a significant correlation between anthropometric measures and the presence and severity of NAFLD. NAFLD group had significantly higher values for weight, BMI, waist-hip ratio, WC, and hip circumference compared to the control group, highlighting the role of obesity in NAFLD development. All NAFLD cases exhibited some degree of liver steatosis, with varying grades, while the control group had normal liver. A strong positive correlation seen between the degree of liver steatosis and measures such as BMI, WC, and hip circumference in the NAFLD group.

Limitations to be considered in this study

The cross-sectional design of our study makes it more difficult to determine a cause-and-effect link between the variables under investigation. The relatively small sample size may have an impact on how broadly the results may be applied.

Recommendations

Monitoring of anthropometric parameters should be taken into consideration for individuals with NAFLD, since they are associated with a greater risk of hepatic steatosis and a worsening of the condition.

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