

## Research Article

# Subjective Hearing Loss Versus Audiometry in the Assessment of Hearing Problems in Community Dwelling Mexican Elderly

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## Keywords

- Community-Dwelling Elderly
- Hearing loss
- Audiometry
- Diagnostic test

## Abstract

**Objective:** To determine the diagnostic test properties of subjective hearing loss (SHL) versus pure tone audiometry (PTA) in community-dwelling elderly.

**Methods:** Cross-sectional, retrospective comparative design to evaluate a diagnostic test, we include exclusively subjects over 60yrs old. SHL was defined by a positive answer to the question "do you feel you have hearing problems?", and by the diagnosis (presence or absence of hearing loss) made by the expert audiologist in base of the PTA test. Results: The final sample was composed by 335 subjects. 67.5% were represented by male patients. The prevalence of SHL was of 17.6% and the prevalence of hearing loss by PTA was of 21.8%. SHL diagnostic properties were as follow: sensitivity 30.1 (CI95%, 16.7-43.6%), specificity 85.9% (CI95%, 80.5-91.3%), positive predictive value (PPV) 37.2% (CI95%, 21.5-53.0%) and negative predictive value (NPV) 85.9% (CI95%, 75.7-87.4%).

**Conclusion:** SHL compared to PTA demonstrate fair good specificity and NPV for the detection of hearing loss, and it might be a useful strategy to identify low risk individuals without hearing problems.

## ABBREVIATIONS

PTA: Pure Tone Audiometry; SHL: Subjective Hearing Loss; PPV: Positive Predictive Value; NPV: Negative Predictive Value.

## INTRODUCTION

Hearing loss is a high-prevalence problem in community dwelling elderly, it affects nearly 40% at age 60, and over 90% at age 80 or older. There are nearly 36 million cases afflicted by hearing loss in the United States of America [1,2].

This problem might compromise communication and safety of the individual, and eventually carries to social isolation, depression and poor quality of life [2]. Recently, hearing loss had been related to dementia of any type, in different populations [3-5].

Some of these outcomes could be prevented or reversed, if hearing loss is detected and treated properly [6-7].

At present, there are useful tests for the assessment of hearing loss, such as the whispered or the clock test, with the inconvenient that they need special training and practice skills to have a fair reliability [8,9]. Audiometry test it is considered one of the preferred strategies by U.S. audiologists, however availability

and costs are its main limitations in the developing world [10,11]. Structured Questionnaires are subject to time availability and trans-cultural differences [10]. Hearing loss assessment has been recently evaluated as a part of a 3-item questionnaire, proving fairly good sensitivity (66.9%) and specificity (85.1%), and it is considered a valid, cost-effective and easily replicable strategy as a screening test in over 50 years population. Subjective hearing loss (SHL) as a part of the medical interview has been previously compared to pure tone audiometry, in several heterogeneous populations and with discrepancy between sensitivity and specificity, and its diagnostic value it is still unknown [12-17].

SHL as part of the routine clinical exam and interview of healthy subjects (that attend to a check-up clinic) has not been previously evaluated with a single question from the clinical interview. The purpose of this study was to determine the diagnostic accuracy of the subjective hearing loss versus pure tone audiometry (PTA, standard reference test) hearing loss in community dwelling elderly.

## MATERIALS AND METHODS

## Patients and setting

Data was retrieved from subjects who attended to a check-

up center at a private hospital in Mexico City, which is one of the largest private centers in the Country and one with the most prestigious check-up centers. All patients included in this analysis were community dwelling adults >60 yrs. old who attend voluntary to the check-up center in the period from January 1<sup>st</sup>, 2010 until December 31<sup>st</sup>, 2012.

Subjects first responded to a self-applicable questionnaire and attended during the course of 6 to 8 hours to different specialists in ophthalmology, dentist, nutritionist, audiologist, orthopedics, and geriatrician (or internist). During this evaluation the patients were screened by a chest X-ray, abdomen ultrasonography, general labs, bone densitometry and a pure tone audiometry.

### Inclusion and exclusion criteria

Adults aged 60 or older were eligible for medical record screening. Patients were excluded in case of incomplete audiograms or inconsistent responses to the question "do you feel you have hearing problems?" of the self-applicable questionnaire form. The questionnaire consisted in >120 items designed to elicit demographics characteristics, personal history, lifestyle habits and general medical information.

### Definition of variables

Air conduction pure-tone thresholds at octave intervals from 500 to 8000 Hz for the right and left ears were obtained using the method recommended by the National Health and Nutrition Examination Survey (NHANES) protocols [13]. Briefly, audition thresholds were obtained inside a noise-isolated room; all tests were performed using Hughson-Westlake procedure; only automated audiometers were employed (Interacoustics AD226, Interacoustics, Eden Prairie, MN). Quality control was obtained by daily calibration of the device and monitoring of room noise levels. The test room was in compliance with national quality standards (ANSI S3.1-1991) for maximum permissible noise levels. The air conduction stimulus was initially performed using supra aural headphones (TDH 39P, Telephonic Corp, Farmingdale, NY).

For the purpose of determining the association between subjective and audiometry-measured hearing loss, SHL was defined by a positive answer to the question "do you feel you have hearing problems?", and by the diagnosis (presence or absence of hearing loss) made by the expert audiologist considering the threshold of 1 or 2 KHZ at >40dBHL in both ears.

The SHL, as measured in this study, was not a component of any specific instrument designed for the screening of hearing loss in the elderly, but just as single component of the patient interview in search of alterations.

### Statistical analysis

We calculated test characteristics (sensitivity, specificity, and predictive values, using a 2 x 2 table). We described proportions of the main diagnosis and demographic variables.

All Data were analyzed with STATA 13.0 (Stata Statistical Software: Release 13. College Station, TX: Stata Corp LP).

