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ORIGINAL ARTICLE

Moderate to severe hepatic steatosis on computerized tomography imaging: Prevalence in obese Pacific Islanders and Asians

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Abstract

Background and Aim: Hepatic steatosis (HS) is common worldwide, but there is little data on the prevalence of HS in Pacific Islanders (PIs) and Asians within the United States. Our aim was to compare prevalence of HS in obese 18–50-year-olds of Asian and PI ethnicity who underwent computerized tomography (CT).
Methods: We performed a retrospective analysis of all members of an integrated healthcare system who self-identified as Asian or PI, were between the ages of 18 and 50 years, had a body mass index (BMI) ≥ 30, and underwent a CT scan that included the liver during 2021, resulting in 748 subjects. Imaging was analyzed using a method sensitive and specific for moderate to severe HS. Additionally, multiple binary logistic regression was performed to explore the relationship between HS and HbA1c, BMI, and age.
Results: Of the 748 patients, 311 (41.6%) had HS. We found no significant difference in the prevalence of HS between Asians and PIs ($\chi^2_1 = 1.3$, $P = 0.25$), between Asian and PI men ($\chi^2_1 = 2.8$, $P = 0.096$), or between Asian and PI women ($\chi^2_1 = 0.053$, $P = 0.82$). Higher odds of HS was associated with increasing BMI (OR = 1.08; 95% CI: 1.06–1.11; $P < 0.001$) and HbA1c (OR = 1.15; 95% CI: 1.04–1.26; $P = 0.00489$), but HS was not associated with age in this age range (OR = 0.993; 95% CI: 0.973–1.01; $P = 0.46$).
Conclusion: Moderate to severe HS is very common in obese Asian and PI adults, and occurs at similar rates in these ethnicities. Abdominal CT imaging presents an opportunity to diagnose HS and provides relevant information to patients and healthcare providers.

Introduction

Non-alcoholic fatty liver disease (NAFLD) is the most common chronic liver disease, with an estimated prevalence of 24% in North American adults.[1] However, previous studies have shown that the prevalence varies by ethnicity even within the United States, with very little data on the prevalence among Asians and almost none for Pacific Islanders (PIs).[2,3]

Hepatic steatosis (HS) is necessary for the diagnosis of NAFLD and is readily detected with computerized tomography (CT) imaging of the abdomen.[1,4,5] An earlier investigation found that there is a higher prevalence of HS in PIs as compared to Asian or White patients in a large, nonrandom sample of CT imaging. This study uses a new cohort and controls for BMI, which is associated with HS.[6–8] Controlling for BMI is necessary because within the United States, 42.6% of native Hawaiians and PIs are obese, compared to 11.2% of Asians.[9]

The aim of this study was to compare the prevalence of HS in obese Asian and PI adults aged between 18 and 50 years.

Methods

This is a retrospective analysis of all patients between the ages of 18 and 50 years who underwent a CT study including the liver during the year 2021 within this integrated healthcare system (IHCS). Other inclusion criteria consisted of individuals who self-identified as being of PI or Asian ethnicity (Table 1) and whose most recent BMI was ≥30. When patients self-identified as both Asian and PI, they were grouped with PI. Imaging for any indication was used; however, all patients were imaged for reasons unrelated to the measurement of hepatic fat content. This study was performed with institutional review board approval with waiver of informed consent because it involved only a review of existing healthcare information with no direct patient interactions and complied with the Health Insurance Portability and Accountability Act (HIPAA).

Imaging was performed on one of four different GE multislice CT scanners (GE Healthcare, Wauwatosa, WI, USA) or an Aquilion multislice CT scanner (Canon Medical Systems,

Table 1 Self-reported patient ethnicities

Asian		Pacific Islander (PI)	
Ethnicity	Number	Ethnicity	Number
Chinese	16	Guamanian	2
Filipino	185	Hawaiian	336
Japanese	43	Maori	1
Korean	6	Marshallese	17
Okinawan	7	Samoan	63
Thai	1	Tongan	17
Vietnamese	2	Other PI	8
Other Asian	2	Unspecified PI	9
Unspecified Asian	33		

Tustin, CA, USA) with 120 kVP. CT angiographic studies and studies not obtained in the portal venous phase were excluded from this study. Diagnosis of moderate to severe HS was made by averaging the attenuation of four elliptical regions of interest (ROIs), two above the portal plane and two below, with two taken from the right lobe and two from the left lobe. Elliptical ROIs of between 50 and 150 mm^2 were selected while avoiding obvious vessels. Values less than 40 Hounsfield units (HU) for noncontrast imaging and 90 HU for contrast-enhanced imaging were considered to represent moderate to severe HS (Fig. 1). Readings were taken independently by three medical students who had previously read at least 500 cases for HS and one staff radiologist with more than 20 years of experience reading CT images. Readers were blind to patient diagnoses and problem lists until after the reading was complete.

