

A Systematic Review and Meta-Analysis of the Diagnostic Accuracy of Head Shaking Induced Nystagmus and Vibration Induced Nystagmus in the Diagnosis of Unilateral Vestibular Hypofunction

Lindsay DiMarco, SPT, MPH; Brian Weisbrod, SPT; Stephanie Igo, SPT; Rebecca Arndt, SPT; Richard Clendaniel, PT, PhD

BACKGROUND

- Unilateral Vestibular Hypofunction (UVH) refers to a condition in which one of the peripheral vestibular receptors is not functioning properly disrupting the normal symmetric input from the inner ears to the central nervous system (CNS).¹
- UVH results in the CNS interpreting the input as continuous head rotation, causing symptoms of vertigo, nausea, postural instability, and nystagmus.¹
- Head shaking induced nystagmus (HSN) and vibration induced nystagmus (VIN) are simple clinical diagnostic procedures for UVH that do not require expensive instrumentation, are non-invasive, and can be performed in a clinician's office as alternatives to the laboratory-based tests, such as the caloric test and rotary chair tests.^{2,3}

PURPOSE

- To evaluate the diagnostic accuracy of the HSN and VIN tests for UVH.

METHODS

- The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Statement was utilized to identify articles for inclusion.
- The systematic search was performed in MEDLINE, CINAHL, and Embase and the quality of studies evaluated using the QUADAS-2 assessment tool.
- A meta-analysis of diagnostic test accuracy was run using a hierarchical summary receiver operating characteristics curve analysis to determine the pooled estimates of test sensitivity, specificity, positive likelihood ratios (LR), and negative LR with their 95% confidence intervals.

Inclusion Criteria: one diagnostic test for HSN or VIN, patients with UVH, clinometric properties were reported or the data necessary to calculate them was included, and studies published in English.

Exclusion Criteria: none applied.

Caloric Test⁴

- Patient in supine
- Each external ear canal is irrigated with warm and cold water for 20 seconds and maximal slow-phase eye velocity is determined
- **Canal paresis (CP) = any asymmetry > 20 - 25%**

HSN Test³

- Head 40 to 45° to each side
- Repeat for 20-30 cycles at 2 Hz
- Stop rotations abruptly
- **If horizontal nystagmus present, test is positive for UVH**

VIN Test⁵

- Vibrator (100 Hz) applied perpendicular to skin over mastoid process with pressure of 10 N
- Maintain for 5-10 seconds
- **If horizontal nystagmus occurs, test is positive for UVH**

