HOME SLEEP APNEA TESTING OF ADULTS WITH CHRONIC HEART FAILURE

Published in Journal Of Clinical Sleep Medicine on 7/1/2021

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INTRODUCTION

- Per CDC - about 6.2 million adults in the United States have heart failure as of 2020.
- Heart failure costs the nation an estimated $30.7 billion in 2012.
- The prevalence of OSA ranges from 20% to up to 60% among the HF population, with rates of OSA typically running higher among those with HFpEF as compared with HFrEF.
- AHA estimates over 8 million people 18 years or older will have heart failure (HF) in 2030

Universal Definition and Classification of Heart Failure (HF)

Definition

HF is a *clinical syndrome* with current or prior

- ***Symptoms and or signs caused by a structural and/or functional cardiac***

And corroborated by at least one of the following:

- ***Elevated natriuretic peptide levels***
- ***Objective evidence of cardiogenic pulmonary or systemic congestion***

Stages

AT RISK *(STAGE A)*	**Patients at risk for HF, but without current or prior symptoms or signs of HF and without structural cardiac changes or elevated biomarkers of heart disease**
PRE-HF *(STAGE B)*	**Patients without current or prior symptoms or signs of HF with evidence of <u>one</u> of the following:** • *Structural Heart Disease* • *Abnormal cardiac function* • *Elevated natriuretic peptide or cardiac troponin levels*
HF *(STAGE C)*	**Patients with current or prior symptoms and/or signs of HF caused by a structural and/or functional cardiac abnormality**
ADVANCED HF *(STAGE D)*	**Severe symptoms and/or signs of HF at rest, recurrent hospitalizations despite GDMT, refractory or intolerant to GDMT, requiring advanced therapies transplantation, mechanical circulatory support, or palliative care**

Classification By EF

HF with reduced EF (HFrEF)
- *HF with **LVEF < 40%***

HF with mildly reduced EF (HFmrEF)
- *HF with **LVEF 41-49%***

HF with preserved EF (HFpEF)
- *HF with **LVEF > 50%***

HF with improved EF (HFimpEF)
- *HF with a baseline LVEF of < 40%, a 10-point increase from baseline LVEF, and a second measurement of LVEF of > 40%*

Language matters! The new universal definition offers opportunities for *more precise communication* and description with terms including ***persistent HF*** instead of "stable HF," and ***HF in remission*** rather than "recovered HF."

Class	Description	Symptoms
Class I	No limitation of physical activity	Ordinary physical activity does not cause symptoms
Class II	Slight limitation of physical activity	Comfortable at rest, but ordinary physical activity results in HF symptoms as: • Palpitations • Fatigue • Shortness of breath
Class III	Marked limitation of physical activity	Comfortable at rest, but less than ordinary activity results in HF symptoms Common symptoms include: • Shortness of breath • Fatigue • Pain
Class IV	HF symptoms present, even at rest	Discomfort with any physical activity. Unable to carry on any physical activity without symptoms of HF Symptoms increase during any activity including: • Persistent cough • PND • Swelling • Cognitive change

American Heart Association.

Management of Sleep Disorders

2a	C-LD	4. In patients with HF and suspicion of sleep-disordered breathing, a formal sleep assessment is reasonable to confirm the diagnosis and differentiate between obstructive and central sleep apnea.[9,10]
2a	B-R	5. In patients with HF and obstructive sleep apnea, continuous positive airway pressure may be reasonable to improve sleep quality and decrease daytime sleepiness.[9,11–13]

CLASS 2a (MODERATE) **Benefit >> Risk**

Suggested phrases for writing recommendations:

- Is reasonable
- Can be useful/effective/beneficial
- Comparative-Effectiveness Phrases†:
  - Treatment/strategy A is probably recommended/indicated in preference to treatment B
  - It is reasonable to choose treatment A over treatment B

LEVEL C-LD **(Limited Data)**

- Randomized or nonrandomized observational or registry studies with limitations of design or execution
- Meta-analyses of such studies
- Physiological or mechanistic studies in human subjects

LEVEL B-R **(Randomized)**

- Moderate-quality evidence‡ from 1 or more RCTs
- Meta-analyses of moderate-quality RCTs

AASM RECOMMENDATIONS

- In the current 2017 guidelines from AASM – HSAT has been regarded as low evidence for evaluation of SDB in CHF patients due to limited data.
- Limitations are present given initial trials evaluating HSAT utility excluded patients with CHF.
- Meta-analysis of these studies found that in a population of 1,000 patients at high risk of moderate to severe OSA (64% prevalence), 45 to 230 more false negative and 18 to 79 more false positives would result from the use of HSAT.

