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ORIGINAL ARTICLE

Association of perirenal fat thickness, abdominal subcutaneous fat thickness and renal sinus fat diameter with hepatic steatosis

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ABSTRACT

Hepatic steatosis (HS), characterized by the abnormal accumulation of triglycerides within hepatocytes, is a prevalent pathological condition. However, its detection rate often underestimates its true prevalence, particularly when assessed using abdominal computed tomography (CT) scans. This quantitative cross-sectional study, conducted from September 2024 to February 2025 at Royal Prima Hospital, aimed to investigate the associations of perirenal fat thickness (PrFT), abdominal subcutaneous fat thickness (ASFT), and renal sinus fat diameter (RSFD) with HS. A non-probability sampling method was utilized, and a total of 272 non-contrast abdominal CT scans were analyzed. Statistical analyses were performed using SPSS software. HS was defined as an average hepatic parenchymal Hounsfield Unit (HU) value at least 10 HU lower than that of the spleen, with an absolute hepatic HU attenuation of less than 40. The grading of HS was determined according to the CT liver-spleen (L-S) ratio: mild (0.7 < CT L-S < 1.0), moderate (0.5 < CT L-S < 0.7), and severe (CT L-S < 0.5). The results demonstrated a significant association between the mean right-left PrFT and the presence of HS (p = 0.007), suggesting that perirenal fat may contribute to the development of HS. In contrast, neither the mean right-left RSFD nor the ASFT showed a significant association with HS presence (p = 0.056 and p = 0.904, respectively). Furthermore, none of the fat measurements (PrFT, ASFT, and RSFD) were significantly associated with the grading of hepatic steatosis (p = 0.800, 0.288, and 0.996, respectively). These findings underscore the potential utility of PrFT as a non-invasive indicator for HS diagnosis. The study also highlights the importance of quantitative measurements, such as hepatic and splenic HU values and CT L-S ratios, for the accurate diagnosis of HS, as visual assessment alone may be insufficient.

Keywords: hepatic steatosis, perirenal fat thickness, abdominal subcutaneous fat thickness, renal sinus fat diameter

INTRODUCTION

Fatty liver or hepatic steatosis (HS) refers to the abnormal accumulation of triglycerides (TG) within hepatocytes.[1] Steatotic Liver Disease (SLD) is an umbrella term that includes Metabolic Dysfunction Associated Steatotic Liver Disease (MASLD), Alcohol-associated/related liver disease (ALD), and Metabolic Dysfunction And Alcohol Associated/Related Liver Disease (MetALD).[2] The most common cause of SLD is Non-alcoholic fatty liver disease (NAFLD).[1] According to the latest consensus (Delphi consensus), NAFLD can now be classified into MASLD and possible MASLD.[3] Therefore, in this paper, the updated terminology MASLD will be used, which was previously referred to as NAFLD in the literature.

The estimated prevalence of SLD in the United States is 34.2% [4] with approximately 80.19 million people affected.[5] MASLD is the most common chronic liver disease worldwide, with a rising prevalence among both adults and children.[6] The estimated global incidence of MASLD is 47 cases per 1,000 population and is higher among men than women. The estimated global incidence of MASLD is 47 cases per 1,000 population, with a higher incidence in men than women. The estimated global prevalence of MASLD among adults is 32%, with males exhibiting a higher prevalence (40%) compared to females (26%). The global prevalence of MASLD has increased over time, from 26% in 2005 to 38% in 2016. The prevalence of

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MASLD exceeds 40% in the Americas and Southeast Asia.[7] According to research by Younossi et al.[8], Southeast Asia ranks as the region with the third highest prevalence of MASLD at 33.07% (range: 18.99–51.03%). The estimated prevalence of MetALD is 2% (1,6-2,9%), ALD 0,7% (0,5-0,9%), etiology specific/cryptogenic 0,03% (0,01-0,08%).[4] However, there is no available data on the prevalence of SLD in Indonesia.

