

## Research Article

# Tinnitus Screener: Results From the First 100 Participants in an Epidemiology Study

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**Purpose:** In the Noise Outcomes in Servicemembers Epidemiology Study, Veterans recently separated from the military undergo comprehensive assessments to initiate long-term monitoring of their auditory function. We developed the Tinnitus Screener, a four-item algorithmic instrument that determines whether tinnitus is present and, if so, whether it is constant or intermittent, or whether only temporary tinnitus has been experienced. Predictive validity data are presented for the first 100 Noise Outcomes in Servicemembers Epidemiology Study participants.

**Method:** The Tinnitus Screener was administered to participants by telephone. In lieu of a gold standard for determining tinnitus presence, the predictive validity of the tinnitus category assigned to participants on the basis of

the Screener results was assessed when the participants attended audiologic testing.

**Results:** Of the 100 participants, 67 screened positive for intermittent or constant tinnitus. Three were categorized as “temporary” tinnitus only, and 30 were categorized as “no tinnitus.” Tinnitus categorization was predictively valid with 96 of the 100 participants.

**Conclusions:** These results provide preliminary evidence that the Screener may be suitable for quickly determining essential parameters of reported tinnitus. We have since revised the instrument to differentiate acute from chronic tinnitus and to identify occasional tinnitus. We are also obtaining measures that will enable assessment of its test-retest reliability.

According to the Department of Veterans Affairs (VA) Veterans Benefits Administration, tinnitus and hearing loss have been, respectively, the first and second most prevalent service-connected disabilities for U.S. military Veterans. Veterans have been reported to have twice the prevalence of tinnitus as nonveterans (Folmer, McMillan, Austin, & Henry, 2011). Reasons for this elevated prevalence of tinnitus among Veterans are not well defined, but causes may include high levels of noise exposure, solvent exposures, or other ototraumatic exposures experienced during military service. In addition,

nonmilitary occupational or recreational exposures may contribute to Veterans’ tinnitus.

A better understanding of the causes of tinnitus and hearing loss will inform interventions to prevent their development and/or exacerbation. Also, VA clinicians and benefits specialists must determine whether Veterans’ auditory problems are caused by events prior to military service versus other causes. Such determinations are often made years after military separation. To address these concerns, a congressionally mandated Institute of Medicine report recommended avenues of research “to fill the void for prospective, longitudinal, epidemiological data on noise-induced hearing loss and tinnitus in military personnel” (Humes, Joellenbeck, & Durch, 2006 p. 208). In response to the Institute of Medicine recommendations, we are conducting a longitudinal epidemiologic study to examine associations between military and nonmilitary noise and other ototoxic or ototraumatic exposures and the risk of early-onset tinnitus and hearing loss. The project is referred to informally as the “NOISE Study” (Noise Outcomes in Servicemembers Epidemiology Study), and the first study objective is to obtain initial data to address the etiology, prevalence, and effects of tinnitus and hearing loss among newly separated Veterans (i.e., separated from military

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service within the past 2.5 years). Second, this study assembles a longitudinal cohort with which to assess changes in tinnitus and hearing over time in relation to military experience and ongoing occupational and recreational exposures. Researchers involved with the NOISE Study have been enrolling Veteran participants since early 2014.

During the telephone screening of candidates, it is essential to determine whether tinnitus is present or absent so that appropriate questionnaires can be mailed out prior to the in-lab baseline assessment. Furthermore, the presence of tinnitus must be categorized as “constant,” “intermittent,” or “temporary.” If constant or intermittent, tinnitus questionnaires are sent out to the participant. If temporary (or absent), they are not sent out. Therefore, we needed screening questions to administer over the telephone to make this determination. The development of these screening questions led to the Tinnitus Screener, a four-item, algorithm-type instrument that rapidly obtains information leading to a designation of tinnitus as constant, intermittent, temporary, or absent for each candidate. The purpose of this article is to report Tinnitus Screener predictive validity data from the first 100 Veteran participants from the NOISE Study.

