# Validity of Modified Whisper Test as Hearing Screening Method

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Original Article

# Validity of Modified Whisper Test as Hearing Screening Method in Presbycusis Patients

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## Abstract

**Background:** Presbycusis is a hearing loss due to the degeneration process which is found at the age of more than 65 years old, with decreased hearing sensitivity in both ears, asymmetrical bilateral sensorineural detection type. **Objective:** To identify the validity of modified whisper test by detecting the hearing level in presbycusis patients. **Methods:** The design of this study was comparative, cross-sectional, prospective study. Subjects were elderly undergoing hearing monitoring at URJ Geriatric and URJ Audiology Dr. Soetomo Hospital, in August–September 2018 and examined using whisper test and audiometry. The statistical analysis used 2 × 2 tables, sensitivity, specificity, positive predictive value, and negative predictive value. **Results:** The lowest sensitivity at frequencies >41–55 dB was at 100%, the lowest specificity at 100%, lowest sensitivity at frequencies >56–70 dB was at 23.07% with specificity at 100%. The positive predictive value (NRP) at frequencies >25–40 dB was 88.46% while the negative predictive value (NPV) was of 100%. **Conclusion:** The modified whisper test can be used as early detection of hearing impairment.

**Keywords:** Audiogram, elderly, presbycusis, whisper test

## Introduction

Presbycusis is a hearing loss due to the degeneration process, which is characterized by decreased hearing sensitivity in both ears resulting in an increase of the hearing threshold with the symmetrical bilateral type of sensorineural hearing loss.[1,2] A striking change in the cochlea is the atrophy and degeneration of the supporting hair cells in the organ of Corti.[3,4] This degeneration process causes high-frequency sensorineural hearing loss with bilateral and symmetrical nature.[4,5] The degree of hearing loss is determined based on the average value of the hearing threshold or pure tone averages (PTA).[6,7] Due to the limitations of audiometry, a simpler modification of the whisper test is performed.[8,9]

This study intends to prove the validity of the modified whisper test by detecting the degree of hearing loss based on the hearing threshold value in presbycusis patients

## Methods

This study was cross-sectional comparative study with a prospective design. The subjects of this study were elderly patients with complaints of hearing loss who came to the Geriatric Outpatient Unit (URJ) and Audiology URJ Dr. Soetomo Hospital, Surabaya, Indonesia. The study was performed between August and September 2018 with inclusion criteria were patients aged 65 years or older with complaints of symmetrical and bilateral sensorineural hearing loss, never used hearing aids, and no history of surgery and ear infections, while exclusion criteria were inability to concentrate or remember the words spoken due to dementia, disturbance of consciousness, or disturbance of balance. The number of samples obtained was 45 elderly or 90 ears. Ethical approval for this study (Ethical Committee number 0482/KEPK/VIII/2018) was provided by the Ethical Committee of Dr. Soetomo General Hospital, Surabaya, on 11 August 2018.

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The examination was performed as follows : the examiner sat in front of the patient, and the examiner's left and right index fingers were pressed on to the tragus of the unexamined ear of the patient and the ear was covered. The fingers were moved so as to produce sound as a masking. The examiner whispered 10 words then the patient has to repeat the words with light and loud sound. If the patient correctly repeated 80% of the whispered words, the ear was regarded as having pass outcome, while correct repetition of <80% was declared not to have pass outcome.

The hearing threshold value (PTA) is the average value of the airborne hearing threshold at frequencies of 500, 1000, 2000, and 4000 Hz. The hearing threshold is the lowest pure tone that can be heard by someone at a certain frequency. The degree of hearing loss based on hearing threshold values in this study refers to International Standard Organization (ISO) criteria or the ISO: normal degree ≤25 dB, mild degree >26–40 dB, moderate degree >41–55 dB, moderately severe degree >56–70 dB, severe degree >71–90 dB, and profound degree >90 dB.[10]

Statistical analysis in this study examined the first performance or the ability of the modified voice whisper test to predict hearing loss using receiver operating characteristic (ROC) curve with an output in the form of area under the curve (AUC). [Table 3]. We also measured the sensitivity and specificity of the modified whispered test The subsequent analysis used a 2 × 2 table, with the output of sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) [Table 4].[11]

**Table 1: Result of the modified whisper test**

| Modified whisper test | *n* (%) |
|---|---|
| Pass | 65 (72.2) |
| Refer | 25 (27.7) |
| Total | 90 (100) |

**Table 2: Distribution of hearing loss degree**

| Hearing loss degree | *n* (%) |
|---|---|
| Normal | 6 (6.66) |
| Mild | 55 (61.11) |
| Moderate | 7 (7.77) |
| Moderately severe | 13 (14.44) |
| Severe | 4 (4.44) |
| Profound | 5 (5.55) |
| Total | 90 (100) |

**Table 3: Area under the curve value in the modified whispered test of hearing loss**

| Obs | ROC area | SE | Asymptotic interval | 95% confidence |
|---|---|---|---|---|
| 90 | 0.9420 | 0.0161 | 0. 91653 | 0.98726 |

SE: Standard error, ROC: Receiver operating characteristic

## Results

In this study, the results of modified whisper test was compared to the results of hearing threshold measurement using audiometry as the as the gold standard and basic examination.