Abdominal obesity (central or visceral) is a significant risk factor for metabolic syndrome. Obesity is characterized by excessive fat accumulation in adipose tissue, subcutaneous regions, or specific organs.[9] Several indicators and methods exist to measure obesity; among them, Body Mass Index (BMI) is widely used as a screening tool. However, BMI has limited accuracy and is not universally applicable across all ethnic groups. Moreover, it cannot distinguish between fat and lean tissue, and is less accurate in patients with edema, malnutrition, age-related muscle loss, low body fat, or high muscle mass.[10] The gold standard for quantitatively evaluating intra-abdominal adipose tissue is computed tomography (CT) and magnetic resonance imaging (MRI).[9]

Not all obese patients develop MASLD; importantly, MASLD can also occur in non-obese and lean individuals, especially in Asian populations.[11] Approximately 19% of non-obese Asians have MASLD, which may be attributed to a higher percentage of visceral adiposity compared to other ethnicities.[7] Increased visceral adipose tissue (VAT) may play a crucial role in this phenomenon, underscoring the need for further research on VAT.[12] Among VAT deposits, perirenal fat can be readily measured using ultrasound, CT, and MRI.[13] Perirenal adipose tissue (PAT), located in the retroperitoneal space surrounding the kidney, is an important component of VAT. Several clinical studies have demonstrated that perirenal fat thickness (PRFT) is closely associated with metabolic dysfunctions such as hypertension, increased insulin resistance, elevated uric acid levels, and dyslipidemia. These findings suggest that PAT may be involved in the pathogenesis of MASLD.[12]

Renal sinus fat (RSF) is an indicator of obesity-related complications.[14] In a study by Inokuchi et al.[14], a strong positive correlation was observed between RSF and the anteroposterior diameter of the renal sinus (APDRS) ($r = 0.802$, $p < 0.01$). The first study investigating fat deposition in the renal sinus (FRS) was conducted on 92 young adults by Doğan and Sarı.[15] They found that FRS could be a useful adjunctive method to assess low-grade HS, although further research with larger and more heterogeneous samples is warranted. To date, no other studies have examined the relationship between FRS and HS. Several studies have also explored subcutaneous fat thickness. For example, Mohamed et al.[16] reported a positive association between abdominal subcutaneous tissue measurements and HS, while Mahmoud et al.[17] found a positive correlation between HS severity and the amount of subcutaneous and visceral fat in a cohort of 130 patients in Egypt.

The gold standard for evaluating parenchymal liver disease, including HS, remains percutaneous hepatic biopsy.[18,19] However, ethical and medical considerations limit its widespread use in MASLD cases. Complications such as bleeding and the impracticality of repeated biopsies for disease monitoring further restrict its application.[18] Additionally, limited access to non-invasive diagnostic methods and selection bias in biopsy-based studies pose challenges in diagnosing HS.[5] Given the growing need for non-invasive hepatic steatosis (HS) diagnosis and limited data on specific fat measurements, researchers are using computed tomography (CT) scans to investigate the connections between these fat depots and HS. The study is driven by three main hypotheses: a) H1: Perirenal fat thickness (PrFT) is associated with hepatic steatosis; b) H2: Abdominal subcutaneous fat thickness (ASFT) is associated with hepatic steatosis; and 3) H3: Renal sinus fat diameter (RSFD), also known as APDRS, is associated with hepatic steatosis.

METHOD

This cross-sectional, analytical observational study investigates correlations between variables without aiming to establish causation. It employs a quantitative approach with hypothesis testing.[20,21] The study includes three independent variables: perirenal fat thickness, abdominal subcutaneous fat thickness, and renal sinus fat diameter, and one dependent variable: hepatic steatosis. A non-probability purposive-quota sampling method[21] was used to select 272 non-contrast abdominal CT scans from Royal Prima Hospital, Indonesia, collected between September 2024 and February 2025. Data were obtained from the Zetta PACS system and electronic medical records.