## Method

The NOISE Study is being conducted at the VA Rehabilitation Research & Development, National Center for Rehabilitative Auditory Research located at the VA Portland Health Care System (VAPORHCS), Portland, OR, and was approved by the VAPORHCS/Oregon Health & Science University Joint Institutional Review Board.

### Participant Recruitment

The primary source for identifying potential study candidates is the VAPORHCS Operation Enduring Freedom/Operation Iraqi Freedom/Operation New Dawn Program Office, which maintains a tracking database of all new VAPORHCS enrollees who served in Iraq (Operation Iraqi Freedom/Operation New Dawn) or Afghanistan (Operation Enduring Freedom) and their dates of military separation. First, recruitment letters are mailed to potential candidates. Study team members also attend postdeployment and other outreach events attended by Veterans where they advertise for the study, give out recruitment letters and/or flyers, and collect names and phone numbers of interested Veterans. To be eligible, candidates must be Veterans or service members living in Oregon or Washington who have received a DD-214 (active service discharge form) or an NGB 22 (National Guard discharge form) within approximately the previous 2.5 years. There are no other inclusion criteria.

### Operational Definitions

Terminology defining tinnitus and its numerous manifestations is not standardized in the literature. For purposes of the NOISE Study, operational definitions were therefore needed. We first differentiated tinnitus from *transient ear noise*, which refers to the sudden onset of a tone in one ear

that is typically accompanied by a sense of fullness and hearing loss in the same ear (Henry, Zaugg, Myers, Kendall, & Michaelides, 2010). All of these symptoms are transient and usually dissipate within a minute or so. Transient ear noise is experienced by virtually everyone and is not a pathological condition. If a candidate has only experienced transient ear noise, then he or she is classified as “tinnitus absent” or “no tinnitus.”

Some persons have only experienced temporary tinnitus. That is, they have been exposed to noise or some other cause of temporary ear or head noise such as medications or a head or neck injury. Temporary tinnitus resolves within 1 to 2 weeks. It is an indication of insult to the auditory system, possibly resulting in damage, but is not a permanent condition (Chermak & Dengerink, 1987).

The majority of published reports consider tinnitus to be chronic if it has been experienced for 3 to 6 months or longer. For purposes of the NOISE Study, tinnitus is considered chronic if it is experienced on an ongoing basis. We operationally subcategorized chronic tinnitus as being either constant (can usually be heard when in a quiet environment) or intermittent (occurs at regular or irregular intervals). Participants respond to a separate question to determine the duration of their tinnitus.

### Questionnaire Design and Administration

The present report includes the first 100 participants enrolled in the NOISE Study. The research coordinator and research audiologists conducted telephone screening with these participants, which included asking the questions from the Tinnitus Screener (Figure 1). The Tinnitus Screener was designed to be brief and appropriate for telephone administration. The four questions are algorithmic in that a person’s response to each question dictates either a decision or the need to respond to the next item. Before asking the questions, the interviewer defines *tinnitus* to the participants to ensure they understand what is being asked.

The first question was designed to differentiate transient ear noise from tinnitus. If participants never experienced (during the past year) “ear or head noise lasting at least 2–3 minutes,” then the presumption was that they had never experienced tinnitus. Such a response categorized participants as “tinnitus absent,” and no further questions from the Tinnitus Screener were asked. If the response was “yes” to this question, the second question was then asked.

Question 2 asks how often people hear their tinnitus “in a quiet room,” with the following three response choices: *always*, *usually*, or *sometimes/occasionally*. If the participants responded “always” or “usually,” they were classified as having constant tinnitus and no further questions were asked from the Tinnitus Screener. If they responded “sometimes/occasionally,” the assumption was that they had only experienced temporary or intermittent tinnitus, and the subsequent (third) question was designed to distinguish between these two possibilities.