AASM American Academy of SLEEP MEDICINE™

CLINICAL QUESTION

- Do HSATs help diagnose sleep-disordered breathing and identify respiratory events including obstructive sleep apnea, central sleep apnea, and Cheyne-Stokes respiration in adults with stable chronic heart failure?

STUDY METHODS

93 patients with CHF referred to sleep testing from January 2016 - January 2019 were recruited into the study.

Peking University People's Hospital in Beijing, China and the Corporal Michael J. Crescenz Veterans Affairs Medical Center in Philadelphia, Pennsylvania

NOX-T3 → PSG+NOX-T3

Patients initially performed an overnight HSAT using the Nox-T3 PM at home followed within 1 week by an in-laboratory PSG with simultaneous NOX-T3

CRITERIA

Inclusion criteria: (1) New York Heart Association Class II–IV symptoms, (2) chronic treatment with loop diuretic, and (3) ejection fraction < 50% or chronic diastolic dysfunction based on standard guidelines.

Exclusion criteria : history of diagnosis or treatment of SDB, inability or unwillingness to provide informed consent, hospitalization within the preceding 3 months, a change in medication in the previous month, a new medical diagnosis in the previous 2 months (eg, myocardial infarction, active infection, thyroid disease, depression or psychosis, cirrhosis, surgery, or cancer), previous sleep testing, prior diagnosis of a sleep disorder or irregular work schedule in the previous 3 months, and supplemental oxygen therapy.

STUDY POPULATION

- 84 patients with chronic heart failure
  - 86.9% males
  - age [mean ± standard deviation] 58.7 ± 16.3 years
  - body mass index 29.4 ± 13.0 kg/m2
  - left ventricular ejection fraction 40.3% ± 11.5%
- Compared to the U.S. participants (n = 17), the Chinese participants (n = 67) were younger in age (56.6 ± 17.2 vs. 69.9 ± 7.7 P = .038) and had a lower BMI (P = .012).

Table 1—Participant characteristics overall and by site.

Measures	Total	PKU	Penn VA	*P**
General				
n	84	67	17	
Age, y	58.7 ± 16.3	56.6 ± 17.2	66.9 ± 7.7	.038
Sex, n (%)				
Male	73 (86.9)	56 (83.6)	17 (100)	.073
Female	11 (13.1)	11 (16.4)	0	
BMI, kg/m^2	29.4 ± 13.0	27.3 ± 5.2	37.4 ± 26.1	.012
LVEF, %	40.3 ± 11.5	39.5 ± 11.2	43.5 ± 12.5	.100
LVEF < 50% (% of participants)	71 (84.5)	59 (88.1)	12 (70.6)	.075
Epworth Sleepiness Scale score	8.6 ± 4.2	8.7 ± 3.9	8.5 ± 4.6	.811
COPD, n (%)	11 (13.1)	2 (3.0)	9 (52.9)	< .001
PSG results				
n	79	65	14	
Total sleep time, min	354.4 ± 65.5	367.9 ± 61.7	291.6 ± 42.8	< .001
Sleep efficiency, %	74.6 ± 11.9	74.5 ± 12.2	75.0 ± 10.4	.964
Sleep stages, %				
N1	17.6 ± 17.0	18.4 ± 15.1	13.6 ± 24.2	.011
N2	51.1 ± 16.9	47.4 ± 13.3	67.9 ± 21.7	< .001
N3/N4	9.1 ± 9.1	10.2 ± 9.0	4.2 ± 8.5	.003
REM sleep	15.5 ± 7.5	15.8 ± 6.9	14.3 ± 9.8	.449
AHI 4%, events/h†	23.8 ± 21.3	24.2 ± 20.6	22.0 ± 24.9	.590
OAI, events/h	6.9 ± 10.8	7.7 ± 11.6	2.8 ± 3.9	.007
CAI, events/h	7.3 ± 10.9	7.8 ± 10.9	4.8 ± 11.0	.410
Total number of OSA	41.4 ± 70.0	75.4 ± 9.4	20.0 ± 5.3	.003
Total number of CSA	44.1 ± 70.0	72.5 ± 9.0	55.4 ± 14.8	.240
Mean SpO_2 during sleep, %	94.1 ± 3.2	94.4 ± 3.0	92.5 ± 3.4	.028
Minimum SpO_2 during sleep, %	79.9 ± 11.8	80.1 ± 11.5	78.9 ± 13.8	.920

END POINTS

- Primary endpoint was to validate the use of an unattended type 3 PM, self-applied at home to diagnose SDB.
- Secondary endpoint was to evaluate its ability to identify different types of respiratory events including OSA, CSA, and CSR in adults with stable CHF.