Imaging analysis was performed on images obtained using a 32-slice Siemens CT scanner. The criteria for diagnosing hepatic steatosis included an average hepatic parenchymal attenuation (in Hounsfield Units, HU) lower than that of the spleen[22], with at least a 10 HU difference compared to the spleen[23], and an absolute hepatic attenuation of less than 40 HU.[16] Hepatic steatosis was also assessed using the CT liver-to-spleen (L-

S) ratio, which was categorized as mild (0.7 < CT L-S < 1.0), moderate (0.5 < CT L-S ≤ 0.7), and severe (CT L-S < 0.5) steatosis. The CT L-S ratio was calculated by dividing the mean hepatic attenuation by the mean splenic attenuation. Hepatic attenuation was measured by averaging the HU values from three circular regions of interest (ROIs), each measuring 3 cm². These ROIs were manually drawn on the left lobe of the liver, the anterior segment of the right lobe, and the posterior segment of the right lobe. Splenic attenuation was calculated as the average HU of three 2 cm² ROIs located in the upper, middle, and lower thirds of the spleen.[12] Measurements were preferentially taken from the peripheral areas of the spleen.[15]

Perirenal fat thickness (PrFT) is defined as the average distance from the lateral and posterior abdominal walls to the level of the renal capsule at the L3–L4 vertebral level (kidney level).[12,24] Abdominal subcutaneous fat thickness (ASFT) is measured as the distance between the skin surface and the outer layer of the abdominal muscle at the umbilicus level.[25,26] The renal sinus fat diameter (RSFD) is assessed by measuring the anteroposterior diameter of the renal sinus (APDRS), which is defined as the line connecting the ventral and dorsal edges of the inner slice between the renal sinuses on axial non-contrast CT images. The measurement slice is selected at the center of the renal hilum, as displayed on the axial CT image.[14]

Previous studies have reported RSFD measurement techniques that require specialized equipment. In contrast, APDRS can be measured using only the tools available on Picture Archiving and Communication Systems (PACS) and CT instruments, making it superior in terms of reproducibility and convenience . A strong positive correlation between RSFD and APDRS was demonstrated using Pearson's product-moment correlation ($r = 0.802$, $p < 0.01$).[14] In this study, the units for PrFT, APDRS, and ASFT were millimeters (mm). The collected data were analyzed using SPSS software, and hypothesis testing was conducted to determine whether significant relationships existed among the variables.

RESULTS

The total sample size of this study was 272 non-contrast abdominal ct scans. Table 1 shows the characteristics of the study sample, with an almost balanced gender distribution between men (49,6%) and women (50,4%) and with an average age of participants of 46 ± 14 years old. The average value of the PrFT was 17,81±7,97 mm, the average value of the left PrFT was 16,77±6,45 mm and the average value of right and left PrFT was 17,29±6,61 mm. The ASFT measurement results showed relatively similar values, with the average right-left ASFT result being 26,41±9,35 mm. Meanwhile, RSFD assessed based on APDRS showed an average right APDRS, left APDRS and right-left APDRS of 10,44±5,29 mm, 12,42±5,64 mm and 11,20±5,19 mm, respectively.

Table 1. Subject characteristic (n=272)