Seven-hundred and forty-eight patients meeting the inclusion criteria above were identified. One CT was evaluated for each patient, and noncontrast studies were used when possible. Electronic medical record (EMR) was then reviewed for an established diagnosis of HS, cirrhosis, diabetes mellitus type 2, and pre-diabetes; an HbA1c measurement closest to the date of the CT study was also recorded.

Statistical analysis was performed using RStudio and a significance of $\alpha = 0.05$. Differences in prevalence of HS between AS and PI individuals, between Asian and PI men, and between Asian and PI women were assessed using a chi-squared test for independence. Multiple binary logistic regression (LR) and single binary LR were used to assess the relationship between HS and HbA1c, BMI, and age.

Results

Of the 748 studied subjects, 41.6% (311) (39.0% [115/295] Asians and 43.3% [196/453] PIs) were found to have moderate to severe HS, and 13.9% (41/295) Asians and 12.8% (58/453) PIs had HS in their problem list. Among those with moderate to severe HS, 21.2% (66/311) had a diagnosis of HS noted in the EMR (Table 2).

Chi-squared tests for independence showed no significant difference in the prevalence of HS between Asians and PIs

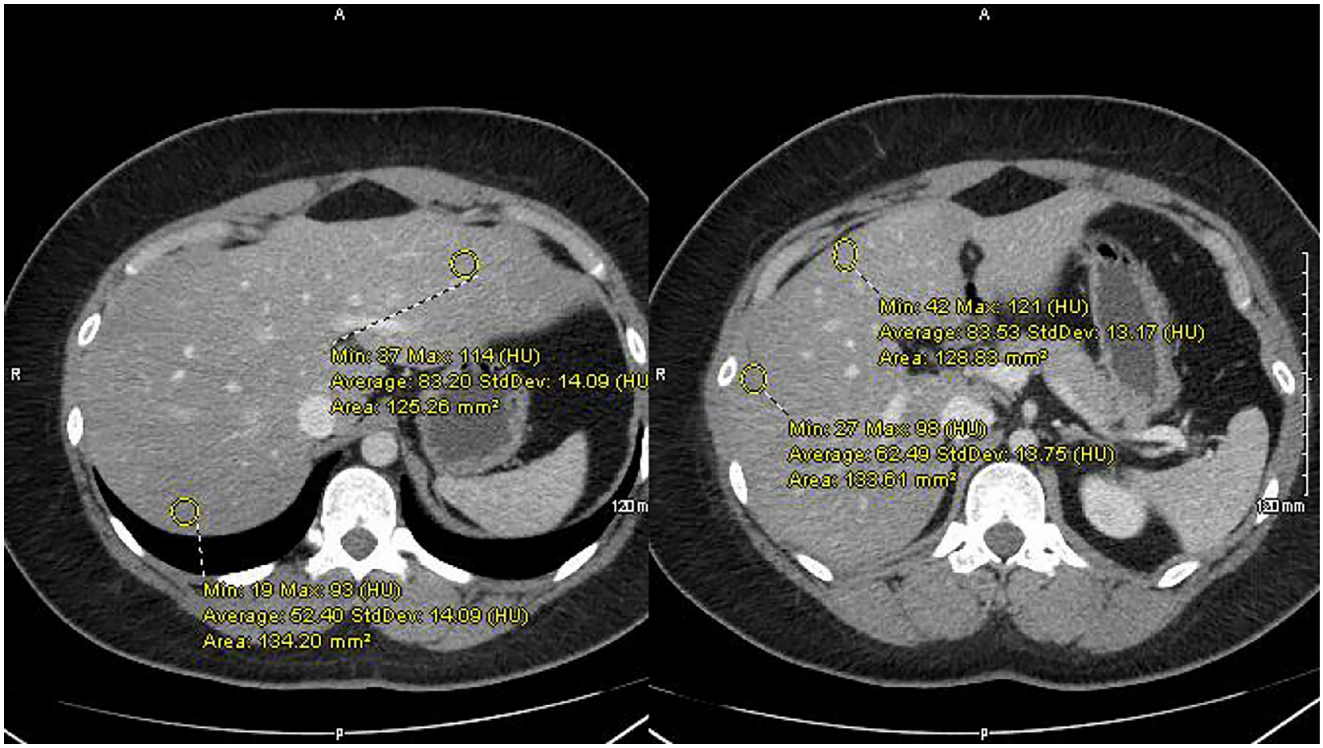

Figure 1 Abdominal computerized tomography with contrast of a 24-year-old with lower abdominal pain. (Left) One region of interest (ROI) in the left lobe and one in the right lobe above the portal plane. (Right) ROIs in the left and right lobe below the portal plane. Average of all four ROIs is less than 90 HU, signifying moderate to severe hepatic steatosis.

