HEARING

TABLE OF CONTENTS

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1. Background and rationale

Hearing impairment increases dramatically in prevalence and severity in old age, especially past age 80. It is the third most prevalent common condition in community dwelling older adults, and is associated with most other common comorbidities, especially dementia and depression. Occupational noise exposure is an important risk factor for hearing loss and is thought to explain its higher prevalence in men. *Preliminary data from the Cardiovascular Health Study (CHS) shows that older blacks had less hearing loss than whites, and suggests that such differences should be accounted for in the evaluation of race differences in cognitive performances.*

In Health ABC, hearing impairment is postulated to increase the risk of mobility impairment by several pathways.

A. It may be associated with decreased social interaction, including less leisure physical activity.

B. Although adventitious hearing loss does not reduce cognitive function per se, it can interfere with cognitive activities that are auditory dependent (Gordon-Salant and Fitzgibbons, 1997). The result may be lower levels of activity and difficulties with medical self-management.

We further hypothesize that these effects maybe occur with mild levels of hearing loss for which many elderly persons are reluctant to seek sensory aids although they may benefit from them. Hand-held screening audiometers only identify individuals with moderate to profound hearing losses and only at a limited number of frequencies. Standard pure tone audiometry in a sound-treated booth allows analysis of both mild and more severe hearing losses. Moreover, it provides information about the configuration of hearing loss.

2. Equipment and supplies

- Handheld otoscope
- Disposable otoscope specula
- Sound treated audiometric test booth (meets current ANSI standards for ambient noise levels for puretone threshold testing)
- TDH earphones with supra-aural cushions
- Portable puretone audiometer (calibrated to current ANSI standards for audiometric testing
- Hand held sound level meter (Radio Shack, model 33-2055)

2.1 Daily Biological Check of Audiometer

1. Every day after turning on the audiometer perform a listening check through each earphone.
    a. Sound Quality
        i. Turn frequency dial to 1000 Hz.
        ii. Turn the intensity (hearing threshold level) dial to 70 dB.
        iii. Listen to the quality of the tone.
        iv. It should be clear and not distorted or noisy.
    b. Pitch
        i. Turn the intensity (hearing threshold level) dial to 70 dB.
        ii. Change the frequency dial from 250 Hz to 500 Hz, 1000 Hz, 2000 Hz, 4000 Hz and 8000 Hz.
        iii. The pitch of the tones should increase as you change the dial.
    c. Loudness
        i. Turn the frequency dial to 1000 Hz.
        ii. Starting at 70 dB decrease the intensity setting in 5 dB steps.
        iii. The loudness of the tone should decrease systematically with each 5 dB step.
2. Record date, examiner's initials and *pass* or *fail* for each check.

Contact Sheila Pratt at 412-383-6537 or spratt@pitt.edu if there is a problem.

3. Safety issues and exclusions

There are no exclusions for this test. If the participant refuses to remove their hearing aid(s) the test will not be performed and the data collection form will be marked refused.

4. Participant and exam room preparation

This test should be conducted in a sound-treated booth within a quiet room. When conducting this test make sure that the area is free from distracting conversation and excessive noise. A log will be kept to record the ambient noise level of the room as each participant is tested.

The participant should be seated in the hearing booth with the examiner seated outside the booth. The participant should not be able to see the examiner manipulating the

signals, but the examiner must be able to easily see the participant raise and lower their arm.

The participant should remove eyeglasses, ear jewelry, hearing aids, and chewing gum.

5. Test administration

Before checking for cerumen in the participant's ears, ask the series of questions (Questions #1 through #7 in the Year 5 Clinic Visit Workbook) regarding ear infections, buzzing in the ear, ear surgery, hearing aids, hearing limits, and noise levels of past jobs, military service, or hobbies.

5.1 Check for cerumen in the ear canal

Before beginning the hearing test, check each ear for cerumen in the ear canal after explaining what you are doing to the participant:

Script: "I will be placing the tip of this instrument in both of your ears, first the right and then the left."