RESULTS

Figure 1—Percentage of participants with and without sleep apnea.

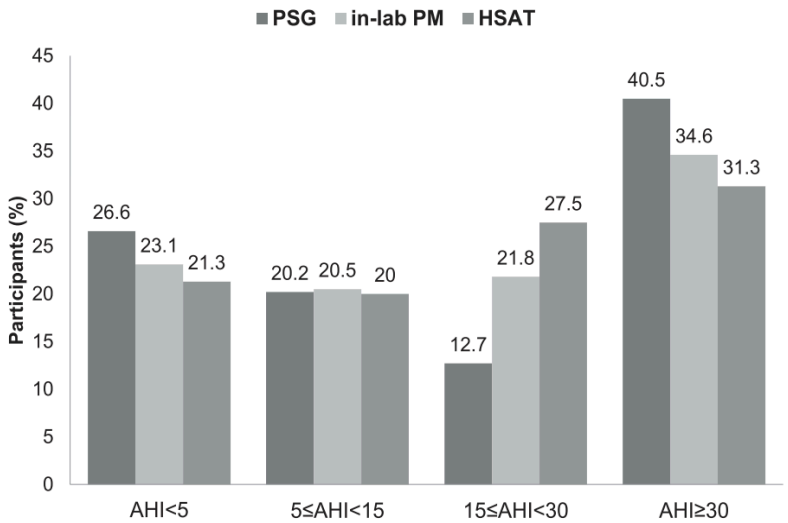


Figure 2—Percentage of different types of events diagnosed from PSG, the in-laboratory PM, and HSAT.

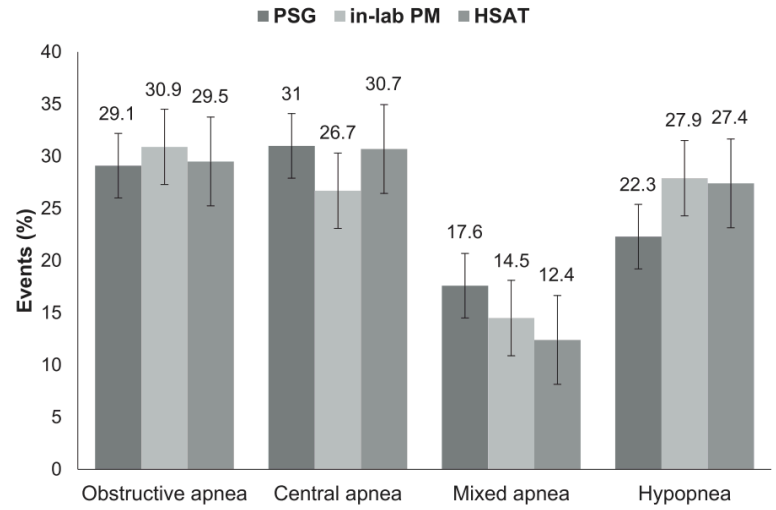


Figure 3—AHI 4% measured by HSAT and the in-laboratory PM compared to PSG.

