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Agreement between the prevalence of non-alcoholic fatty liver disease determined by transient elastography and fatty liver indices

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Keywords

controlled attenuation parameter-transient elastography; liver indices; correlation

Introduction

Nonalcoholic fatty liver disease (NAFLD) is a global public health problem linked to the rising prevalence of obesity and metabolic disorders.[1] Accurate estimates of NAFLD in populations are challenging as the gold-standard for detection is liver biopsy, an invasive procedure which precludes its use in research settings.[2] NAFLD can also be detected via non-invasive imaging such as ultrasound, MRI-PDFF, MR-spectroscopy, and the controlled attenuation parameter derived via transient elastography (CAP-TE).[2] Given the complexities of imaging in population studies, however, many estimates have been based on calculated indices, such as the Fatty Liver Index (FLI),[3] and the Hepatic Steatosis Index (HSI).[4] Concern has been raised that the indices underestimate the prevalence of NAFLD,[5] thus downplaying the scope of the public health challenge. Ability to examine whether these concerns are substantive has been provided by a recent study of the US population. Using data from the study, it was reported that the US prevalence of CAP-TE determined NAFLD was 47.8%.[6] The current analysis used data from the same national study to examine how well the fatty liver indices corresponded to CAP-TE determined NAFLD. As the majority of persons with NAFLD reportedly have elevated alanine aminotransferase (ALT) levels,[7] the correspondence between elevated ALT and CAP-TE was also examined.

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Authors' Contributions: Gieira S. Jones was involved in acquisition of the data, analysis and interpretation of the results, and drafting of the manuscript. Christian S. Alvarez was involved with acquisition of the data, interpretation of the results and critical review of the manuscript. Barry I. Graubard was involved with acquisition of the data, analysis and interpretation of the data and critical review of the manuscript. Katherine A. McGlynn was involved with study concept and design, interpretation of the results drafting of the manuscript, critical review of the manuscript and study supervision.

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Methods

The analysis used data from the National Health and Nutrition Examination Survey (NHANES) conducted 2017–2018. The study methodology is shown in Supplementary Materials.

Results

The analytic sample included 4,593 persons aged 18 years and older, of whom 51.0% were women, 33.9% were Non-Hispanic White, 22.7% were Non-Hispanic Black, 23.6% were Hispanic or Mexican-American and 19.8% were Asian or persons of other racial/ethnic groups. The age-adjusted prevalence of NAFLD by CAP-TE was 48.1% (54.2% men; 42.2% women), while the prevalence by FLI was 47.6% (55.8% men; 39.7% women), by HSI was 53.5% (60.2% men; 46.8% women), and by elevated ALT was 11.2% (13.5% men; 7.7% women) (Table 1). The weighted percent-agreement between the liver indices and CAP-TE was 75.1% for FLI, 74.3% for HSI and 56.2% for elevated ALT. The percent-agreement by sex and race/ethnicity ranged from 72.7% to 76.7% for FLI and HSI, and from 52.9 to 63.7% for elevated ALT. Areas under the receiver operator curve (AUROC) were 0.85 for FLI and 0.82 for HSI (Supplementary Materials).

Discussion

In the current analysis, the agreement between prevalence of NAFLD by liver indices vs CAP-TE was good, overall, for both FLI and HSI, but not for elevated ALT. Both indices were concordant with CAP-TE on men having a higher prevalence than women, and Hispanic persons having the highest prevalence among racial/ethnic groups. The ranking of prevalence among other racial/ethnic groups, however, was inconsistent with CAP-TE. While CAP-TE found the second-highest prevalence among Asians and the lowest among non-Hispanic Black persons, both FLI and HSI estimated the second-highest prevalence among non-Hispanic Black persons and the lowest among Asians. FLI had slightly better percent-agreement among non-Hispanic White and Black persons, while HSI had slightly better agreement among Hispanic and Asian persons.