Retract the participant's pinna (lower part of the ear lobe) with the thumb and index finger. Gently pull it slightly up and back. This facilitates insertion of the tip.

Grasp AudioScope3 and gently insert speculum tip into the ear canal. Since the lining of the bony canal is very sensitive, use gentle manipulation to insert the speculum. The handle may also be held in a horizontal position. Use your little finger to stabilize the instrument with respect to the participant's head.

Position the tip so that the tympanic membrane or a portion of it can be visualized. Visualization ensures free passage of sound. Before attempting visualization, tip the participant's head toward their opposite shoulder to bring the canal horizontal. **If cerumen is blocking the ear canal, note that on the data collection form.**

5.2 Introduce and administer test

Script: "The object of this test is to find the faintest tones that you can hear. Different tone pitches will be heard in each ear one at a time. Some of the tones will be high pitched and some will be low pitched. Some of the tones will be very soft. Please raise your hand as soon as you hear the tones begin and lower your hand as soon as the tones stop. Raise your hand even if you hear the faintest sound and have to guess."

Place the earphones on the participant's ears. The position of the two earphones should be maximally extended on the headband to provide adequate room for the participant's head. Any long hair covering the ears should be displaced. Place the earphones over the ear canal with the red patch on the right ear and the blue patch over the left ear.

Script: "Does this feel OK?"

Begin the test at the 1000 Hz level on the left ear first. Gradually increase the dB level by 5 dB at a time until the participant raises their hand. The stimulus should be administered at a 1 to 2 second interval separated by 1 to 5 seconds of toneless intervals. This should be variable so that the participant doesn't pick up the patterns. When the participant raises their hand indicating that they have heard the stimulus, decrease the dB level by 10 dB.

If the participant gives an immediate hand signal to this new level again, decrease by 10dB. The signal should be decreased by 10 dB until inaudibility. This is the starting level for determining threshold.

Threshold determination: The first tone presentation should occur 10 dB below the minimal response level found during the familiarization stage. The duration of each tone need be no longer than 1 second with most listeners. Signals should be presented in a variable fashion (an irregular temporal pattern), so that the participant doesn't identify any pattern, with the interval between tones being no shorter than 1 second.

After each lack of response the presentation level should be increased 5 dB until one occurs. After noting the hearing level, the intensity is then decreased 10 dB and another series of 5 dB ascending levels is initiated. This sequence is repeated until a threshold level is determined. The ANSI S3.21 threshold criterion is "the lowest hearing level at which responses occur in at least one-half of a series of ascending trials, with a minimum of two responses out of three required at a single level."

Audiometric threshold data may be recorded in tabular form (numerical hearing level in dB for each test frequency).

Repeat the same procedure at 2000 Hz, 4000 Hz, 8000 Hz, 250 Hz, and 500 Hz. Audiometric threshold levels should be recorded on the data collection for each test frequency.

Next, repeat this protocol for the right ear. Before starting to test the right ear, open the door to the hearing booth after completing the test of the left ear. Opening the door serves to let a little air into the booth, to break up some of the monotony of the test, and to inform the participant about what is next.

5.3 Record keeping

The clinics will keep a log of the ambient noise levels in the testing room for each participant that is screened (see Appendix 2).

6. Procedures for performing the measurement at home

This examination is not feasible for home visits.

7. Alert values/Follow-up/Reporting to participants

There are no alert values for this test. A report will be given to the participants at the end of their clinic visit.

8. Quality Assurance

8.1 Training and Certification

The examiner requires no special qualifications or experience to perform this assessment. Training will be provided at the Health ABC on-site training at one or both of the field centers covering basic machine operation and the fundamentals of testing. Operators should practice on other staff members until reliable measurements are achieved.