Question 3 focuses on whether a person’s tinnitus was caused by a recent event. The following examples of

**Figure 1.** The tinnitus screener. Four items are used to determine whether a person has tinnitus or has only experienced “transient ear noise,” which is a normal auditory phenomenon. Tinnitus can be classified as “constant” or “intermittent.” In some cases, people have only experienced “temporary” tinnitus, which would most typically be associated with loud noise exposure that results in a temporary threshold shift.

### TINNITUS SCREENER

Name: \_\_\_\_\_ Date: \_\_\_\_\_

#### Tinnitus is ringing, buzzing, humming, or other noises in your ears or head.

<p>1. Have you ever experienced tinnitus lasting <u>more than 2-3 minutes</u>?</p> <p>A. NO (<b>TINNITUS ABSENT</b>; do <b>not</b> fill out tinnitus questionnaires)</p> <p>B. YES: <b>Go to #2</b></p>
<p>2. In a quiet room, can you hear tinnitus....</p> <p>A. Always? (<b>CONSTANT TINNITUS</b>; fill out tinnitus questionnaires)</p> <p>B. Usually? (<b>CONSTANT TINNITUS</b>; fill out tinnitus questionnaires)</p> <p>C. Sometimes/Occasionally? <b>Go to #3</b></p>
<p>3. When you have heard tinnitus, was it caused by a recent event? (Examples: loud concert, head cold, allergies, some medications)</p> <p>A. NO: (<b>INTERMITTENT TINNITUS</b>; fill out tinnitus questionnaires)</p> <p>B. YES, Always: (<b>TEMPORARY TINNITUS</b>; do <b>not</b> fill out tinnitus questionnaires)</p> <p>C. YES, Sometimes: <b>Go to #4</b></p>
<p>4. Does your tinnitus seem to “come and go” <u>on its own</u>, in addition to being caused by a recent event(s)?</p> <p>A. YES: (<b>INTERMITTENT TINNITUS</b>; fill out tinnitus questionnaires)</p> <p>B. NO: (<b>TEMPORARY TINNITUS</b>; do <b>not</b> fill out tinnitus questionnaires)</p>

such an event are given: “loud concert, head cold, allergies, some medications.” Three response options are provided, each of which results in a different outcome. A “no” response indicates that temporary tinnitus has not been experienced, and the tinnitus is classified as intermittent. If the response is “yes, always,” the tinnitus is linked to a tinnitus-inducing event(s) and is considered temporary. Either of these first two responses ends the Tinnitus Screener questions. A response of “yes, sometimes” indicates that the distinction between temporary and intermittent tinnitus is equivocal, and a fourth question is asked to identify one or the other classification.

Question 4 asks if the tinnitus comes and goes on its own in addition to being caused by some event(s). Two response choices are possible: *yes* or *no*. If the answer is “yes,” the tinnitus is classified as intermittent. If the answer is “no,” the tinnitus is classified as temporary.

If the Tinnitus Screener results in a classification of constant or intermittent tinnitus, the participant is considered to experience chronic tinnitus and is mailed the tinnitus

questionnaires (along with the other NOISE Study questionnaires) to complete and bring to the appointment for audiologic testing. The tinnitus questionnaires include the Tinnitus Functional Index (TFI; Meikle et al., 2012) and the Tinnitus History Questionnaire, which is adapted from a questionnaire we use with all of our tinnitus studies to obtain basic descriptions of a person’s tinnitus (Johnson, 1998). If the classification is tinnitus absent or temporary tinnitus, the participant is considered to not experience chronic tinnitus and does not complete the tinnitus questionnaires.

#### Response Verification

It should be noted that no gold standard exists for verifying the accuracy of any instrument that is intended to detect the presence of tinnitus. Tinnitus identification relies entirely on self-report. As described previously, the experience of ear or head noises has temporal characteristics (constancy, intermittency) that we have defined operationally.

As a consequence, our verification efforts are consistent with these operational definitions.