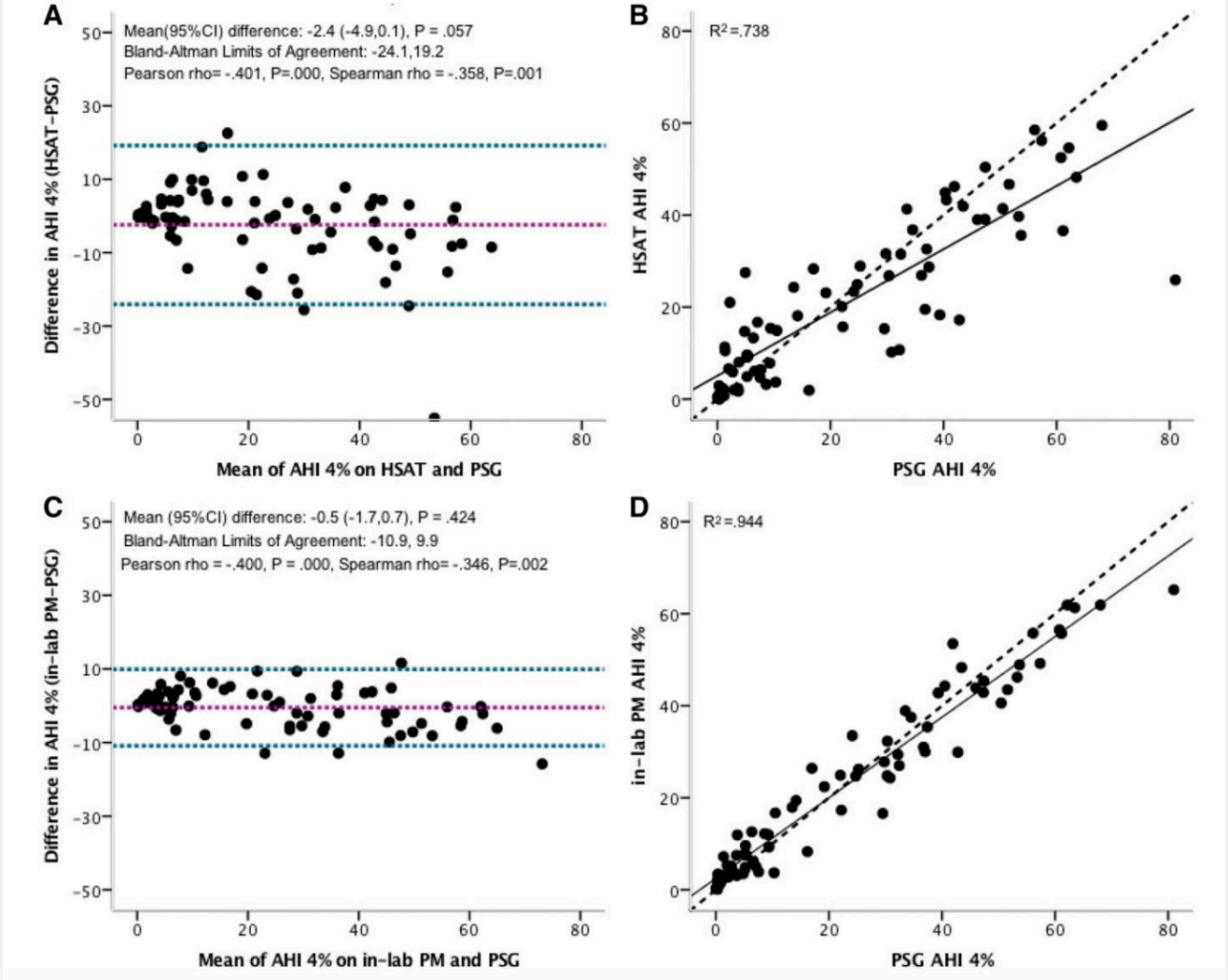


Figure 4—OAI measured by HSAT and the in-laboratory PM compared to PSG.

