

# Tinnitus Screener Short-Term Test-Retest Reliability in a Military Population

Emily J. Thielman<sup>1</sup>, Kelly M. Reavis<sup>1,2</sup>, Sarah M. Theodoroff<sup>1,3</sup>, Leslie D. Grush<sup>1</sup>, Susan Griest<sup>1</sup>, Brandon Smith<sup>1,3</sup>,

James Schultz<sup>4</sup>, Carlos Esquivel<sup>4</sup>, James A. Henry<sup>1,3</sup>

<sup>1</sup>National Center for Rehabilitative Auditory Research (NCRAR), VA Portland Health Care System (VAPORHCS), Portland, OR

<sup>2</sup>School of Public Health, Oregon Health & Science University, Portland, Oregon, USA

<sup>3</sup>Department of Otolaryngology/Head and Neck Surgery, Oregon Health & Science University, Portland, Oregon

<sup>4</sup>DoD Hearing Center of Excellence, Defense Health Agency, San Antonio, Texas

## Introduction

The Tinnitus Screener (TS) was introduced in 2015 as a 4-item algorithmic instrument to assess the temporal characteristics of tinnitus<sup>1</sup>. It was developed to determine if a research participant should complete tinnitus questionnaires and testing. Administering the 4-item TS resulted in one of four tinnitus categories: constant tinnitus (always or usually heard in a quiet room), intermittent tinnitus (lasting ≥ 3 minutes but not always or usually present), temporary tinnitus (caused by an event, then resolving), or no tinnitus (including transient ear noise). Additional tinnitus questionnaires and testing were then administered only to participants who screened as having constant or intermittent tinnitus. The TS was subsequently revised as a 6-item version to (1) include an additional category, occasional tinnitus (lasting ≥ 3 minutes, experienced less than weekly), (2) revise the definition for intermittent tinnitus (lasting ≥ 3 minutes, experienced at least weekly), and (3) capture tinnitus duration (acute < 6 months vs. chronic ≥ 6 months). Previously, the 4-item TS was validated against an in-person audiologist assessment. The purpose of the present analysis was to estimate the test-retest reliability of the 6-item TS in a military population.

## Methods

### Participants (n=449)

- Military Service members (196) and Veterans (253) enrolled in the Noise Outcomes in Servicemembers Epidemiology (NOISE) study<sup>2</sup>
- Tested at the VA National Center for Rehabilitative Auditory Research (NCRAR) in Portland, Oregon or the DoD Hearing Center of Excellence (HCE) in San Antonio, Texas

### Changes to Tinnitus Screener

**Question 2:** “Have you experienced tinnitus for at least 6 months?”

- Yes → Chronic (persistent)
- No → Acute (recent onset)
- *Note: These designations apply only to those who screen positive for constant or intermittent tinnitus*

**Question 6:** “On average, do you experience tinnitus:”

- Daily } → Intermittent tinnitus
- Several times a week }
- Several times a month } → Occasional tinnitus
- Several times a year }