The purpose of the Tinnitus Screener is to predict the results of the TFI and Tinnitus History Questionnaire with respect to whether a participant is judged to have tinnitus and, if so, what category of tinnitus. In particular, we are reporting the predictive validity of the Tinnitus Screener for the judgment reached on the basis of the two tinnitus questionnaires. In this context, it is important to define *predictive validity*. Hulley et al. (2001) point out that there are different meanings to the term *validity*:

Criterion-related validity is the degree to which a measure correlates with an external criterion of the phenomenon under investigation. A variation of criterion-related validity is predictive validity, the ability of the measure to predict the future occurrence of that criterion. (p. 45)

For these first 100 participants, the accuracy of the tinnitus percept was verified when participants were in the sound booth for audiologic testing. The research audiologist asked the participants if they heard tinnitus. If yes, then the location of their tinnitus and whether their tinnitus was “typical today” was determined. If a participant screened negative on the Tinnitus Screener but was positive for tinnitus in the sound booth, then that participant completed the tinnitus questionnaires during the lab visit.

### Data Analysis

Data from this study were provided to the National Center for Rehabilitative Auditory Research data manager who developed and maintained a database. The data manager performed double entry of the data to check for and remediate any errors. To evaluate potential differences between tinnitus categories, an analysis of variance was performed to test differences between tinnitus categories and selected interval-level factors (such as age, years of military service, etc.). Post hoc analyses using the Bonferroni post hoc criterion were used to determine significance. A chi-square test of independence using Bonferroni adjusted alpha levels of .01 per test (.05/5) was performed to examine differences between tinnitus categories and nominal/categorical factors.

### Results

Of these first 100 participants, 84 were men and 16 were women (Table 1). They ranged in age from 21 to 58 years ( $M = 33.5$ ,  $SD = 8.8$ ; Table 2). Using the Tinnitus Screener, 67 of the participants screened positive for either intermittent or constant tinnitus and completed the additional tinnitus questionnaires for the NOISE Study. Three participants were identified as having experienced only temporary tinnitus, and the remaining 30 were categorized as “no tinnitus.” The Tinnitus Screener was accurate with 96 of the 100 participants (four of the participants screened negative with the Tinnitus Screener, and when

they attended their appointment, it was reported that they did have tinnitus).

Tables 1 and 2 provide further data on these 100 participants to examine relevant factors that might differ between the tinnitus categories. (Note: Table 1 includes categorical factors and results of chi square analyses. Table 2 includes interval-level factors and the results of the analysis of variance.) Because the “temporary” tinnitus category included only three participants, those with temporary tinnitus were most appropriately placed in the “no tinnitus” group. The mean age of the participants was similar between the three categories, ranging from 32 to 35 years (Table 2). Years of military service differed only slightly between groups, ranging from 8.5 years (for intermittent tinnitus) to 11.0 years (for constant tinnitus). Age and years of military service were not significantly different between the three tinnitus categories ( $p > .05$ ).

Pure-tone hearing thresholds were averaged across the participants with respect to ear (right vs. left) and frequency (low = 0.25–2 kHz; high = 3–8 kHz), resulting in four combinations (Table 2). For each of the four combinations, the average thresholds were significantly higher (poorer hearing ability) for those with constant tinnitus than for the no/temporary tinnitus participants ( $p \leq .01$ ). For the constant tinnitus participants, the right ear/high-frequency average thresholds were also significantly higher than for the intermittent tinnitus participants ( $p = .02$ ).

TFI mean scores differed significantly ( $p = .02$ ) between constant (mean TFI = 37.7) and intermittent (mean TFI = 22.5) tinnitus groups (Table 2). On the basis of the Tinnitus Screener results, four participants were placed in the no tinnitus/temporary tinnitus category prior to their lab visit. These four participants reported that they did experience tinnitus during test procedures while in the sound booth. Therefore, they completed the TFI, and their TFI mean score of 24.9 ( $SD = 21.8$ ) was not significantly different from the mean scores for either the intermittent tinnitus or constant tinnitus participants. (Please note that these numbers are not included in Table 2 to avoid giving the impression that all of the no/temporary tinnitus participants completed the TFI.)

