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# Perception of hearing loss: use of the subjective faces scale to screen hearing among the elderly

Letícia Pimenta Costa-Guarisco [1]
Daniela Dalpubel [2]
Ludimila Labanca [3]
Marcos Hortes Nisihara Chagas [1]

**Abstract** *Presbycusis is a disorder present among the elderly. However, it is under-diagnosed, making it important to develop and enhance simple screening tools. Objective: The subjective faces scale has been proposed as a method to assess auditory self-perception among the elderly, and its correlation with audiological tests. Methods: We looked at elderly patients referred to the audiology service of a reference center for the care of the elderly in a public university hospital between February and November 2013. Patients were submitted to meatoscopy, tonal and vocal audiometry and the whisper test. They also answered the subjective faces scale. A total of 164 elderly individuals participated, and the average age was 77. Results: We found a good correlation between the subjective faces scale and audiometry thresholds (r = 0.66). Our results show that the faces and hearing loss correlate, with face 1 corresponding to normal hearing, face 2 to mild hearing loss, and face 3 to Grade I moderate hearing loss. When evaluating the psychometric qualities of the subjective faces scale, we found that faces 2 or 3 have good sensitivity and specificity, with the area under the ROC curve being 0.81. Conclusion: The subjective faces scale seems to be a good, low-cost and easy to use supplementary tool for auditory screening in geriatric services.*

**Key words** *Presbycusis, Elderly, Hearing loss, Diagnostic*

[1] Departamento de Gerontologia, Centro de Ciências Biológicas e da Saúde, Universidade Federal de São Carlos (UFSCar). Rodovia Washington Luís Km 235, Jardim Guanabara. 13565-905 São Carlos SP Brasil. lepcosta@hotmail.com
[2] Programa de Pós-Graduação em Enfermagem, Centro de Ciências Biológicas e da Saúde, UFSCar. São Carlos SP Brasil.
[3] Faculdade de Medicina, Universidade Federal de Minas Gerais. Belo Horizonte MG Brasil.

## Introduction

An aging population has long been a reality in developed nations, but is a new challenge for developing nations such as Brazil. According to the most recent IBGE[1] census, 12.6% of the Brazilian population is 60 or over, and by 2050 the elderly component of the country's age pyramid will have increased by 29%. This gives rise to political, economic and social concerns as to how to address this new reality, understanding that aging is a natural and desirable process, despite its unique requirements. Since the late 20th century, and especially at the start of the 21st, public policies fostering dignified and sustainable aging have been discussed and implemented in Brazil[2]. In the past 10 years, new courses on aging have been created and accredited, as well as health and management specialties in gerontology. It is healthy and essential that people be encourage to age fully and healthily. Thus, aging related pathologies[3] that compromise bio-psychosocial functions, such as presbycusis, must be addressed broadly and responsibly.

Presbycusis is characterized by changes in the ear and/or hearing system due to age. Presbycusis is a type of neurosensorial, bilateral and symmetric hearing loss that initially affects high frequency (sharp) sounds, and the ability to understand speech. Because of its slow, gradual and progressive nature, onset is silent and barely perceptible, evolving to greater hearing loss, ultimately involving also low and medium frequencies[4]. At this point there is already biopsychosocial involvement, as the person affected will have difficulty communicating, feel socially isolated, have low self-esteem, present symptoms of depression and an increased risk of cognitive decline[5]. Although presbycusis does not affect longevity, it has a major impact on the quality of life of the individual affected and his/her family, thus the need for early diagnosis.

The prevalence of hearing loss among the elderly ranges from 30 to 90%, increasing with age[6]. Presbycusis is the third most prevalent pathology in this age group, behind only arthritis and arterial hypertension[7]. The high prevalence of hearing loss among the elderly may be explained by numerous factors such as mutations of mitochondrial DNA, genetic disorders, hypertension, diabetes, metabolic and other systemic diseases. Excess noise and poor diet over a long time, as well as the use of certain medications[8-10], may also be involved, and are further complicated by the aging process.