## RESULTS AND DISCUSSIONS

The sample population was composed by 335 subjects of

60 and over yrs. old, with an average age of 66.3 +5.8 yrs. Most patients were male (67.4%, n=226). In the study population we identified, 59 cases of subjective hearing loss (17.6%), and 73 audiometry analysis with the definitive diagnosis of hearing loss (21.8%). Demographic data of interest are shown in table 1.

Among those with hearing loss, men were more affected, both in the subjective hearing loss (69.5%, n=41) and in the PTA hearing loss group (54.8%, data not shown). Table 2 corresponds to the 2x2 table, to the analysis of diagnostic test properties. SHL had a sensitivity of 30.1% (CI95%, 16.7-43.6%), Specificity of 85.9% (CI95%, 80.5-91.3%), Positive Predictive Value (PPV) of 37.2% (CI95%, 21.5-53.0%) and Negative Predictive Value (NPV) of 85.9% (CI95%, 75.7-87.4%).

Our study found that SHL had a fair good specificity and negative predictive value, and it could identify individuals without PTA hearing loss, and most important without the need of an audiometry. In our analysis, none of the variables were associated with the probability of hearing loss in the subject [data not shown].

To our knowledge, this study is the first of its kind in Mexico and Latin America.

Our findings are similar to those of Reuben et al, in 1998. In that study, the author developed a 6-item hearing loss screening instrument in a national survey, the NHANES compared to PTA. Although, its sample was greater than ours (n=917), it employed an adult population from the age 55 to 74. and it corresponded to a cohort sub analysis of an epidemiologic study, the prevalence of hearing loss was of 24% (subjective) and, of 14.2% by audiometry [using the same cutoff point of > 40dB], also men were more affected than women, both in the subjective

**Table 1:** Demographic characteristics of participants.

	SHL (n=59)	Non SHL (n=276)	P
Age (mean ± SD)	66.1 ± 6.1	66.4 ± 5.5	NS
Female, n (%)	18 (30.5)	91 (33.0)	NS
Number of drugs (mean ± SD)	3.1 ± 2.4	2.9 ± 2.6	NS
Smoking, n (%)	28 (49.0)	96 (34.8)	0.04
Alcohol use, n (%)	50 (84.7)	210 (76.1)	NS
Diabetes, n (%)	6 (10.2)	30 (10.9)	NS
Hypertension, n (%)	18 (30.5)	92 (33.3)	NS
NSAID use, n (%)	7 (11.9)	22 (8.0)	NS

**Abbreviations:** SHL: Subjective Hearing Loss; SD: Standard Deviation; NSAID: Nonsteroidal Anti-Inflammatory Drug; NS: Non-statistical Significance.

**Table 2:** Subjective Hearing Loss Diagnostic Test Properties.

	PTA with hearing loss	
	Yes	No
SHL	22	37
Non SHL	51	225

**Abbreviations:** PTA: Pure Tone Audiometry; SHL: Subjective Hearing Loss

and audiometry-measured group [12]. This trial although it throw similar prevalence, it employed a 6-item specific designed instrument for the screening of hearing loss, not a single question from the usual clinical interview.

Other report was developed in Australia, and recruit adult subjects over 15 yrs. old and considered SHL [it applied a 4 item instrument] in case of a positive answer to one of three different categories of hearing impairment and it was compared to PTA. In this study the author employed an epidemiologic database derived from a national survey and found a prevalence of 15.3% for the SHL and of 17% for the PTA diagnosed hearing impairment [15]. Although this study found a similar prevalence [but slightly lower than ours], it was developed in a younger population and it applied a complex 4-item instrument.

Other reports have found different prevalences, employed a heterogeneous set of population [younger subjects, or nursing home residents] and applied SHL instruments with multiple items and not a single question from the clinical questionnaire applied during the patient medical exam [13,14], [16,17].

This paper has some limitations. It is retrospective in nature, so we could not found any factor associated with the presence of hearing loss. We lost several subjects, because of the incomplete fulfilling of the hearing loss question in the interrogatory form. The main strength of this analysis is that, a single question in the medical interview, the SHL, could be as good as an audiometry to found individuals without PTA hearing loss, and that we could spare this diagnostic test in the low risk population. If we consider, that audiometry is expensive in the developing world, and that it is complex to perform, the SHL could save costs in the screening evaluation of the elderly. Also, SHL [as it was searched in this study] was through the usual clinical interview, with one single question and not with a structured specific multiple item instrument; in such way, SHL could be search without the need for the development and validation of any specific instrument and, with a fair good diagnostic properties compared to PTA.

The correct identification of hearing loss is relevant in the elderly, since it is associated with disability, risk of falling, social isolation, depression, hospitalization and dementia [2,3],[18-20]. In some specific scenarios it could be necessary to develop locally valid screening instruments other than audiometry but, in the meantime a single question during the patient interview could help us to discard hearing loss. In such manner, we need to return to the patient as the corner stone of the clinical knowledge, in order to safely identify elderly without hearing problems.

## CONCLUSION

Compare to PTA, subjective hearing loss had an excellence performance regarding its diagnostic test properties, since it had high specificity and NPV. Subjective hearing loss could be employed in the medical interview as a valid screening intervention, especially in case audiometry is not available.

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## Author's contribution

The author developed the conceptualization and design of the study, performed the full analysis, and interpreted the data. He wrote the manuscript.

## Conflict of Interest

The author perceived incomes from Bayer Pharmaceuticals, since he perform as a Medical Science Liaison for that Company in Mexico.

## Disclosure

The author made the analysis and interpretation of the data, during his time as medical staff in the Diagnosis and Treatment Comprehensive Center of Medical Sur Hospital, between 2011 and 2013.

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