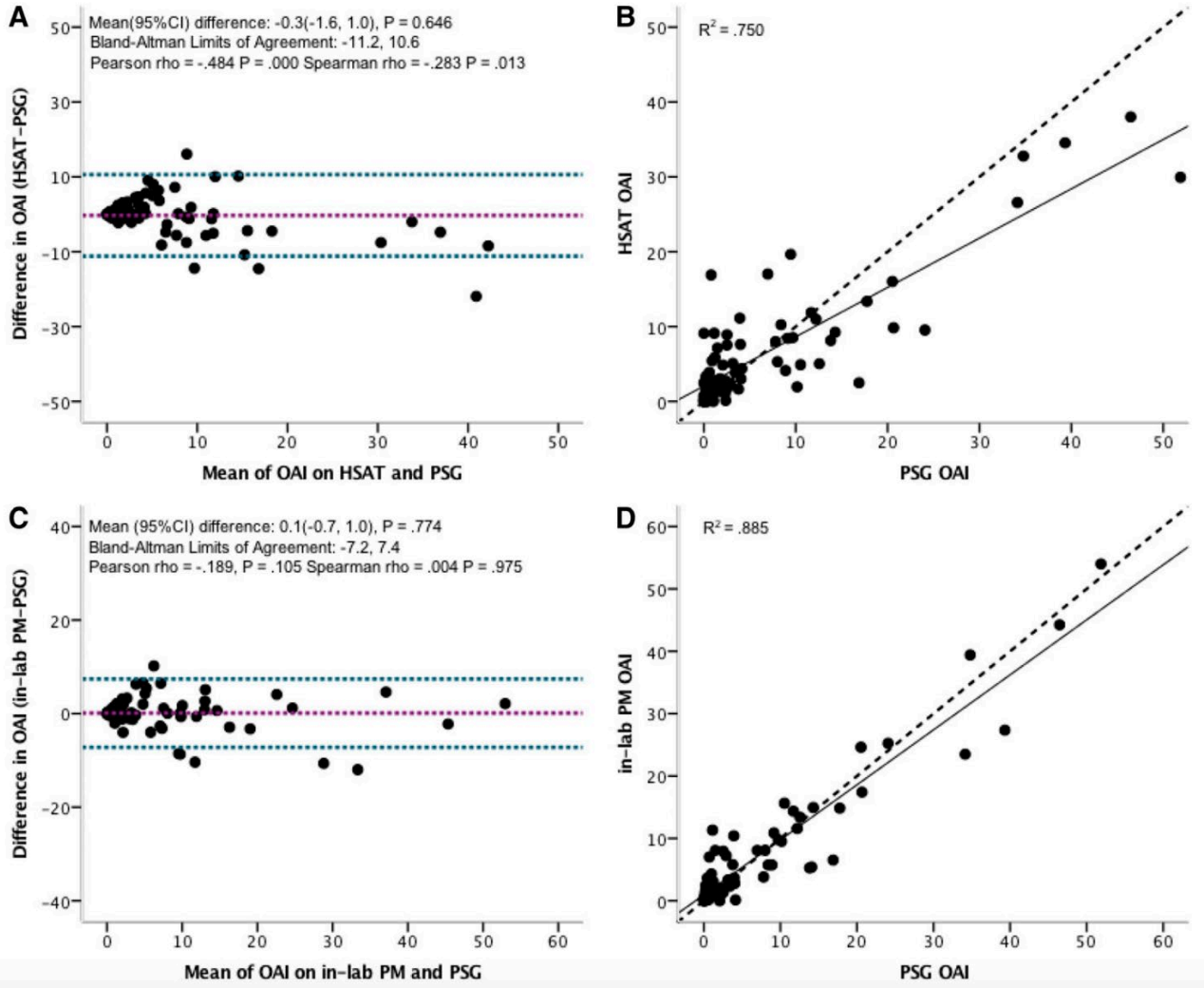
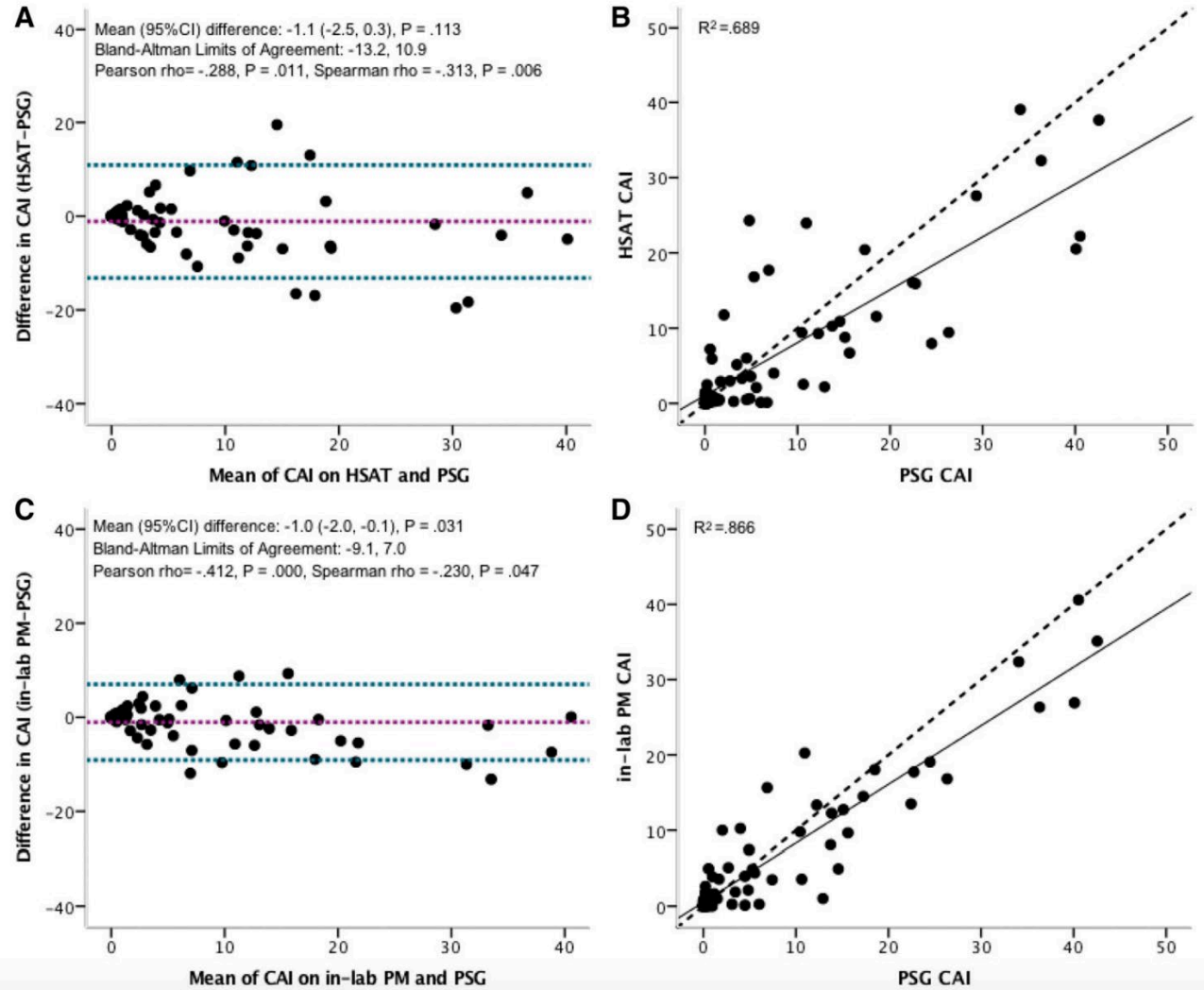