Since 2004, the National Policy for Attention to Hearing Loss has provided Brazilians with auditory care within the public healthcare network. This covers full and universal care for the diagnosis of hearing loss, selection and adjustment of individual sound amplification devices (hearing aids), and auditory rehabilitation when necessary[11]. To provide patients with the right to suitable diagnosis and treatment, it is the duty of every professional dealing with the elderly to watch out for the possibility of hearing loss and, if such loss is suspected, refer the individual to suitable detailed assessment. However, identifying possible hearing loss can be a problem, as the elderly person may not recognize the problem or not report it.

Diagnosing hearing loss is done using liminar tonal audiometry, a test performed by audiologists or physicians, which measures the type and extent of hearing loss. In addition to liminar tonal audiometry, the diagnosis may be complemented by speech audiometry, which measures a person's ability to discriminate and detect speech sounds, classifying an individual's loss of the ability to communicate as a result of his/her hearing loss. However, the gold-standard for diagnosing hearing loss requires high-cost equipment, expert professionals and a suitable environment[12], all of which make it difficult to implement in primary care, especially far from the larger urban centers. For this reason, presbycusis is under-diagnosed in the thousands of elderly seen by the primary care system, resulting in the consequences of hearing loss such as social isolation, lack of understanding, depression and cognitive decline, often avoidable had the loss been diagnosed in a timely way, and if the patients received rehabilitation[5]. The elderly are rarely assessed in terms of how hearing loss impacts their quality of life.

A possible way to assess self-perception of hearing in the elderly is to use the subjective faces scale (Wong Baker Face Scale), however this method has never been used to assess presbycusis. The subjective faces scale became a common tool to measure pain in the 80s, in particular among pediatric patients due to its simplicity and ease of use[13,14]. Normally this scale uses five to seven stylized faces, each one a circle with unchanging eyes and a mouth that changes from a smile - an almost half-circle turned up, meaning happiness or extreme satisfaction, through a similar half-circle turned down, meaning sadness or extreme dissatisfaction[15]. The patient is asked to show the face that best represents his/her self-perception or feeling about the problem being assessed.

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Because it is simple, fast and easy to apply, this study decided to assess the correlation between the subjective faces scale and auditory thresholds, and the speech percent recognition index. It was also used to assess the psychometric qualities of the subjective faces scale as a new tool for auditory screening of the elderly.

## Methods

This study was approved by the Institution's Research Ethics Committee.

This is a cross-sectional study to assess the correlation between the results of audiology tests of an elderly population, and their subjective perception of hearing loss using the faces scale method. Furthermore, the study contributes measurements of the accuracy of the subjective face test and the whisper test to track hearing loss in this population.

We looked at elderly patients referred to the audiology service of a reference center for the care of the elderly in a public university hospital between February and November 2013. As is standard practice, all of the patients submitted to hearing tests were first submitted to anamnesis, meatoscopy, and tonal and vocal audiometry.

This study included those aged 60 or over who agreed to participate in the study and signed the Free and Informed Consent Form. In this case, in addition to being submitted to routine audiological assessment, the patients were given the Subjective Faces scale and the whisper scale.

Exclusion criteria were people unable to understand the procedure, failure to complete the proposed audiological assessment, obstruction of the external acoustic meatus, conductive or mixed auditory impairment, asymmetric hearing loss or those with a different degree of hearing loss in each ear. These criteria seek to suitably identify the neurosensory and symmetric characteristics of presbycusis.

One hundred and eighty five elderly were invited to participate, 21 of whom were excluded. The final sample was made up of 164 participants, 104 women (63%) and 60 men (37%). The average age was 77 (± 8.129), and 83% had 4 or fewer years of schooling.

Tests were performed in a quiet room while the patient was seated. Audiology, the whisper test and the subjective faces scale were all applied by an experienced phonoaudiologist. Procedures were performed in the following order: anamnesis, meatoscopy, subjective faces scale, whisper test, tonal and vocal audiometry. The following tools were used:

*1 - Subjective faces scale to assess self-perception of hearing:* using a large, easy to see figure showing five stylized faces (Figure 1). The evaluator briefly explained the faces and their differences to make sure the elderly individual could visually differentiate between them, then asked: *choose the face that best represents how satisfied you are with your hearing*. If the question was not understood it was repeated to make sure the individual understood.