From a total of 90 ears of elderly patients who performed the modified whisper test, 65 ears (72.22%) had pass outcome and 25 ears (27.77%) had refer outcome [Table 1].

Audiometry results were calculated on an average of all frequencies (250 Hz–4000 Hz); there were 6 normal ears (6.66%), mild impairment in 55 (61.11%), moderate in 7 ears (7.77%), moderately severe in 13 (14.44%), severe in 4 ears (4.44%), and profound in as many as 5 ears (5.55%) [Table 2].

The ROC curve which shows that the modified whisper test had a good diagnostic value because the curve was far from the 50% line and close to 100%.

The AUC value obtained from the ROC method was 94.2% (95% confidence interval [CI], 91.65%–98.72%). Statistically, the AUC value of 94.2% is relatively strong.

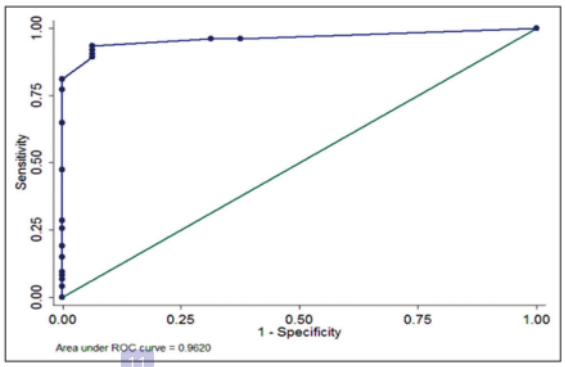


**Figure 1:** The receiver operating characteristic curve in the modified whispered test hearing loss

**Table 4: Sensitivity and specificity of the modified whispered test**

| Modified whispered test | Audiogram result (%) | | | | |
|---|---|---|---|---|---|
| | >25-40 dB (mild) | >41-55 dB (moderate) | >56-70 dB (moderately severe) | >71-90 dB (severe) | >90 dB (profound) |
| Sensitivity | 83 | 100 | 23.07 | 25 | 40 |
| Specificity | 100 | 100 | 100 | 100 | 100 |
| PPV | 88.46 | 53.84 | 33.33 | 14.28 | 25 |
| NPV | 100 | 0 | 100 | 100 | 100 |

PPV: Positive predicitve value, NPV: Negative predicitive value

AUC value of 94.2% means that a modified whisper test score [Figure 1] is reliable for use as a diagnostic tool. The AUC percentage of 94.2% means that if a modified whisper test is applied to determine the presence or absence of hearing impairment in 90 normal ears, the accurate outcome may be obtained from 90 ears of the patients. In this study, the resulted confidence interval of the modified whisper test in the population ranged between 91.65% to 98.72%.

Audiogram examination results at all frequencies showed that the highest sensitivity was at the frequencies of >41–55 dB (100%) with specificity at 100%, while the lowest sensitivity 23.07% was at frequencies of >56–70 dB with specificity at 100%. The positive predictive value (PPV) was at the frequencies >25–40 dB of 88.46% while the negative predictive value (NPV) was 100%.

## Discussion

The results of audiometry examination at all frequencies were as many as 6 normal ears (6.66%) while those with hearing impaired were 84 ears (93.33%). These results are in accordance with a study by Lee *et al*. who reported that there is a correlation between age and sex on hearing loss in the elderly. The average hearing threshold increases by 1 dB every year at the age of 60 years and over and there is a significant decrease in the hearing threshold at frequencies of 4 and 8 kHz between men and women.[12] Another study in South Carolina, USA, found that presbycusis was found mostly in those aged 60–70 years.[13] In contrast, a study in Qatar found that the highest prevalence of presbycusis in the middle age group of 50–59 years.[14]

In this study, modification of whispered voice test in 45 elderly revealed that as many as 65 ears (72.22%) had pass outcome and the remaining 25 ears (27.77%) did not pass. The whisper voice test is a simple method; it does not require sophisticated equipment or provide manipulation to the patient, so this procedure is safe and is not dangerous to elderly.

The results of the audiogram as the gold standard for hearing loss are calculated from the average hearing threshold of all frequencies. The 3-meter whisper test study conducted by Purnami, obtained quite reliable results. The sensitivity of the examination was 80% and the specificity of 95.2%.[9] These results are consistent with Pirozzo's research, which found that the whisper test is more specific in adults (sensitivity 80%–96%, specificity 90%–98%).[15] The results of the examination at the age of the elderly are considered adequately effective enough to diagnose hearing loss by considering the practical implementation procedures, its simplicity, and it can be performed anywhere so that it meets the required screening method criteria.

## Conclusion

Modified whispered test can be used as an early detection of hearing loss.

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### Conflicts of interest

There are no conflicts of interest.

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