Table 2 Patient population characteristics, with hepatic steatosis (HS) as determined by computerized tomography.

	Asian			Pacific Islanders			Total		
	Women	Men	Combined	Women	Men	Combined	Women	Men	Combined
+HS	62	53	115	107	89	196	169	142	311
–HS	102	78	180	168	89	257	270	167	437
Age (mean ± SD)	38.21 (9.79)	39.05 (8.44)	38.58 (9.21)	37.91 (8.27)	39.19 (7.57)	38.42 (8.02)	38.03 (8.85)	39.13 (7.94)	38.48 (8.50)
BMI (mean ± SD)	35.83 (5.77)	36.19 (6.33)	35.99 (6.02)	39.12 (7.96)	38.58 (7.84)	38.91 (7.91)	37.89 (7.39)	37.57 (7.32)	37.76 (7.36)
HbA1c (mean ± SD)	6.05 (1.10)	6.08 (1.24)	6.06 (1.16)	6.30 (1.82)	6.64 (2.14)	6.44 (1.96)	6.21 (1.59)	6.41 (1.84)	6.29 (1.70)
+ DM (in problem list)	36	30	66	65	49	114	101	79	180
+ Pre-DM (in problem list)	34	31	65	55	37	92	89	68	157
+ HS (in problem list)	23	18	41	38	20	58	61	38	99
+ Cirrhosis (in problem list)	1	0	1	3	5	8	4	5	9

Existing diagnoses in electronic medical record included.

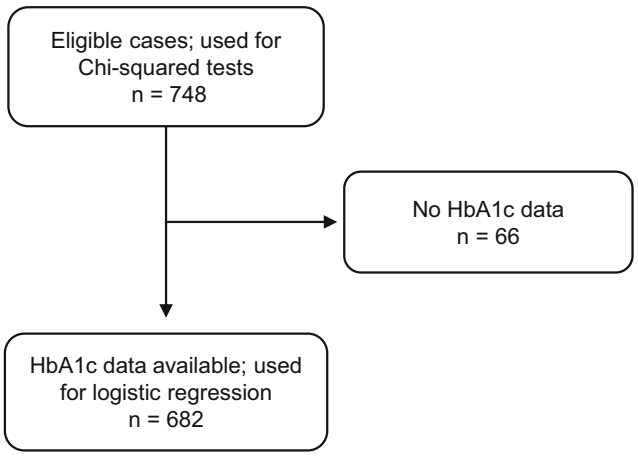

Figure 2 Chart describing exclusion from logistic regression.

($\chi^2_1 = 1.3$, $P = 0.25$). There was no significant difference in prevalence between Asian and PI men ($\chi^2_1 = 2.8$, $P = 0.096$). There was no significant difference between Asian and PI women ($\chi^2_1 = 0.053$, $P = 0.82$).

Multiple binary LR was used to analyze the relationship between HS and HbA1c, BMI, and age. Sixty-six of 748 patients did not have HbA1c data and were excluded from LR (Fig. 2). Higher odds of HS was associated with increasing BMI (OR = 1.08; 95% CI: 1.06–1.11; $P < 0.001$) and HbA1c (OR = 1.15; 95% CI: 1.04–1.26; $P = 0.005$), but HS was not associated with age in this limited age range (OR = 0.993; 95% CI: 0.973–1.01; $P = 0.46$).

Simple binary LR was performed to analyze the same relationships (Table 3). Higher odds of HS was associated with increasing BMI (OR = 1.09; 95% CI: 1.06–1.11; $P < 0.001$). Increasing HbA1c was also associated with higher odds of HS (OR = 1.15; 95% CI: 1.05–1.26; $P = 0.0023$). Increasing age was not associated with higher odds of HS (OR = 0.99; 95% CI: 0.98–1.01; $P = 0.56$).