Variable	N=272
Gender (N(%))	
Male	135 (49,6)
Female	137 (50,4)
Age (Mean±SD) (years old)	46,01±14,61
Posterior right PrFT (Mean±SD) (mm)	9,84±7,09
Lateral right PrFT (Mean±SD) (mm)	25,88±11,26
Average Right PrFT (Mean±SD) (mm)	17,81±7,97
Posterior left PrFT (Mean±SD) (mm)	10,73±8,62
Lateral left PrFT (Mean±SD) (mm)	22,81±8,62
Average left PrFT (Mean±SD) (mm)	16,77±6,45
Average right and left PrFT (Mean±SD) (mm)	17,29±6,61
Right ASFT (Mean±SD) (mm)	26,59±9,22
Left ASFT (Mean±SD) (mm)	26,42±9,44
Average right and left ASFT (Mean±SD) (mm)	26,41±9,35
Right APDRS (Mean±SD) (mm)	10,44±5,29
Left APDRS (Mean±SD) (mm)	12,42±5,64
Average right and left APDRS (Mean±SD) (mm)	11,20±5,19
HU of the left lobe of the liver (Mean±SD)	50,43±12,39
HU of the anterior right lobe of the liver (Mean±SD)	49,76±12,58
HU of the posterior right lobe of the liver (Mean±SD)	49,12±12,95
Average HU of right and left lobe of the liver (Mean±SD)	47,77±12,44
HU of 1/3 upper part of the spleen (Mean±SD)	50,89±3,32
HU of 1/3 mid part of the spleen (Mean±SD)	51,24±3,42
HU of 1/3 lower part of the spleen (Mean±SD)	52,48±3,39
Average 1/3 upper, 1/3 mid and 1/3 lower part of the spleen (Mean±SD)	51,54±2,99
CT L-S	1,00±0,25
Hepatic Steatosis (N(%))	
Yes	64 (23,5)
No	208(76,5)
Hepatic Steatosis grading(N(%))	
Mild	42 (15,4)
Moderate	12 (4,4)
Severe	10 (3,7)

From the density analysis using Hounsfield Units (HU), the average HU of the right and left lobes of the liver was 47.77 ± 12.44, while the average HU of the spleen (all parts) was 51.54 ± 2.99. Based on the results of this study, 64 samples (23.5%) exhibited hepatic steatosis. Among these patients, grading based on CT L-S revealed that 15.4% (42 samples) had mild hepatic steatosis, 4.4% (12 samples) had moderate hepatic steatosis, and 3.7% (10 samples) had severe hepatic steatosis.

As presented in Table 2, a gender-based analysis of hepatic steatosis (HS) prevalence revealed that among males, 79.3% did not have HS, whereas 20.7% presented with HS. For females, 73.7% were in the non-HS group, and 26.3% were in the HS group. The average age of subjects was comparable between the non-HS and HS groups, both approximating 46 years.

The study demonstrated that the hepatic steatosis (HS) group exhibited higher PrFT values compared to the non-HS group. Specifically, the average right-left PrFT was significantly higher in the HS group (18.97 ± 6.30 mm) than in the non-HS group (16.78 ± 6.63 mm). Similarly, ASFT results were elevated in the HS group (28.36 ± 8.13 mm) when compared to the non-HS group (25.81 ± 9.64 mm). In contrast, RSFD values, as determined by APDRS, showed relatively similar results between the HS and non-HS groups.

Table 2. Characteristics based on the presence or absence of hepatic steatosis

Variable	Non-hepatic steatosis	Hepatic steatosis
Gender (N(%))		
Male	107 (79,3)	28 (20,7)
Female	101 (73,7)	36 (26,3)
Age (Mean±SD) (years old)	46,00±15,53	46,05±11,20
Posterior right PrFT (Mean±SD) (mm)	9,46±7,28	11,10±6,32
Lateral right PrFT (Mean±SD) (mm)	24,54±10,33	30,31±13,01
Average Right PrFT (Mean±SD) (mm)	17,00±7,58	20,47±8,56
Posterior left PrFT (Mean±SD) (mm)	10,50±7,95	11,51±5,73
Lateral left PrFT (Mean±SD) (mm)	22,62±8,63	22,43±8,61
Average left PrFT (Mean±SD) (mm)	16,56±6,73	17,47±5,46
Average right and left PrFT (Mean±SD) (mm)	16,78±6,63	18,97±6,30
Right ASFT (Mean±SD) (mm)	25,84±9,57	29,09±7,46
Left ASFT (Mean±SD) (mm)	25,78±9,89	28,53±7,43
Average right and left ASFT (Mean±SD) (mm)	25,81±9,64	28,36±8,13
Right APDRS (Mean±SD) (mm)	10,15±4,84	11,35±6,48
Left APDRS (Mean±SD) (mm)	12,44±5,51	12,35±6,08
Average right and left APDRS (Mean±SD) (mm)	11,24±4,68	11,09±6,62
HU of the anterior right lobe of the liver (Mean±SD)	54,76±5,96	33,53±14,64
HU of the posterior right lobe of the liver (Mean±SD)	54,32±6,05	33,45±14,21
HU of the left lobe of the liver (Mean±SD)	55,30±6,39	34,59±13,88
Average HU of right and left lobe of the liver (Mean±SD)	54,79±5,80	33,45±14,21

