Assessing the Diagnostic Value of Pure Tone Averages

Linnea Munro, BS[1], Doug Sladen, PhD[2], Nicholas Reed, PhD[3], Ashley Nassiri, MD[4], Matthew Fitzgerald, PhD[1]

[1] Stanford University – Department of Otolaryngology Head & Neck Surgery, [2] University of British Columbia – School of Audiology and Speech Sciences , [3] New York University – Departments of Otolaryngology - Head & Neck Surgery and Population Health, [4] University of Colorado Anschutz School of Medicine – Department of Otolaryngology and Head & Neck Surgery

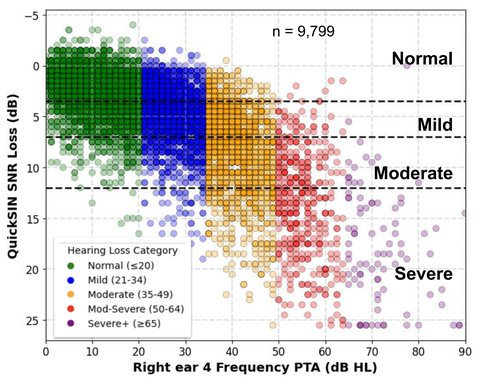
Introduction

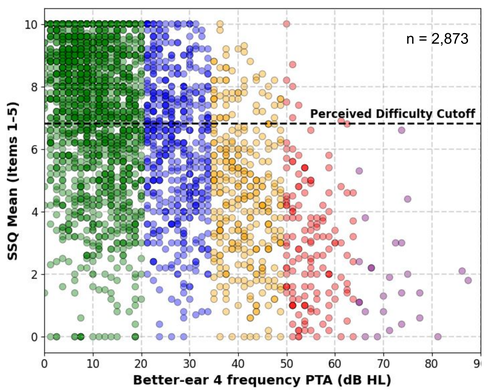
- The pure-tone average (PTA) has been used for nearly 100 years to summarize hearing thresholds into a single value. It is often used to make inferences about a patient's speech understanding, real world communication ability, and need for intervention.
- The World Health Organization has suggested the use of the 4-frequency PTA (0.5, 1, 2, and 4 kHz) to characterize hearing loss, and has proposed that 20 dB HL is an appropriate cutoff to identify hearing difficulties.[3]
- While average data from some studies suggest this is reasonable, others have questioned this approach.[4] Furthermore, some individuals with normal 4-freq PTA values may have significant high-frequency hearing loss.
- Here we examined the accuracy of the 4-frequency PTA to identify speech in noise deficits and perceived disability in individuals seen in an outpatient clinical environment.

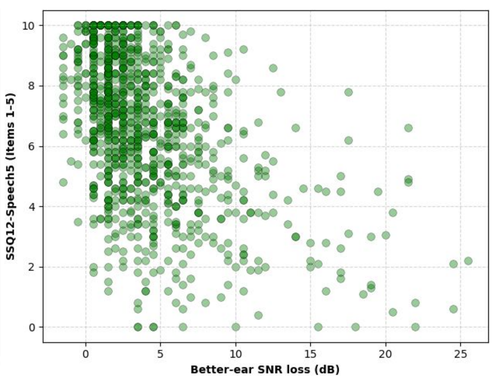
Methods

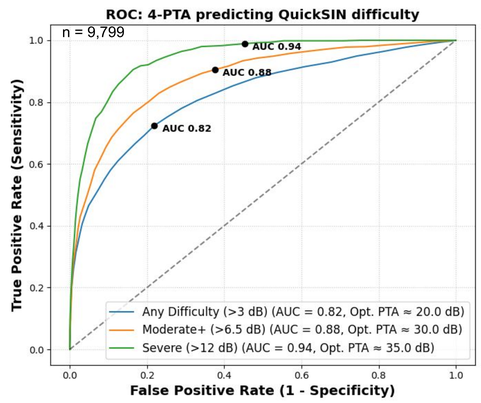
- This retrospective study analyzed data from over 10,000 patients who have had audiometric testing at the Stanford Ear Institute.
- All participants completed pure-tone audiometry, monaural word recognition in quiet, and monaural QuickSIN. We also looked at a subset of participants who completed the Speech, Spatial, and Qualities of Hearing Scale (SSQ) questionnaire.
- Receiver operating characteristic (ROC) analyses, odds ratios, and linear regressions were performed.

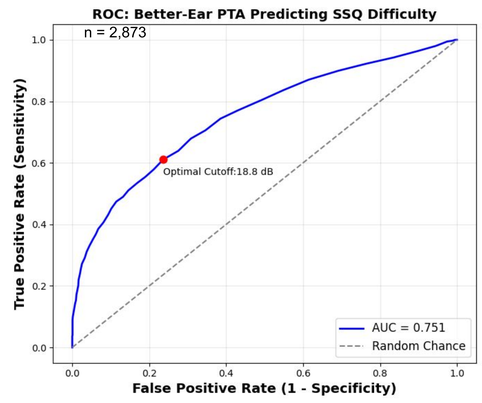
A 4-frequency PTA cutoff of 20 dB cutoff appears to be reasonably accurate at identifying both speech in noise deficits and perceived auditory disability