### Data Collection

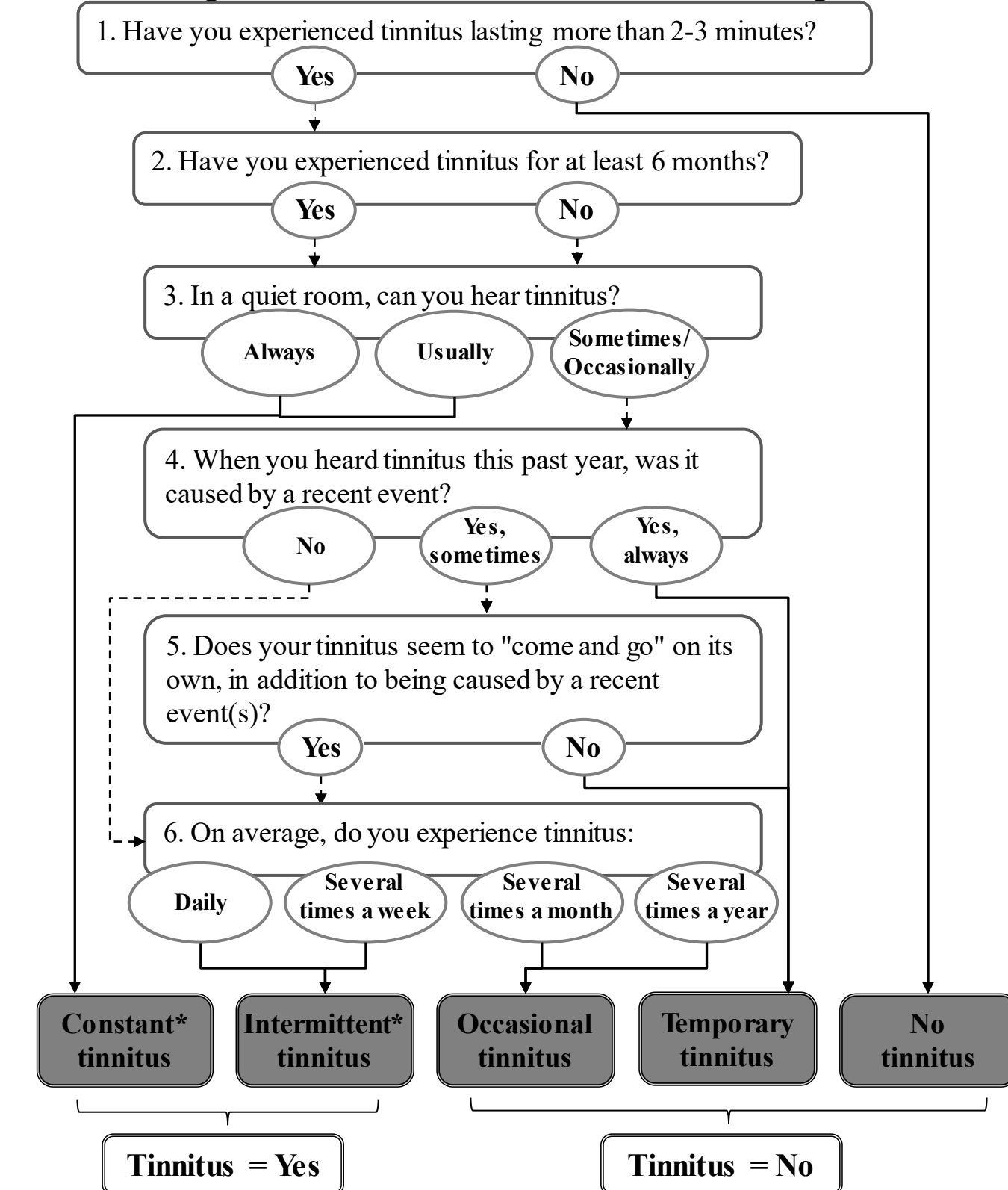
- Two administrations of the 6-item TS, between 7 and 31 days apart
- At the NCRAR, first administration (time 1) by a research assistant over the phone, second (time 2) by an audiologist in person
- At the HCE, times 1 and 2 both administered in person by an audiologist

### Analyses

- TS results from time 1 and time 2 were assigned a tinnitus category and classification (see **Table 1** for definitions)
- The Kappa statistic was calculated for results overall, and for sub-samples including by sex, military status, and hearing loss in low-, high-, and extended-high-frequency ranges

## Results

**Figure 1.** Decision tree for 6-item Tinnitus Screener. Each TS question is shown, with the response choices below. Arrows from each response indicate either the tinnitus categorization (solid arrow) or the next question to be asked (dashed arrow). Resulting tinnitus categories, and classifications, are shown along the bottom.