Density analysis, quantified by Hounsfield Unit (HU) values, revealed that the HS group exhibited significantly lower hepatic HU values compared to the non-HS group across all assessed regions: the right anterior lobe, right posterior lobe, and left lobe. Specifically, the average hepatic HU for the right and left lobes combined was 33.45 ± 14.21 in the HS group, substantially lower than the 54.79 ± 5.80 observed in the non-HS group.

Table 3. Characteristics based on grading of hepatic steatosis

Variable	Hepatic steatosis		
	Mild	Moderate	Severe
Gender (N(%))			
Male	20 (14,8)	5 (3,7)	3 (2,2)
Female	22 (16,1)	7 (5,1)	7 (5,1)
Age (Mean±SD) (years old)	46,12±11,06	44±10,82	48,20±12,92
Posterior right PrFT (Mean±SD) (mm)	10,90±5,39	10,91±6,78	12,20±9,49
Lateral right PrFT (Mean±SD) (mm)	27,95±7,01	26,90±7,13	44,00±25,27
Average Right PrFT (Mean±SD) (mm)	19,42±4,88	17,79±7,89	28,10±16,14
Posterior left PrFT (Mean±SD) (mm)	11,52±5,80	12,58±5,23	10,20±6,30
Lateral left PrFT (Mean±SD) (mm)	22,85±9,02	23,08±5,77	26,30±9,83
Average left PrFT (Mean±SD) (mm)	17,19±5,43	17,83±3,46	18,25±7,66
Average right and left PrFT (Mean±SD) (mm)	18,30±4,58	17,81±5,05	23,17±11,30
Right ASFT (Mean±SD) (mm)	28,78±7,85	30,27±4,71	29,10±8,69
Left ASFT (Mean±SD) (mm)	28,11±7,96	29,90±4,57	28,80±8,06
Average right and left ASFT (Mean±SD) (mm)	28,45±7,81	27,58±9,70	28,95±8,28
Right APDRS (Mean±SD) (mm)	11,26±5,51	11,83±9,49	11,20±6,76
Left APDRS (Mean±SD) (mm)	12,14±5,96	13,33±7,45	12,10±5,23
Average right and left APDRS (Mean±SD) (mm)	10,84±6,22	12,00±8,54	11,05±6,32
HU of the anterior right lobe of the liver (Mean±SD)	40,80±4,97	29,66±2,46	7,60±19,13
HU of the posterior right lobe of the liver (Mean±SD)	39,59±5,05	27,91±4,10	6,60±20,42
HU of the left lobe of the liver (Mean±SD)	41,50±4,85	30,41±5,26	10,60±17,97
Average HU of right and left lobe of the liver (Mean±SD)	40,63±4,28	29,33±2,64	8,26±18,82

Based on the table of sample characteristics evaluated according to the grading of hepatic steatosis, the distribution of subjects with mild, moderate, and severe hepatic steatosis showed that the majority of cases in this study were mild, comprising 20 men (14.8%) and 22 women (16.1%). In contrast, the numbers of subjects with moderate and severe hepatic steatosis were lower, with 5 males and 7 females in the moderate group, and 3 males and 7 females in the severe group, respectively. There was no significant

difference in age among the mild, moderate, and severe hepatic steatosis groups, with mean ages of 46, 44, and 48 years, respectively.