*2 - Whisper test:* the stimulus was in the form of a standard question whispered by the evaluator about 33 cm from the participant's ear and outside of his/her visual field. This was the question: "What is your name?" The result was classified as positive or negative for hearing loss. The test was considered positive for hearing loss if the individual was unable to understand or correctly answer the question.

*3 - Audiology assessment:* Audiology was performed by a phonoaudiologist and member of the research team, using a Vibra Som AVS-500 audiometer. The same method was used to gather air conduction data between 200 and 8,000 Hz, and bone conduction data betweem 500 and 4,000 Hz. Hearing loss was classified using the average air conduction auditory threshold in the 500, 1,000, 2,000 and 4,000 Hz frequencies. Auditory thresholds under 21dB were not considered hearing losss. Values between 21 and 40 dBNA were considered mild hearing loss, 41-55 dBNA were considered Grade I moderate hearing loss, 57-70 DBNA Grade II moderate hearing loss, and anything over 70 dBNA severe to profound hearing loss[16].

The speech recognition test was applied using a list of 25 single-syllable words asked into each ear, 40 dB above the average auditory threshholds at 500, 1,000 and 2,000 Hz. The Speech Recognition Percent Index (SRPI) was then calculated, with anything over 92% being considered normal hearing.

The Kolmogorov-Smirnov was performed to assess the normality of the variables. The Kruskal-Wallis test was applied to analyze the differ-

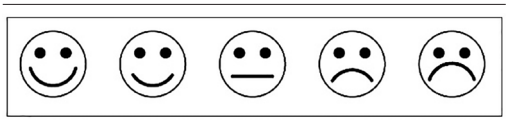

**Figure 1.** The Subjective Faces scale.

ence between median auditory thresholds and the SRPI for each face. Spearman's correlation was used to assess the correlation between hearing loss and SRPI using the subjective faces scale. To determine the quality of this correlation we used the following scale: 0 - 0.2: very poor correlation; 0.21 - 0.4: poor correlation; 0.41 - 0.6: fair correlation; 0.61 - 0.8: good correlation; 0.8 - 1.0: excellent correlation[17].

Sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) were calculated for all cut-off points of the subjective faces scale to check its ability to differentiate between elderly individuals with and without presbycusis. We also determined the area under the ROC curve for the subjective faces scale and the whisper test.

## Results

Figure 2 shows the audiometric profile of the study participants, and the median intensities (dBNA) by frequency (Hz) and ear. The median SRPI was 80 dBNA in the right and left ear (minimum of 0 and maximum of 100). The p value for the paired difference test (Wilcoxon test) was 0.664 for SRPI and > 0.05 for the audiometry thresholds, indicating symmetrical audiological profiles in both ears. Considering this, an average of the results obtained in the right and left ears was used for data analysis. Thus, for each participating elerly individual we have one number for the average auditory threshold, and one for SRPI.

Figure 3 shows a correlation between the subjective faces scale and the auditory threshold of the elderly person (Figure 3A), and the speech recognition percent (Figure 3B). The correlation between the subjective faces scale, the auditory threshold (r = 0.66) and the percent speech recognition (r = -0.70) shows that the greater the dissatisfaction with hearing, the higher the auditory threshold (in other words, a more significant hearing loss), and the lower the speech recognition percent (worse performance in the speech recognition test).

Figure 4 shows a comparative analysis of each face and the median values for auditory threshold and SRPI. In terms of the auditory threshold, results show a statistically significant difference when we compare all faces, with the exception of faces 4 and 5 (Figure 4A). In terms of the SRPI, results show a statistically significant difference when we compare all faces, with the exception of faces 1 and 2, and 4 and 5 (Figure 4B).

Table 1 shows the values of sensitivity, specificity, predictive value and accuracy of the subjective faces scale when used for the whisper test. The areas under the ROC curve were 0.80 for the whisper test, and 0.81 for the subjective face test.

## Discussion

This study was motivated by the importance of evaluating auditory screening tests to be applied mainly in a primary care setting. Screening tests are expected to exhibit a good level of accuracy, and be quick and easy to apply, with no need for special equipment, special locations or training.

This study was performed at an audiology outpatient service, on people referred following a geriatric visit. We found a 76.8% prevalence of hearing loss among the elderly. This finding is in line with other studies of ambulatory care samples[18,19], however it is higher than studies using population-based samples[20].