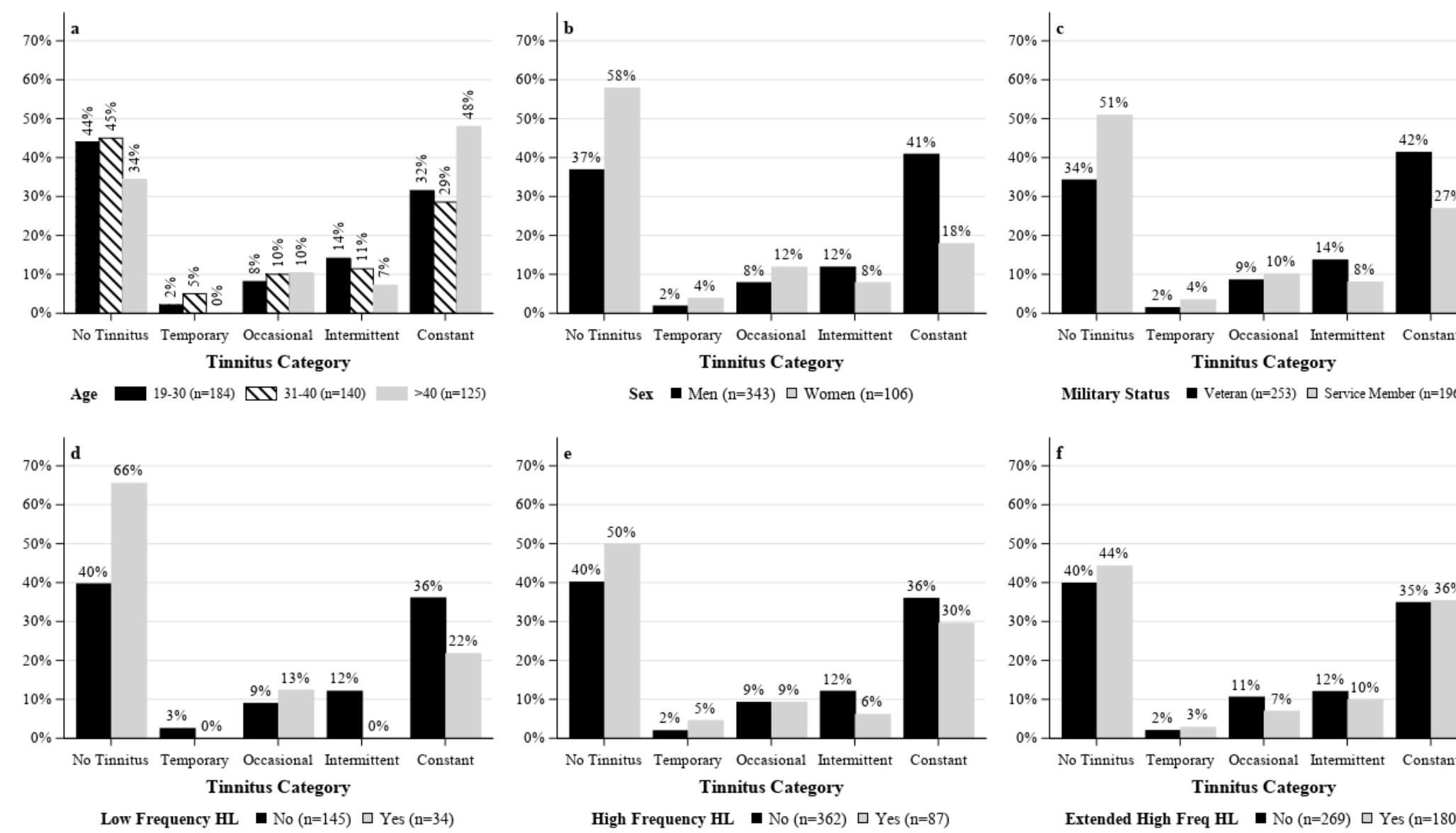


\* If Q2=Yes, tinnitus is *chronic*; if Q2=No, tinnitus is *acute*

**Table 1.** Tinnitus categorization and classification based on frequency and duration.

Primary Tinnitus Categorization	Primary Tinnitus Classification	Frequency of Occurrence	Symptoms/Duration
No tinnitus (including transient ear noise)	Tinnitus = No	Random or never	May experience sudden tone in 1 ear, usually accompanied by sense of ear fullness and hearing loss. All symptoms resolve within 2-3 minutes.
Temporary	Tinnitus = No	Follows tinnitus-inducing event, usually noise exposure but also some medications and chemicals	May accompany temporary change in hearing, can be a warning sign that temporary hearing loss has occurred. Can last 1 or more days, but always resolves
Occasional	Tinnitus = No	Less than weekly	Lasts at least 2-3 minutes
Intermittent	Tinnitus = Yes	At least daily or weekly	Lasts at least 2-3 minutes
Constant	Tinnitus = Yes	Always audible in quiet	Continuous sound

**Figure 2.** Six bar charts showing the frequency distribution of tinnitus categorizations at time 1 for various categorical subgroupings of the sample. Panel a shows age categories, panel b sex, panel c military status, panels d-f low, high, and extended high frequency hearing loss. Percentage labels on the bars are within subgroup proportions.