Training should include:

- Observe measurement by experienced examiner
- Read the operations manual with the goal of understanding:
  - the proper use of equipment
  - the proper calibration and adjustment of equipment
  - detailed testing procedures
- Practice on colleagues and "naïve" volunteers
- Discuss problems and questions with local expert or QC officer

8.2 Certification Requirements

- Complete training requirements
- Demonstrate calibration process
- Perform test on two volunteers under the observation of the clinic QC officer or designated learning expert:
  - According to protocol, as demonstrated by completed QC checklist

8.3 Quality Assurance Checklist

Introduction

- ☐ Main points of script correctly and clearly delivered
- ☐ Exam conducted in a quiet room
- ☐ Participant is not wearing eyeglasses, ear jewelry, or hearing aids; and is not chewing gum
- ☐ Noise level entered on log

Inspection for cerumen

Right ear

- ☐ Participant's pinna is retracted properly with the thumb and index finger

- ☐ Speculum tip stabilized and gently inserted into ear canal, handle held in a horizontal position
- ☐ Participant's head tilted toward their opposite shoulder
- ☐ Records whether or not cerumen is present in the ear

Left ear

- ☐ Participant's pinna is retracted properly with the thumb and index finger
- ☐ Speculum tip stabilized and gently inserted into ear canal, handle held in a horizontal position
- ☐ Participant's head tilted toward their opposite shoulder
- ☐ Records on data collection form whether or not cerumen is present in the ear

Before testing

- ☐ Participant cannot see examiner while seated in booth
- ☐ Examiner is able to see participant raise and lower their arm
- ☐ Earphones are extended on the headband before being placed on the participants head to create a good fit
- ☐ Participant's hair is not covering their ears
- ☐ Correct earphone placement – red patch over the right ear and blue patch over the left ear
- ☐ Examiner checks in with the participant: "Does this feel OK?"

Left ear
1000 Hz

- ☐ Signals decreased and increased appropriately
- ☐ Signals presented in an irregular temporal pattern
- ☐ At least 1 second passed between signals
- ☐ Audiometric threshold levels recorded on the data collection form

2000 Hz

- ☐ Signals decreased and increased appropriately
- ☐ Signals presented in an irregular temporal pattern
- ☐ At least 1 second passed between signals
- ☐ Audiometric threshold levels recorded on the data collection form

4000 Hz

- ☐ Signals decreased and increased appropriately
- ☐ Signals presented in an irregular temporal pattern
- ☐ At least 1 second passed between signals
- ☐ Audiometric threshold levels recorded on the data collection form

8000 Hz

- ☐ Signals decreased and increased appropriately
- ☐ Signals presented in an irregular temporal pattern
- ☐ At least 1 second passed between signals
- ☐ Audiometric threshold levels recorded on the data collection form

250 Hz

- ☐ Signals decreased and increased appropriately
- ☐ Signals presented in an irregular temporal pattern
- ☐ At least 1 second passed between signal
- ☐ Audiometric threshold levels recorded on the data collection form

500 Hz

- ☐ Signals decreased and increased appropriately
- ☐ Signals presented in an irregular temporal pattern
- ☐ At least 1 second passed between signals
- ☐ Audiometric threshold levels recorded on the data collection form

Right ear
1000 Hz

- ☐ Signals decreased and increased appropriately
- ☐ Signals presented in an irregular temporal pattern
- ☐ At least 1 second passed between signals
- ☐ Audiometric threshold levels recorded on the data collection form

2000 Hz

- ☐ Signals decreased and increased appropriately
- ☐ Signals presented in an irregular temporal pattern
- ☐ At least 1 second passed between signals
- ☐ Audiometric threshold levels recorded on the data collection form

4000 Hz

- ☐ Signals decreased and increased appropriately
- ☐ Signals presented in an irregular temporal pattern
- ☐ At least 1 second passed between signals
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8000 Hz