Table 3 Relationship between hepatic steatosis (HS) and HbA1c, BMI, and age as determined by logistic regression

		Odds ratio	95% confidence interval	*P*-value
Simple binary LR	HbA1c	1.15	1.05–1.26	0.002
	BMI	1.09	1.06–1.11	<0.001
	Age	0.99	0.98–1.01	0.560
Multiple binary LR	HbA1c	1.15	1.04–1.26	0.005
	BMI	1.08	1.06–1.11	<0.001
	Age	0.993	0.973–1.01	0.460

Conclusions

PIs and Asians are often underrepresented in studies of disease processes. The importance of this study is that it addresses this underrepresentation with a very selective choice of study population in whom there is a very high prevalence of moderate to severe HS. We found that there was no statistically significant difference in the prevalence between Asians and PIs when controlled for age and BMI ($P = 0.25$). HS was prevalent in 39.0% of obese Asians and 43.3% of PIs who had CT imaging of the abdomen for other indications.

Boyce et al. found that 15% of obese patients screened for colorectal cancer with noncontrast CT had moderate to severe HS with HU < 40, but they did not report the ethnicity.[7] Another study within the United States found that 11.9% of obese patients had liver attenuation values <40 HU and that HS was less common in ethnically Chinese patients than in Hispanic, Black, or Caucasian patients, but it used a different age range.[8] Harrison et al. found that among 664 U.S. adults at a military medical center attending a colonoscopy class, 38% had NAFLD but it only included 9 PIs, while 41% of 29 Asians in the same study had NAFLD.[3] That study included mild HS in the reported percentages, but did not exclude people with BMI < 30, so direct comparison is difficult. Another U.S. study using MRI found HS in 25% of patients, with a 7%–9% increase in odds of HS per one point increase in BMI, although only 15 of 1006 patients were Asian.[10] The value of the current study is that we included over 400 patients who self-identified as PIs and almost 300 as Asians, and found a higher than expected prevalence of moderate to severe HS. In the study by Takakusagi et al. the authors found a higher prevalence of HS in PIs compared to Asians. However, the results of this study demonstrate that when controlled for

BMI and age, there is no difference in the prevalence of HS between these populations.[11]

Setiawan et al. found only 2.3% of native Hawaiians and 4.4% of Japanese Americans had NAFLD, as identified by insurance carrier claims.[12] The far lower rates based on insurance claims likely reflect the often asymptomatic, and frequently undiagnosed, nature of NAFLD.

HS is common in obese Asian and PI adults and occurs at similar rates in both ethnicities. Most (96%) U.S. adults with NAFLD are unaware of their liver disease.[13] Abdominal CT imaging presents an opportunity to diagnose HS and provides relevant information to patients and their primary care providers in the setting of recently published clinical practice guidelines for NAFLD.[14] Per these guidelines, people with HS found on imaging are at high risk and should be screened for clinically significant fibrosis and cirrhosis. Additionally, for those found to have non-alcoholic steatohepatitis (NASH), treatment with pioglitazone and/or GLP-1 is recommended for type 2 DM, and semaglutide is recommended for obesity.

Our results suggest that moderate to severe HS is highly prevalent in any obese adult population and occurs in relatively young subjects between the ages of 18 and 50 years. As such, relevant imaging should be examined for HS to guide further diagnostic testing, risk stratification, and treatment.[15]

Both BMI and Hba1c were found to be important correlated variables for the presence of moderate to severe HS in this population, lending further support to recent clinical practice guidelines that focus on management of obesity, diabetes, hypertension, and dyslipidemia. These correlated variables are important because obesity is roughly 4 times and diabetes is roughly 2 times as common in PIs as in Asians. In the setting of limited resources, this can help prioritize screening.[9] Additionally, following HS diagnosis, fibrosis risk stratification using FIB-4 and other tools can drive referrals for the prevention of cirrhosis.[14]

Limitations of this study include the use of self-reported ethnicity, which may be inaccurate. In addition, some patients were multi-ethnic, with both PI and Asian ethnicities. We did not have data on alcohol use by our patients, which is an important consideration in the etiology of liver disease; we were unable to distinguish between alcoholic fatty liver disease and NAFLD, but assessing for HS is unaffected by this limitation. A further limitation is that the population sampled only included people with pre-existing imaging, which does not represent a random sample of the population. However, given that the prevalence of moderate to severe HS in this obese and relatively young population exceeded 40%, it is important that radiologists recognize this condition. Moderate to severe HS has a high prevalence in obese Asian and PI patients between the ages of 18 and 50 years who undergo CT imaging for reasons not related to fatty liver disease, stressing the importance of radiologist reporting of this finding.

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