Other factors that were thought to possibly correlate with tinnitus were evaluated. Of the 100 participants, 32 reported that they had experienced at least one traumatic brain injury (TBI) while in the military (Table 1). Of these 32 participants, 20 (62.5%) reported constant tinnitus, eight (25%) reported intermittent tinnitus, and four (12.5%) reported no/temporary tinnitus. The proportion of participants in each tinnitus category was found to be dependent on the presence or absence of a military TBI ( $p = .005$ ). The largest category for those with a military TBI was constant tinnitus (62.5% vs. 32.4% for no military TBI), whereas the largest category for those with no military TBI was no/temporary tinnitus (42.6% vs. 12.5% for those with military TBI).

Of the 100 participants, 46 reported that they had experienced at least one “blast wave” while in the military (Table 1). Of these 46 participants, 22 (47.8%) had constant

**Table 1.** Differences between tinnitus status and selected categorical factors, chi square.

Subject factors	No tinnitus/temporary tinnitus (n = 33)	Intermittent tinnitus (n = 25)	Constant tinnitus (n = 42)	All (N = 100)	P value
	n (%)	n (%)	n (%)	n (%)	
Gender					
Male	27 (32.2)	20 (23.8)	37 (44.0)	84 (84.0)	ns
Female	6 (37.5)	5 (31.3)	5 (31.2)	16 (16.0)	
Military TBI reported					
No	29 (42.6)	17 (25.0)	22 (32.4)	68 (68.0)	.005 <sup>a</sup>
Yes	4 (12.5)	8 (25.0)	20 (62.5)	32 (32.0)	
Military "blast wave" reported					
No	21 (38.9)	13 (24.1)	20 (37.0)	54 (54.0)	ns
Yes	12 (26.1)	12 (26.1)	22 (47.8)	46 (46.0)	
Service-connected for hearing loss or tinnitus?					
No	26 (43.3)	14 (23.3)	20 (33.3)	60 (60.0)	ns
Hearing loss only	0 (0.0)	1 (100.0)	0 (0.0)	1 (1.0)	
Tinnitus only	4 (15.4)	7 (26.9)	15 (57.7)	26 (26.0)	
Hearing loss and Tinnitus	0 (0.0)	2 (33.3)	4 (66.7)	6 (6.0)	
Hearing loss and/or Tinnitus claim in process	3 (42.9)	1 (14.3)	3 (42.9)	7 (7.0)	
Military branch <sup>b</sup>					
Army	12 (23.5)	17 (33.3)	22 (43.1)	51 (51)	ns
Marines	9 (43.0)	4 (19.0)	8 (38.1)	21 (21)	
Air Force	4 (25.0)	3 (18.8)	9 (56.3)	16 (16)	
Navy	8 (66.7)	1 (8.3)	3 (25.0)	12 (12)	

Note. TBI = traumatic brain injury; ns = not significant.

<sup>a</sup>Chi square, Bonferroni correction used to set significance level at  $p < .01$  (.05/5). <sup>b</sup>Some participants reported service in more than one branch.

tinnitus, 12 (26.1%) had intermittent tinnitus, and 12 (26.1%) had no/temporary tinnitus. The prevalence of exposure to a blast wave was not significantly different across the three tinnitus categories ( $p > .05$ ).