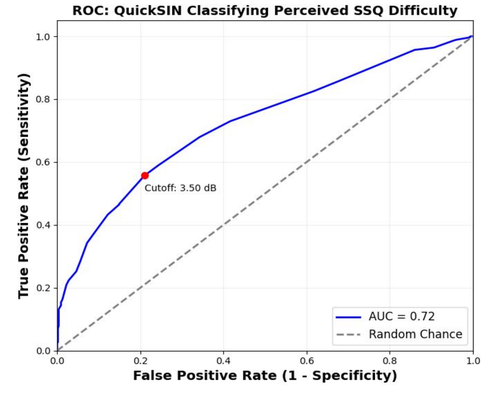




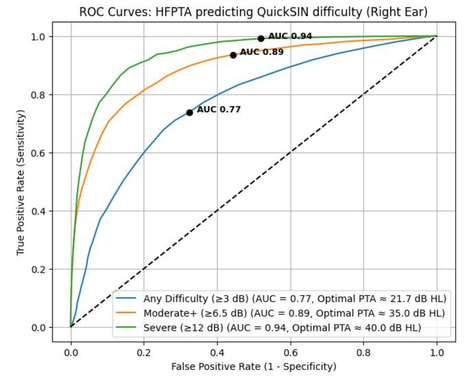




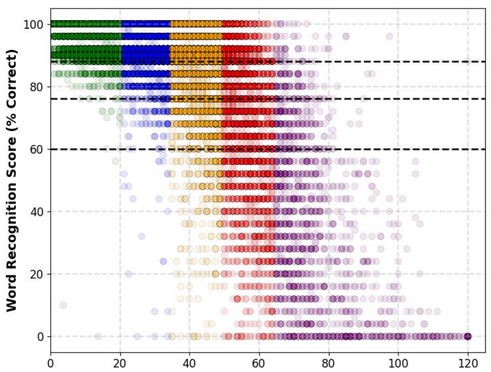




Use of HFPTA slightly increases amount of loss needed to ID speech in noise deficits



Word recognition in quiet is poor choice to identify deficits because of ceiling effect



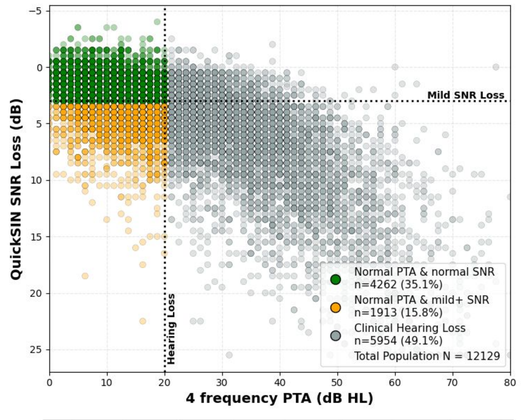
A 20 dB cut-off misses ~30% of people with speech-in-noise or perceived hearing difficulties.

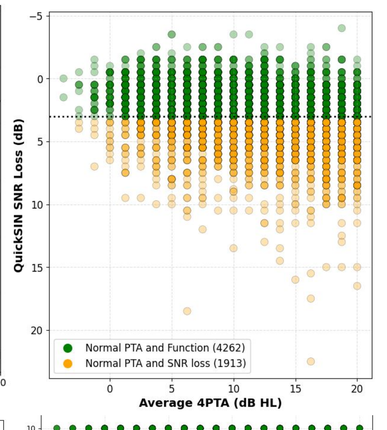
Missed speech in noise difficulty			
PTA Cut-off	Total n	Total missed	Percent Missed
≤20 dB	6175	1913	31%
≤15 dB	4695	1197	26%

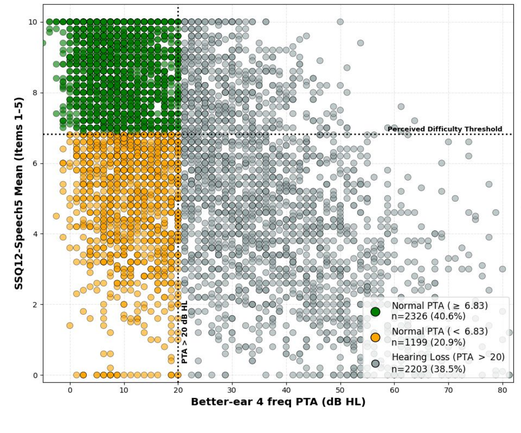
Patients with a PTA between 16-20 dB are 2.74 times more likely to experience abnormal speech-in-noise difficulty (SNR > 3 dB) compared to those in the 0-15 dB

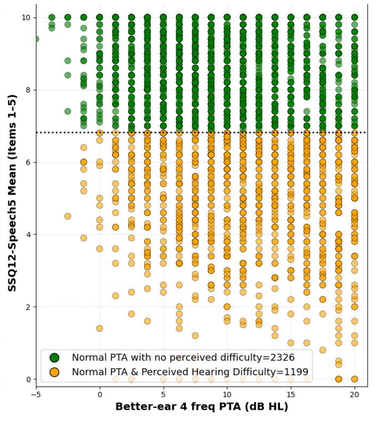
Missed Perceived Difficulty			
PTA Cut-off	Total n	Total missed	Percent Missed
≤20 dB	3525	1199	34%
≤15 dB	2881	862	30%

Patients with a PTA between 16-20 dB are 2.57 times more likely to report perceived hearing difficulty (SSQ < 6.83) compared to those in the 0-15 dB









Summary

- Preliminary analysis suggests a 4-freq PTA cutoff of 20 dB is 75-80% effective at sorting individuals with speech in noise deficits or perceived hearing difficulties.
- Approximately 30% of individuals with 4-freq PTA values < 20 have measured or perceived deficits with speech in noise.
- Use of HFPTA effectively increases the diagnostic cutoff because of the high-frequency emphasis. Adding the threshold at 500 Hz into the PTA calculation may unintentionally obscure some high frequency losses

Acknowledgments

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References

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