Comparison of perirenal fat thickness (PrFT) values across the different grades of hepatic steatosis revealed significant differences. PrFT was higher in the severe group compared to the moderate and mild groups. The average right PrFT in the severe hepatic steatosis group was 28.10 ± 16.14 mm, which was greater than in the moderate (17.79 ± 7.89 mm) and mild (19.42 ± 4.88 mm) groups. A similar pattern was observed for the average left PrFT, with severe hepatic steatosis showing a higher value (18.25 ± 7.66 mm) than moderate (17.83 ± 3.46 mm) and mild (17.19 ± 5.43 mm) groups, although the difference between mild and moderate groups was minimal. Additionally, the average right-left PrFT difference was highest in the severe group (23.17 ± 11.30 mm), compared to moderate (17.81 ± 5.05 mm) and mild (18.30 ± 4.58 mm) groups.

Abdominal subcutaneous fat thickness (ASFT) evaluated in relation to hepatic steatosis grading showed no significant differences. Similarly, the right renal sinus fat diameter (RSFD; APDRS) did not exhibit a clear increasing trend with the severity of hepatic steatosis, showing variable mean values across groups. Hepatic density, measured in Hounsfield units (HU), demonstrated a clear decreasing trend as the severity of hepatic steatosis increased. The mean hepatic HU values for the right and left lobes were 40.63 ± 4.28 in the mild group, 29.33 ± 2.64 in the moderate group, and 8.26 ± 18.82 in the severe group. Normality was assessed using the Kolmogorov-Smirnov test, followed by independent t-tests and Mann-Whitney tests as appropriate. The ASFT variable was normally distributed, warranting the use of an independent t-test, while other variables were analyzed using the Mann-Whitney test.

As shown in Table 4, there was a significant association between the average right-left perirenal fat thickness and the presence of hepatic steatosis ($p = 0.007$, $p < 0.05$). In contrast, the average right-left renal sinus fat diameter and abdominal subcutaneous fat thickness did not differ significantly between groups with and without hepatic steatosis, with p-values of 0.056 and 0.904, respectively ($p > 0.05$).

Table 4. Association of perirenal fat thickness, abdominal subcutaneous fat thickness and renal sinus fat diameter with presence/absence of hepatic steatosis

Variable	Non-hepatic Steatosis	Hepatic steatosis	*P-value*
Average right and left PrFT (Mean±SD)	16,78±6,63	18,97±6,30	0,007
Average right and left ASFT (Mean±SD)	25,81±9,64	28,36±8,13	0,056*
Average right and left APDRS (Mean±SD)	11,24±4,68	11,09±6,62	0,904

**Independent T-Test*

To assess the relationship between perirenal fat thickness, abdominal subcutaneous fat thickness, and renal sinus fat diameter with the grade of hepatic steatosis, the Kolmogorov-Smirnov test was first performed to evaluate data normality. The results indicated that abdominal subcutaneous fat thickness was normally distributed, whereas the other variables were not. Consequently, a one-way ANOVA was applied to analyze the association between abdominal subcutaneous fat thickness and hepatic steatosis grade, while the Kruskal-Wallis test was used to examine the relationships of perirenal fat thickness and renal sinus fat diameter with hepatic steatosis grading.

Table 5. Association of perirenal fat thickness, abdominal subcutaneous fat thickness and renal sinus fat diameter with grading of hepatic steatosis

Variable	Hepatic steatosis			*P-value*
	Mild	Moderate	Severe	
Average right and left PrFT (Mean±SD)	18,30±4,58	17,81±5,05	18,30±4,58	0,800
Average right and left ASFT (Mean±SD)	28,45±7,81	27,58±9,70	28,95±8,28	0,288
Average right and left APDRS (Mean±SD)	10,84±6,22	12,00±8,54	11,05±6,32	0,996

As shown in Table 5, the mean values of right-left perirenal fat thickness (PrFT), abdominal subcutaneous fat thickness (ASFT), and anteroposterior diameter of the renal sinus (APDRS) did not demonstrate significant associations with hepatic steatosis grade, with p-values of 0.800, 0.288, and 0.996, respectively ($p > 0.05$).