Military Veterans can have a service-connected disability awarded for tinnitus, hearing loss, or a combination of the two. Of the 100 participants, 33 self-reported a service-connected disability for tinnitus and/or hearing loss

(Table 1). Only one of these was service connected for hearing loss only (and had intermittent tinnitus), and 26 were service connected for tinnitus only, of which 15 (57.7%) had constant tinnitus, seven (26.9%) had intermittent tinnitus, and four (15.4%) had no/temporary tinnitus. Six participants were service connected for both tinnitus and hearing loss, of which four (66.6%) had constant tinnitus and two (33.3%) had intermittent tinnitus. The prevalence of

**Table 2.** Differences between tinnitus status and selected interval-level factors, analysis of variance.

Subject factors	No tinnitus/temporary tinnitus (n = 33)	Intermittent tinnitus (n = 25)	Constant tinnitus (n = 42)	All (N = 100)	Constant versus no/temporary tinnitus	Constant versus intermittent tinnitus
	M (SD)	M (SD)	M (SD)	M (SD)	p value	p value
Age of subject	32.0 (8.0)	33.0 (7.0)	35.1 (10.2)	33.5 (8.8)	ns	ns
Years of military service	9.7 (7.4)	8.5 (6.1)	11.0 (8.6)	9.9 (7.6)	ns	ns
Average pure tone thresholds (dB HL)						
RE: low frequency	10.2 (6.4)	12.0 (5.0)	14.6 (7.0)	12.5 (6.6)	.01 <sup>a</sup>	ns
RE: high frequency	9.0 (6.2)	11.0 (6.9)	19.6 (17.4)	14.0 (13.1)	.001 <sup>a</sup>	.02 <sup>a</sup>
LE: low frequency	9.6 (5.6)	12.7 (6.0)	14.3 (7.4)	12.3 (6.8)	.009 <sup>a</sup>	ns
LE: high frequency	11.1 (9.0)	15.4 (13.0)	20.6 (16.0)	16.2 (13.7)	.009 <sup>a</sup>	ns
Tinnitus Functional Index	NA	22.5 (15.6)	37.7 (22.7)	31.9 (21.5)	ns	.02 <sup>a</sup>

Note. dB HL = decibels in hearing level; ns = not significant; NA = not applicable.

<sup>a</sup>One-way analysis of variance, Bonferroni post hoc test criterion.

service-connected disabilities for tinnitus, hearing loss, or both was not significantly different across the three tinnitus categories ( $p > .01$ ). In addition, seven participants had a claim in process (two for tinnitus only, one for hearing loss only, four for both tinnitus and hearing loss).

Table 1 shows the numbers of participants in each of the four military branches: 51 (51%) in the Army, 21 (21%) in the Marines, 16 (16%) in the Air Force, and 12 (12%) in the Navy. It might be noted that eight (66.7%) of the 12 Navy participants had no/temporary tinnitus, only one (8.3%) had intermittent tinnitus, and three (25%) had constant tinnitus—a pattern that appeared different from the other three branches. However, the prevalence of tinnitus within each military branch was not significantly different across the three tinnitus categories ( $p > .01$ ).

## Discussion

The NOISE Study is laying the foundation for a longitudinal cohort study in which data continue to be gathered at incremental time points over Veterans' lifetimes, allowing us to examine the effects and interplay between military and postmilitary exposures and delayed-onset audiologic problems. An important focus of the NOISE Study is tinnitus, and the tinnitus data collected will enable analyses to determine how tinnitus characteristics and effects are correlated with various types of exposures and numerous other factors. This study, if sustained on a long-term basis, offers unprecedented opportunities for learning how auditory system functioning is related to life events and medical conditions.

Because of the study's focus on tinnitus, we needed a method to identify participants who truly experience tinnitus. Whereas the definition of *tinnitus* may seem obvious, there are numerous distinctions in what people experience as head or ear noises, not all of which would fall in the category of chronic tinnitus. We have described the distinctions that were considered important for the NOISE Study. Both transient ear noise and temporary tinnitus do not qualify as ongoing or persistent pathological conditions, and so in each of these cases, participants were categorized as "no tinnitus." Tinnitus that is experienced at least intermittently, that is, daily or weekly, is considered the minimum requirement for tinnitus that is ongoing or persistent. For purposes of the NOISE Study, participants reporting either intermittent or constant tinnitus were categorized as having chronic tinnitus.