Hearing loss was classified based on audiometric assessments. As expected[21] mild and Grade I moderate hearing loss were found most frequently, with a prevalence of 35% and 36% respectively, confirming slow and gradual onset presbycusis, also revealed by the median audiometric response of the sample (Figure 2). This means that often the elderly take a long time to realize they are losing their sense of hearing, and this fact is also ignored by their families. Often it is not even mentioned during geriatric office vistis[22]. Figure 3 shows good correlation between the subjective faces scale, the audiometric threshold and speech recognition. Taken together, these results and the findings in Figure 4 show a correlation between the faces and the degree of hearing loss, with face 1 corresponding to normal hearing (up to 20 dBNA), face 2 to mild hearing loss (25-40 dBNA), and face 3 to moderate Grade I hearing loss (40 to 55 dBNA). The p values in Figure 4 show that there is a statistical difference between the faces. Although there were no differences between faces 4 and 5 ($p < 0.44$), both correlated with moderate, Grade II hearing loss.

When we analyze the subjective faces scale and the ability to discriminate speech, we find good degree of negative correlation (r = -0.70), showing that difficulty with speech recognition influences the subjective face assessment. Figure 4 shows no statistically significant different between faces 1 and 2, both of which may represent no difficulty or mild difficulty understanding speech. However, starting with face 3 (neutral),

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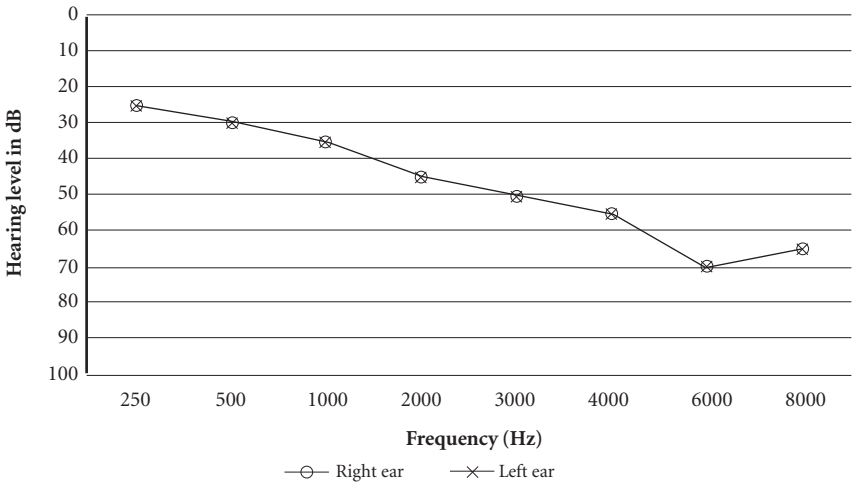