DISCUSSION

This study focuses on examining the association between perirenal fat thickness, abdominal subcutaneous fat thickness, and renal sinus fat diameter with hepatic steatosis at RSU Royal Prima Medan. The research model was adapted from previous studies by Doğan and Sarı[15], Mohamed et al.[16] and Yang et

al.[12], with 3 hypotheses. incorporating three hypotheses. The results indicate that only one of the three hypotheses tested demonstrated a significant relationship. Specifically, Hypothesis H1 showed a significant association, whereas Hypotheses H2 and H3 did not.

Hypothesis H1 evaluated the association between perirenal fat thickness and hepatic steatosis, yielding a p-value of 0.007 ($p < 0.05$). These findings align with the study by Yang et al. (2023), which involved 867 patients with Type 2 Diabetes Mellitus (DM) in China and reported a significant correlation between perirenal fat thickness (PrFT) and CT liver-spleen attenuation difference (CT L-S) ($p < 0.001$). Moreover, PrFT was negatively correlated with CT L-S in both the overall population and patients with Metabolic Dysfunction-Associated Steatotic Liver Disease (MASLD).[12] Another study conducted in Beijing, China, involving 593 DM patients and 231 MASLD patients, similarly found that patients with severe MASLD exhibited higher PrFT compared to those with mild MASLD ($p = 0.026$ and $p < 0.001$, respectively).[11]

Hypothesis H2 assessed the relationship between abdominal subcutaneous fat thickness and hepatic steatosis, resulting in a p-value of 0.056 ($p > 0.05$). These findings contrast with a previous study conducted on 143 patients in Menoufia, Egypt, which reported a positive association between abdominal subcutaneous fat thickness and hepatic steatosis ($p = 0.015$).[16] Additionally, another study in Cairo, Egypt, involving 59 obese patients with MASLD but without DM, found significant positive correlations between abdominal subcutaneous fat thickness measured at the midline below the xiphoid process in front of the left liver lobe (LSFT) and at the umbilical region (USFT) with the severity of hepatic steatosis (both $p < 0.001$).[19]

Hypothesis H3 examined the association between renal sinus fat diameter and hepatic steatosis, yielding a p-value of 0.904 ($p > 0.05$). This result is inconsistent with a previous study in Turkey involving 92 subjects, which found that the mean renal sinus fat diameter was significantly higher in patients with hepatic steatosis compared to those without ($p = 0.02$).[15] The discrepancies between the current study and previous research may be attributed to differences in sample size, study location, type of CT scan used, and study period. These factors could potentially influence the study outcomes.

CONCLUSION

This study demonstrated a significant relationship between the average right-left perirenal fat thickness (PrFT) and hepatic steatosis (HS) ($p = 0.007$). In contrast, the average right and left renal sinus fat density (RSFD) and anterior subcutaneous fat thickness (ASFT) showed no significant association with HS, with p-values of 0.056 and 0.904, respectively ($p > 0.05$). Additionally, this study highlights the importance of measuring hepatic Hounsfield units (HU), splenic HU, and the CT liver-to-spleen (L-S) ratio for the diagnosis of hepatic steatosis. The findings indicate that assessment of hepatic steatosis should not rely solely on visual evaluation of hepatic density, as the liver may appear normal on CT scans despite the presence of steatosis. Furthermore, evaluation of surrounding organs, such as perirenal fat thickness, can enhance the diagnostic accuracy for Steatotic Liver Disease (SLD). Future research with a broader scope and a larger, more diverse sample size is essential, along with the inclusion of additional variables associated with hepatic steatosis.

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