- ☐ Signals decreased and increased appropriately
- ☐ Signals presented in an irregular temporal pattern
- ☐ At least 1 second passed between signals
- ☐ Audiometric threshold levels recorded on the data collection form

250 Hz

- ☐ Signals decreased and increased appropriately
- ☐ Signals presented in an irregular temporal pattern
- ☐ At least 1 second passed between signals
- ☐ Audiometric threshold levels recorded on the data collection form

500 Hz

- ☐ Signals decreased and increased appropriately
- ☐ Signals presented in an irregular temporal pattern
- ☐ At least 1 second passed between signals
- ☐ Audiometric threshold levels recorded on the data collection form

9. References

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Appendix 1. Daily Biological Check of Audiometer

DATE	EXAMINER	Sound Quality		Pitch Across Frequencies at 70 dB		Loudness Across Intensity Settings at 1000 Hz	
		Right	Left	Right	Left	Right	Left

3. Every day after turning on the audiometer perform a listening check through each earphone.
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4. Record date, examiner's initials and *pass* or *fail* for each check.

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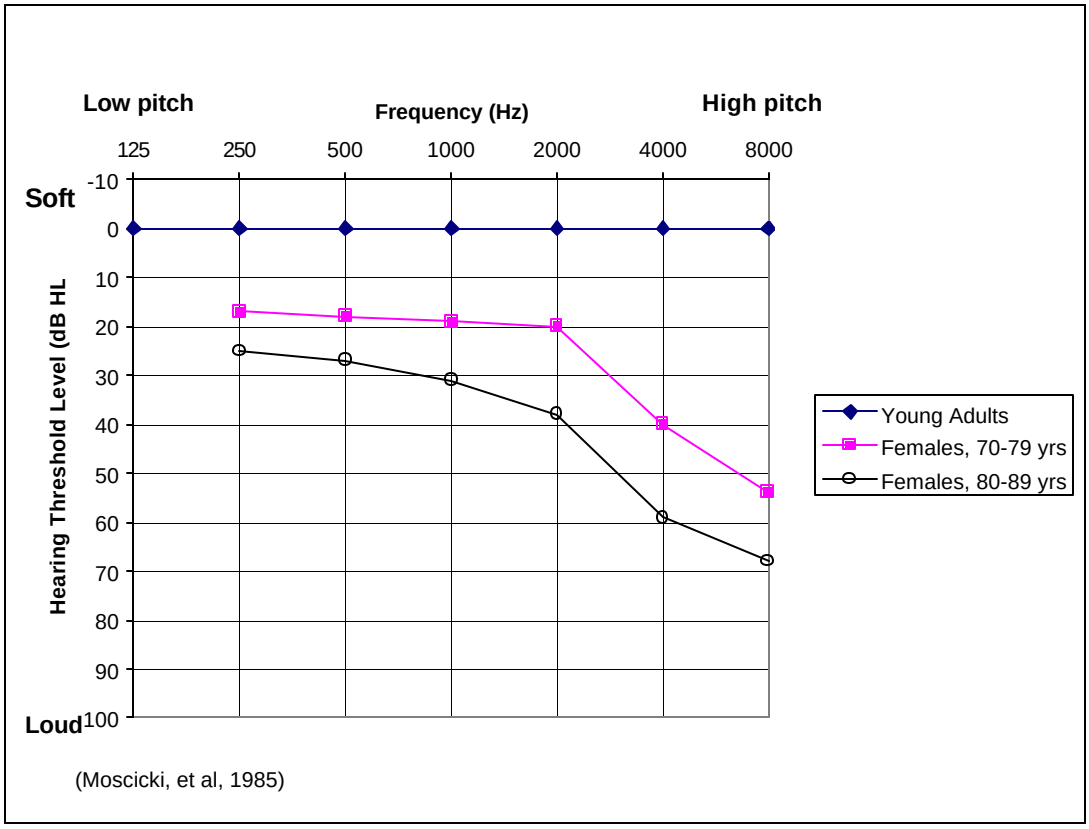
Appendix 2. Noise Levels During Hearing Screening

DATE	TIME	PARTICIPANT	EXAMINER	NOISE LEVEL

1. Record noise levels where you do the testing.
2. Try to record for each time you see a participant.
3. Set the SLM to the A scale and to the fast setting. Watch it for a minute and record the most stable or typical level observed.