**Table 2.** Reliability coefficients by sub-sample for the five tinnitus categories (no, temporary, occasional, intermittent, constant) compared between time 1 and time 2, and tinnitus classification (yes/no) compared between time 1 and time 2.

	N	5-Category Kappa	Classification yes/no Kappa
<b>Overall</b>	449	0.79	0.80
<b>Age</b>			
19 – 30	184	0.80	0.82
31 – 40	140	0.71	0.68
> 40	125	0.84	0.87
<b>Sex</b>			
Men	343	0.81	0.83
Women	106	0.66	0.57
<b>Military Status</b>			
Service member	196	0.73	0.72
Veteran	253	0.81	0.83
<b>Low Frequency HL</b>			
Yes	34	0.57	0.64
No	415	0.80	0.80
<b>High Frequency HL</b>			
Yes	87	0.78	0.81
No	362	0.77	0.78
<b>Extended High Frequency HL</b>			
Yes	180	0.80	0.80
No	269	0.77	0.79

HL = hearing loss

## Discussion

- Based on responses to the 6-item Tinnitus Screener, our prevalence estimate of tinnitus in Service members and Veterans was 31% and 53%, respectively.
- The 6-item Tinnitus Screener has good test-retest reliability. Kappa of 0.7 and weighted Kappa of 0.79 indicate substantial agreement between the two time points.
- No substantial differences in agreement were observed by age, sex, military status, or hearing loss.
- The 6-item TS appears to yield results consistent with the previously validated 4-item version.
- The 6-item TS is recommended for use in research and clinical care settings to inform decision making based on the temporal characteristics of tinnitus - specifically, tinnitus duration and if tinnitus is constant, intermittent, occasional, temporary, or a different phenomenon such as transient ear noise.
- The 6-item TS is also recommended for researchers to document change among tinnitus categories over time.

## References

- Henry, J. A., Griest, S., Austin, D., Helt, W., Gordon, J., Thielman, E., . . . Carlson, K. (2016). Tinnitus Screener: Results from the first 100 participants in an epidemiology study. *American Journal of Audiology*, 25(2), 153-160. doi:10.1044/2016\_AJA-15-0076
- Gordon, J. S., Griest, S. E., Thielman, E. J., Carlson, K. F., Helt, W. J., Lewis, M. S., . . . Henry, J. A. (2017). Audiologic characteristics in a sample of recently-separated military Veterans: The Noise Outcomes in Servicemembers Epidemiology Study (NOISE Study). *Hearing Research*, 349, 21-30. doi:10.1016/j.heares.2016.11.014
- Landis, J. R., & Koch, G. G. (1977). An application of hierarchical kappa-type statistics in the assessment of majority agreement among multiple observers. *Biometrics*, 33(2), 363-374.

## Acknowledgements

The U.S. Army Medical Research Acquisition Activity, 820 Chandler Street, Fort Detrick MD 21702-5014 is the awarding and administering acquisition office. Work supported by the Office of the of Defense, the Assistant Secretary of Defense for Health Affairs, Joint Warfighter Medical Research Program (W81XWH-17-1-0020) and a U.S. Department of VA RR&D Research Career Scientist Award (#C9247S). This material is the result of work supported with resources and the use of facilities at the VA RR&D NCRAR (#C9230C) at the VAPORHCS. Opinions, interpretations, conclusions and recommendations are those of the author and are not necessarily endorsed by the Department of the Army, Department of Defense, Department of Veterans Affairs, or the U.S. Government. Poster presented virtually at the JDVAC Annual Meeting, April 5, 2022.