CONCLUSIONS

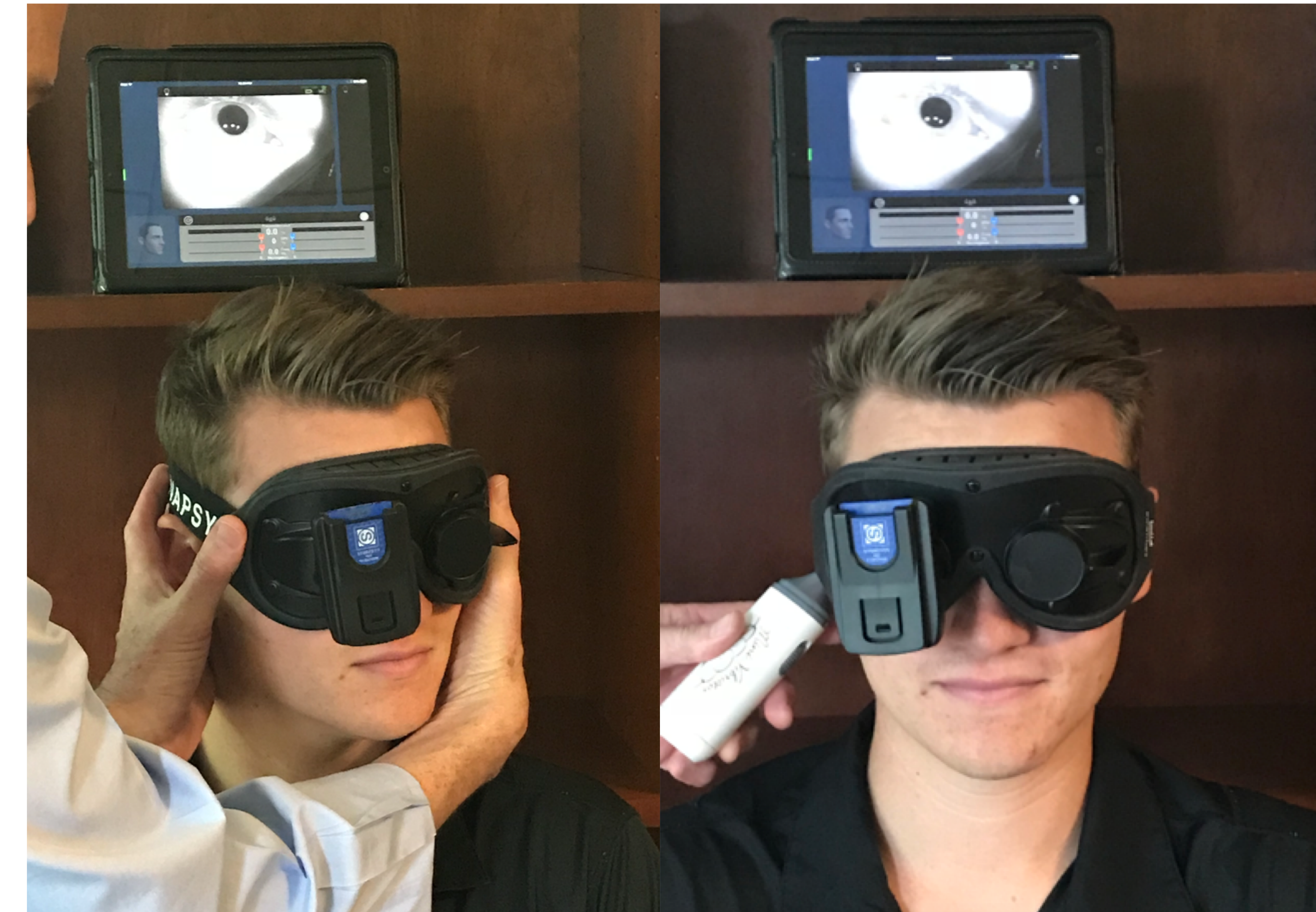
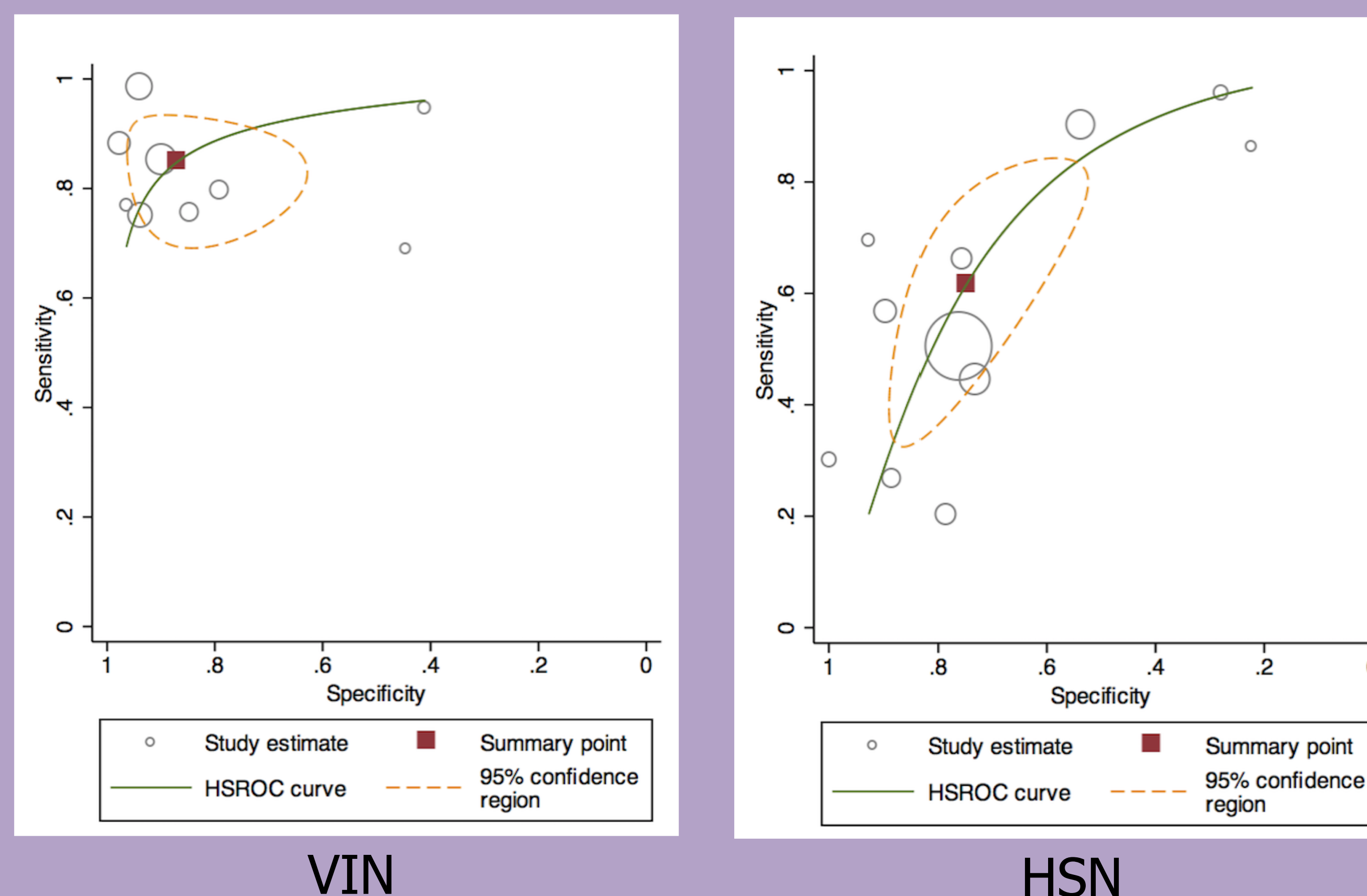
- HSN and VIN tests have higher specificity than sensitivity when it comes to diagnosing UVH.
- VIN methods have higher sensitivity, specificity, and stronger LR than HSN methods.
- Due to the inconsistencies in the published studies, further research should be conducted to obtain more precise diagnostic accuracy values in specific patient populations.