Appendix 3 – AUDIOMETRIC RESULTS

HEARING TEST IN WOMEN



(Moscicki, et al, 1985)

The Audiogram

The graph above is called an audiogram. Audiograms are used to plot the **lowest level** (hearing threshold level) that people can hear different tones. Young adults have hearing thresholds around 0 decibels. Hearing thresholds for people with normal hearing are usually between -10 decibels and 20 decibels. Average conversational speech is around 50 to 60 decibels. As we get older we tend to lose hearing. We especially have trouble hearing high pitched sounds.

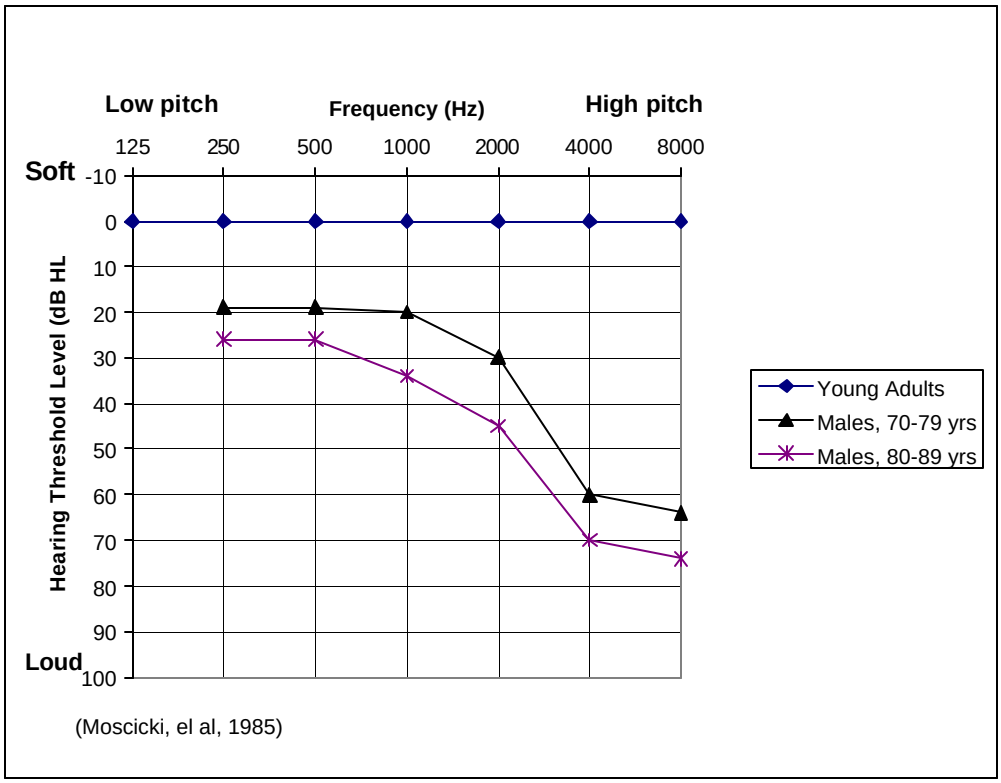
The audiogram shows the average hearing thresholds for young adults and for women between the ages of 70-79 and 80-89 years.

Understanding Your Hearing Results

If your hearing test results were not as good as the results of other people your age, or if you are finding it difficult to have a conversation, you may want to visit a hearing specialist

(audiologist). Based on a complete hearing evaluation, the audiologist may refer you to a doctor or recommend a hearing aid or other hearing device.

HEARING TEST IN MEN



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