**Figure 2**. Audiometric profile of the study participants: median auditory thresholds in the right and left ear.

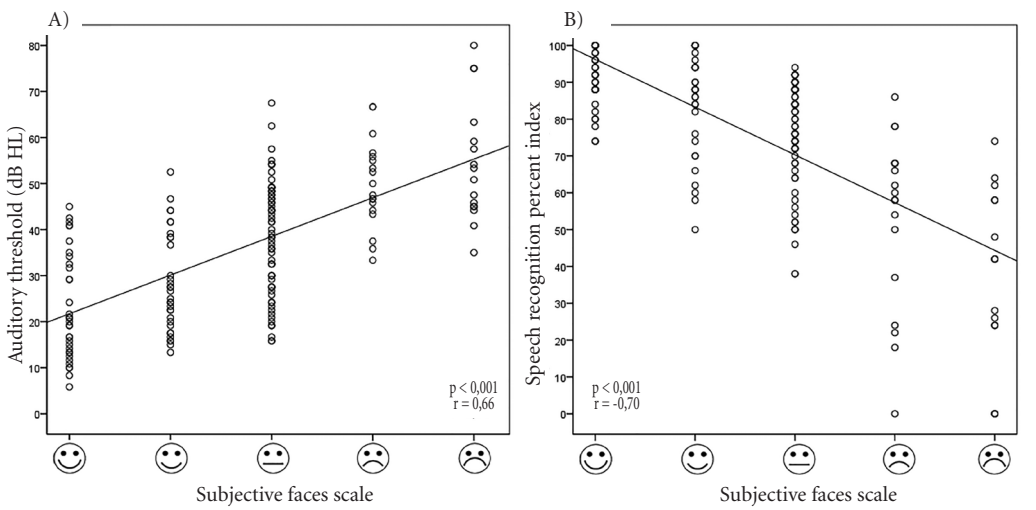


**Figure 3**. (A) Correlation between the subjective faces scale and the auditory threshold of elderly participants. (B) Correlation between the subjective faces scale and the speech recognition percent indicator. r = degree of correlation (Spearman).

we find an association between difficulty understanding speech and a level of discrimination of less than 80%. Faces 4 and 5 also reflect compromised communication, with values under 50% making it difficult to follow a conversation[23].

These results allow us to state that the impact of hearing loss is influenced by its magnitude. In other words, the greater the loss of hearing, the greater the loss in auditory and communication ability. The subjective faces scale was used here to assess its accuracy and ability to represent self-perceived hearing problems. Although it is a subjective assessment and highly influenced by individual life experiences and expectations, the scale is consistent with the auditory reality of the subjects assessed.

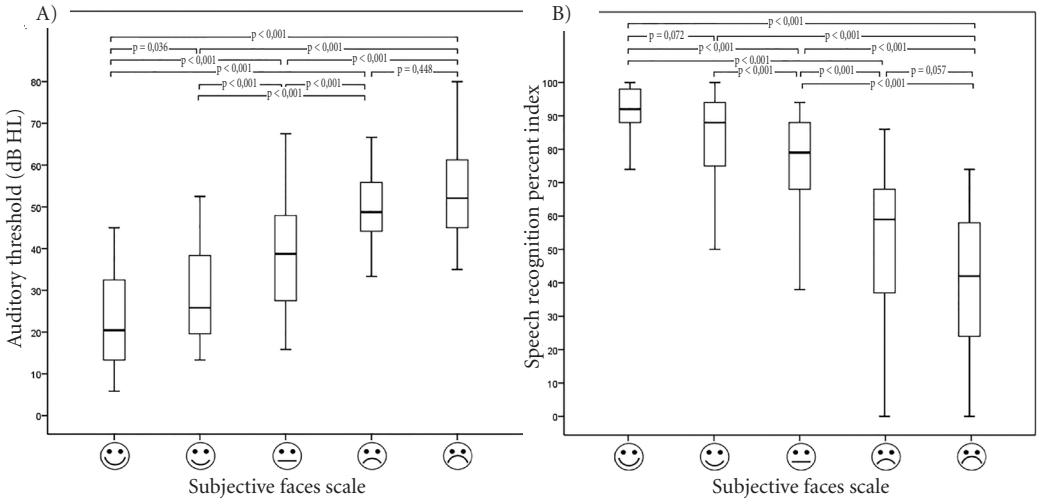


**Figure 4**. (A) Comparative analysis of the median auditory thresholds and each face. (B) Comparative analysis of the median speech recognition percentage and each face; p = probability of significant (Kruskal-Wallis test).

**Table 1**. Sensitivity, specificity and predictive value of the subjective faces scale and the whisper test compared to hearing loss.

| Cut-off points | ☺ | 😐 | ☹ | ☹ | Whisper test |
|---|---|---|---|---|---|
| **Sensitivity** | 88.9% | 71.4% | 27.0% | 12.7% | 76.2% |
| **Specificity** | 52.6% | 78.9% | 100% | 100% | 84.2% |
| **Positive predictive value** | 86.6% | 91.8% | 100% | 100% | 94.1% |
| **Negative predictive value** | 58.8% | 45.4 % | 29.2% | 25.7% | 51.6% |

As a rule, mild loss of hearing (up to 40 dBNA) is quite subtle and often imperceptible to the person affected, who can still understand speech in silent environments, and hear most of the familiar environmental sounds. His or her problems with speech are limited to perceiving voices and low or distant, causing no social loss. Moderate hearing loss (Grade I - up to 55 dBNA and Grade II - up to 70 dBNA) has a bit more impact, and speech must be louder and lip-reading is used to complement what is heard and keep up with the conversation[23]. This means that loud environments are extremely detrimental to good communication. In this case, the individual will find it difficult to hold a conversation in a group, bothering not only the individual affected, but also his/her family members. The same happens with the TV volume, which must be set higher, leading to irritation and misunderstanding among those who live with the elderly person[24,25]. From this point on, hearing loss could keep the elderly individual away from his social and family circle. In this study, a higher degree of hearing loss correlated positively with less satisfaction on the subjective faces scale.