RESULTS

- 22 studies were considered acceptable for data extraction: for the meta-analysis, 9 studies were included in both the VIN and HSN statistical analyses.

	Sensitivity	Specificity	LR+	Prob. Shift	LR-	Prob. Shift
VIN	0.85 (0.76 - 0.91)	0.87 (0.74 - 0.94)	6.47 (2.98 - 14.04)	Mod	0.17 (0.10 - 0.29)	Mod
HSN	0.62 (0.42 - 0.78)	0.75 (0.60 - 0.85)	2.45 (1.75 - 3.42)	Small	0.51 (0.35 - 0.76)	Small

Hierarchical Summary Receiver Operating Characteristic Curve Analyses



CLINICAL RELEVANCE

- The HSN and VIN tests are better utilized as diagnostic tests to rule in UVH.
- If only one test is to be used, the VIN test should be selected due to its higher diagnostic accuracy values.

ACKNOWLEDGEMENTS / REFERENCES

We would like to thank Leila Ledbetter, MLIS for her assistance in developing the search strategy.

1. Bayat A, Saki N. Effects of vestibular rehabilitation interventions in the elderly with chronic unilateral vestibular hypofunction. *Iran J Otorhinolaryngol.* 2017;29(93):183-188.
2. Abadi RV. Mechanisms underlying nystagmus. *J R Soc Med.* 2002;95(2):231-234.
3. Angeli SI, Velandia S, Snapp H. Head-shaking nystagmus predicts greater disability in unilateral peripheral vestibulopathy. *Am J Otolaryngol.* 2011;32(6):522-527.
4. Iwasaki S, Ito K, Abbey K, Murofushi T. Prediction of canal paresis using head-shaking nystagmus test. *Acta Otolaryngol.* 2004;124(7):803-806.
5. Dumas G, Curthoys IS, Lion A, Perrin P, Schmerber S. The skull vibration-induced nystagmus test of vestibular function – a review. *Front Neurol.* 2017;8:41.