Few prior studies have examined the percent-agreement between CAP-TE determined NAFLD and liver indices. The studies that have compared measures of NAFLD have usually done so in clinic populations and have calculated correlation coefficients rather than percent-agreement. For example, one study that compared persons with and without metabolic risk factors reported a modest correlation (r=0.52) between FLI and CAP-TE that was even lower among study participants without metabolic risk factors (r=0.48).[8] While examining correlation is valuable, two measures can be correlated but not in agreement with one another, thus examining percent-agreement is a better estimation of correspondence in the measures.

The current study's strengths included the large sample size and use of a nationally representative sample of the general population rather than a clinic population. Limitations included the inability to exclude heavy alcohol consumers and the lack of liver biopsy to use as a gold-standard.

In conclusion, FLI and HSI provide good estimates of CAP-TE determined NAFLD in the U.S. population. As the measurements to calculate FLI and HSI can be done in surveys more easily than CAP-TE exams, the use of the indices is a reasonable substitute for obtaining population estimates. From a public health perspective, estimating NAFLD in populations is important as NAFLD can require treatment, and can increase the likelihood of developing cardiovascular disease, diabetes, liver disease and cancer, while increasing the risk of diabetes-specific and all-cause mortality. As the current estimate indicates that almost 50% of the US adult population has NAFLD, public health attention is clearly warranted.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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Abbreviations:

NAFLD	nonalcoholic fatty liver disease
CAP-TE	controlled attenuation parameter-transient elastography
FLI	fatty liver index
HSI	hepatic steatosis index
NHANES	National Health and Nutrition Examination Survey

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Table 1.

Age standardized prevalence of NAFLD as measured by the controlled attenuation parameter of transient elastography (CAP-TE), the Fatty Liver index (FLI), the Hepatic Steatosis Index (HSI) and elevated ALT level.

		CAP-TE	FLI[1]		HSI[2]		Elevated ALT[3]	
	n	NAFLD Prevalence	NAFLD Prevalence	Agreement with CAP-TE	NAFLD Prevalence	Agreement with CAP-TE	NAFLD Prevalence	Agreement with CAP-TE
All	4,593	48.1%	47.6%	75.11% (75.10, 75.12)	53.5%	74.27% (74.27, 74.28)	11.2%	56.18% (56.17, 56.19)
Sex								
Men	2,250	54.2%	55.8%	73.63% (73.62, 73.64)	60.2%	74.41% (74.40, 74.42)	14.5%	52.90% (52.89, 52.91)
Women	2,343	42.2%	39.7%	76.52% (76.51, 76.53)	46.8%	74.14% (74.13, 74.15)	7.7%	59.29% (59.28, 59.30)
Race/Ethnicity								
Non-Hispanic White	1,558	47.2%	46.2%	75.33% (75.32, 75.34)	51.7%	74.32% (74.31, 74.33)	10.8%	55.07% (55.06, 55.08)
Non-Hipanic Black	1,041	40.0%	46.9%	76.69% (76.67, 76.72)	55.4%	72.67% (72.65, 72.69)	6.7%	63.71% (63.69, 63.74)
Hispanic/ Mexican American	1,083	56.3%	56.0%	74.44% (74.43, 75.46)	61.9%	74.47% (74.46, 74.49)	14.4%	54.16% (54.14, 54.17)
Asian/Other	911	47.6%	40.5%	73.27% (73.25, 73.29)	47.5%	75.29% (75.27, 75.31)	12.1%	58.51% (58.49, 58.53)

[1] Fatty LIver Index (FLI) = (e0.953×loge(triglycerides) + 0.139 × BMI + 0.718 × loge(GGT) + 0.053 × waist circumference − 15.745) / (1 + e0.953 × loge(triglycerides) + 0.139 × BMI + 0.718 × loge(GGT) + 0.053×waistcircumference − 15.745) × 100

[2] Hepatic Steatosis Index (HSI) = 8 × (ALT/AST ratio) + BMI (+2, if female; +2, if diabetes mellitus)

[3] Elevated ALT = ALT (male > 40, female > 31)