Figure 5—CAI measured by HSAT and the in-laboratory PM compared to PSG.

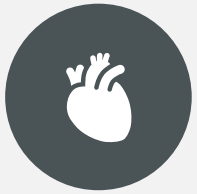


CONCLUSIONS

Apnea-hypopnea index was 22.0 ± 17.0 events/h according to HSAT, 26.8 ± 20.5 events/h on an in-laboratory portable monitor, and 23.8 ± 21.3 events/h using PSG (P =.373).

HSAT underestimated the apnea-hypopnea index to a greater extent at a higher apnea-hypopnea index (rho = –.358; P < .001)

Similar levels of agreement from HSAT vs PSG were observed when comparing the obstructive apnea index, central apnea index, and percentage of time in a Cheyne-Stokes respiration pattern.



At an apnea-hypopnea index ≥ 5 events/h to diagnose SDB, HSAT had 86.7% sensitivity, 76.5% specificity, 92.9% positive predictive value, and 61.9% negative predictive value compared to PSG.

Detection of Cheyne-Stokes respiration using HSAT showed 94.6% sensitivity, 91.1% specificity, 88.6% positive predictive value, and 97.6% negative predictive value compared to PSG.

STRENGTHS AND WEAKNESSES

- Strengths: evaluation of HSAT using a type 3 PM to help diagnose SDB and identify different types of SDB including OSA, CSA, and CSR in adults with stable CHF
- Weaknesses:
  - Male predominance
  - Limited heterozygosity
  - Low sample size
  - Did not assess night-to-night variability

TAKE HOME POINTS

- HSATs can be of diagnostic utility in patients with CHF
- More data should be gathered as we progress and more HSATs are available such as WATCHPAT
- CHF will continue to increase and if we can help mitigate treatment for CHF via treating SDB then we as sleep medicine providers can work alongside cardiologists and other medical providers in improving CHF treatment in our country.