The Tinnitus Screener functioned well to correctly identify tinnitus presence in 96% of the first 100 enrolled participants. The inaccurate categorization pertained to four of the participants who screened negative on the Tinnitus Screener over the telephone and then were determined to have chronic tinnitus when they attended their appointment for full testing. These four participants completed the tinnitus questionnaires during the appointment. Their mean score on the TFI was 24.9 ( $SD = 21.8$ ).

The TFI is a 25-item questionnaire that evaluates a broad array of tinnitus-related problems using a 0-to-10 response format. (For additional information on the design

and suggested use of this questionnaire, see Meikle et al. [2012].) The preliminary data presented here reveal that the constant tinnitus group reported a significantly higher degree of tinnitus-related distress ( $M = 37.7$ ) when compared with the intermittent group ( $M = 22.5$ ). A score of  $<25$  suggests tinnitus to be a mild problem, 25 to 50 is suggestive of a problem for which an individual might seek medical attention, and a score  $>50$  is consistent with very bothersome tinnitus.

In addition to the 33 participants who self-reported a service-connected disability for tinnitus and/or hearing loss (Table 1), seven had a claim in process for a service-connected auditory disability (two for tinnitus, one for hearing loss, and four for both tinnitus and hearing loss). The participants were informed that their research results were completely independent from any clinical data and would have no effect on claims, in process or awarded, for service-connected tinnitus and/or hearing loss. However, it cannot be ruled out that some of these Veterans could have provided biased responses on the Tinnitus Screener if they believed their responses might influence a claim for service connection or an existing award. (However, the four inaccuracies in the categorization by the Tinnitus Screener were Veterans who did not believe they had tinnitus until they were tested in the sound booth.) It should also be noted that the definitions of tinnitus categories used in the NOISE Study and described in this article are not the same as the definition of tinnitus used by the VA to determine service connection.

Additional participant factors reported in Table 1 include self-reported military TBI and exposure to a military blast wave. It is important to consider these factors because it is unknown to what extent these exposures may result in developing tinnitus or hearing problems over time (Humes et al., 2006). At the time of this analysis, 32 of the first 100 participants reported experiencing TBI, of which 28 reported tinnitus. It will be important to determine if any of the four with military TBI who did not initially report tinnitus develop it in the future.

There have been numerous attempts to classify tinnitus using different approaches (Cianfrone et al., 2015; Douek, 1981; Nodar, 1978; Noreña, Cransac, & Chery-Croze, 1999). It is generally accepted that tinnitus can involve different mechanisms, and therefore there are likely yet-to-be-discovered types of tinnitus that would enable different diagnoses (Zenner, 1998). However, to date no standard classification exists other than to differentiate primary (i.e., sensorineural or neurophysiologic) tinnitus from secondary tinnitus (i.e., somatic tinnitus or somatosounds; Tunkel et al., 2014). Secondary tinnitus is generated as an acoustic signal somewhere in the head or neck, with an origin that can be muscular, respiratory, skeletal, or vascular (Henry, Dennis, & Schechter, 2005). A patient with suspected somatic tinnitus should be referred for a medical examination by an otolaryngologist (Henry et al., 2010). It should be noted that none of the participants in the NOISE Study were suspected of having secondary/somatic tinnitus.

The Tinnitus Screener was designed to be administered interview style, and all data reported herein were obtained via telephone administration. It would seem reasonable to expect the instrument to provide equivalent results whether administered over the telephone or in person. That premise is currently being evaluated in the NOISE Study because we recently changed the protocol to administer the instrument over the telephone and again when the participant arrives for in-person testing. Obtaining results two times separated by a short time interval (typically 1 to 2 weeks) will also allow us to evaluate the test-retest reliability of the instrument, which was not possible with the first 100 participants.