When analyzing the ability of the scale to discriminate, we find that face 3 (neutral) has good sensitivity (71.4%) and specificity (78.9%). We should point out the high sensitivity of face 2 (88.9%), which should also be used in screening situations (Table 1). However, the literature contains no other studies using the faces scale for auditory screening, which could be used to discuss the results of this study. For this reason, we used

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the whisper test, traditionally used by geriatric services, to discuss our results. Both the whisper test and the subjective face test showed similar sensitivity and specificity (Table 1), showing that the face test has discriminative psychometric properties similar to the most often used test to screen for hearing loss in primary care and in specialized Geriatric and Gerontology services. One should also point out that although simple, the whisper test must be applied cautiously, as it requires a silent environment and some experience on the part of the evaluator, as there is no standard technique for applying it. Furthermore, the whisper test does not take into consideration the elderly person's perception of his/her own hearing loss, or any loss of functionality, nor the social, family and psychological impact. This means the subjective faces scale may be an important complementary tool for functional screening of hearing loss, given its psychometric characteristics (area under the ROC curve = 0.81), and the fact that it is simple and easy to apply, having been originally developed for a population that has problem communicating - pediatric patients[13,14].

In an attempt to identify hearing loss in the elderly, and assess the magnitude of the problems they face, self-perception questionnaires such as the *Hearing Handicap Inventory for the Elderly (HHIE)*[25,26] have been used in national and international studies. Results have been satisfactory when compared to the results of audiology tests[27,28]. In Brazil, the HHIE has shown itself to be a highly sensitive and specific auditory screening test, capable of identifying hearing loss in the elderly who come into the healthcare service[29]. In India, a study of 175 elderly shows that the HHIE performs better for more significant hearing losses[30]. Other forms of self-reporting hearing perception have been considered indicative of the absence or presence of hearing loss. A large-scale study conducted in Japan on 12,495 employees of a technology company reports agreement between self-reported hearing loss using a question, and the result of tonal audiometry, in 83% of the elderly, thus concluding that a subjective assessment of hearing loss may be used as a screening method[31].

The elderly person's perception of his/her hearing may be subject to a number of issues such as life experience, culture, years of schooling, cognition and context. All of these can influence the ability to adapt to, and accept the disability and the aging process. Furthermore, the slow, gradual and progressive nature of presbycusis means the affected individual will develop mechanisms to adapt, such as reorganizing the surrounding environment, using alternative resources and staying away from situations that might hinder their communication. This will reduce the impact of hearing loss on their life, but possibly exacerbate social losses[32].

Despite favorable results when using the subjective faces scale as a screening method among the elderly, further studies should be considered to explore the relationship between satisfaction, perception of loss and hearing loss to evaluate their psychometric qualities in primary care.

Finally, it is never too much to remember that while presbycusis is progressive and irreversible, it can be treated and rehabilitated with excellent electronic sound amplification devices provided by the Public Health Primary Care for Auditory Health services[11]. It is important to point out that whether or not the individual complains of hearing loss, diagnosis and intervention should happen as early as possible for the successful adaptation and use of these devices, as the smaller the hearing loss the more preserved will be the auditory processing skills, and thus the better will be the individual's readaptation to the universe of sound[33].

## Conclusion

This study shows that the subjective faces scale can be a low cost, easy to use supporting tool for auditory screening in geriatric services. Future studies should be performed to determine its psychometric characteristics in primary care.

## Collaborations

LP Costa-Guarisco worked on the conception of the work and on the data collection, on the writing of the manuscript, on the analysis of the data and final revision of the manuscript. D Dalpubel, L Labanca and MHN Chagas worked on writing the manuscript, analyzing the data and final review of the manuscript.

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