The NOISE Study participants agree to complete mailed follow-up questionnaires annually and comprehensive in-person testing every 5 years. The first annual mailed follow-up was recently initiated. The Tinnitus Screener was included in the packet of questionnaires for all participants and was modified to be used as a self-administered instrument for this purpose. For the self-administered version, the content (questions and response choices) remained unchanged. The modification involved the removal of the tinnitus categories from the form (see Figure 1), and instructions were provided on the form to indicate whether the tinnitus questionnaires (included in the packet) were to be completed by the participant. Data are not yet available to report the results from the self-administered version.

As a result of this study, we have made revisions to the Tinnitus Screener. We used the following four categories for tinnitus: constant, intermittent, temporary, and no tinnitus. For the NOISE Study, we considered both constant and intermittent tinnitus to be chronic tinnitus. However, the tinnitus management guidelines published by the American Academy of Otolaryngology–Head & Neck Surgery Foundation (and most tinnitus studies) consider tinnitus to be chronic only if it has been experienced for 6 months or more (Tunkel et al., 2014). Tinnitus of less than 6 months would be considered acute. We are currently making the distinction between chronic and acute tinnitus on the basis of the American Academy of Otolaryngology–Head & Neck Surgery Foundation guidelines.

Another possible tinnitus category is “occasional” tinnitus. *Intermittent* would imply that the tinnitus is essentially ongoing, but it comes and goes. This is a gray area, and it is difficult to ascertain whether the tinnitus really does appear and disappear or whether it is a distraction issue or related to a changing acoustic environment. For some people, their tinnitus might really be occasional, meaning they hear it once in a while, but not on a regular basis, as would be the case for intermittent tinnitus. Therefore, we now include “occasional” tinnitus as one of our categories, and on the basis of the results of the Tinnitus Screener, in-booth questioning, and other answers to tinnitus questions, each subject is categorized as one of the following:

- Chronic tinnitus = tinnitus of at least 6 months’ duration; subcategories are “constant” and “intermittent” (constant = can usually hear it when in a quiet environment; intermittent = tinnitus

vacillates between “present” and “not present” on a regular basis, at least daily or weekly)

- Acute tinnitus = tinnitus of less than 6 months’ duration; subcategories are “constant” and “intermittent”
- Occasional tinnitus = tinnitus that is experienced on an irregular basis, for example, every few weeks/months
- Temporary tinnitus = tinnitus that has been linked to some event (e.g., noise or medications) and lasted a period of time (usually days) following an event and then subsided
- No tinnitus = none of the above

We have revised the Tinnitus Screener and developed a method of tinnitus verification and categorization that takes into account tinnitus being chronic only if it has been experienced for 6 months or more and the possibility of “occasional” tinnitus. We use the Tinnitus Screener over the telephone and again when participants arrive for testing. When participants are sitting in the sound booth, we ask them the questions on the verification form and check one of four boxes: true positive, true negative, false positive, false negative. The current six-item version of the Tinnitus Screener, along with the verification form, is available online (<http://www.ncrar.research.va.gov/Education/Documents/TinnitusDocuments/TinnitusScreener.pdf>). The continued use of the Tinnitus Screener will provide data to more formally validate the instrument for sensitivity and specificity. It is important to note that the lack of a gold standard must always be a caveat until such a standard is established.

## Conclusion

Because about 90% of people who experience tinnitus also have a hearing impairment (Coles, 1995; Dobie, 2004; Johnson, 1998; Schechter, Henry, Zaugg, & Fausti, 2002), the presence of chronic tinnitus indicates a need for auditory assessment. Therefore, it is essential to have a brief screening instrument to determine whether tinnitus is present or absent and, if present, to better classify its status. The Tinnitus Screener has so far functioned well for this purpose and has application in both clinic and research environments. It has the potential to become a routine tool for clinicians and researchers to quickly and accurately categorize a person’s tinnitus with respect to chronic/acute, constant, intermittent, occasional, temporary, or absent. There are of course other categorization schemas, but this is a reasonable starting point for anyone who claims to have tinnitus. With our continued use of the new six-item version of the Tinnitus Screener, we will have additional data that will support analyses to more definitively determine its performance parameters.

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