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Clinical Reviews and Case Reports

Xhuvani Adrian *

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Research Article

Introducing Speech Audiometry in Albanian Language

Xhuvani Adrian [1*], Ferrary Evelyne [2], Vasili Dritan [3], Sulaj Holta [4], Hervochon Remi [1], Beci Bahri [6], Boci Besim [7], Tankere Frederic [1]

[1] ENT Department, Pitié-Salpêtrière Hospital, APHP Sorbonne University, Paris, France.

[2] Technologies etv thérapie génique pour la surdité, Institut de l'audition, Pasteur/INSERM, Paris, France.

[3] ENT Department Salus Hospital, Tirana, Albania.

[4] ENT Department, Hygeia Hospital, Tirana, Albania.

[5] Phonetician, Paris, France.

[6] ENT Department Mother Theresa Hospital, Tirana, Albania.

***Correspondence Author:** Xhuvani Adrian, ENT Department, Pitié-Salpêtrière Hospital, APHP Sorbonne University, Paris, France.

Received Date: August 14, 2023 | Accepted Date: August 28, 2023 | Published Date: October 11, 2023

Citation: Xhuvani Adrian, Ferrary Evelyne, Vasili Dritan, Sulaj Holta, Hervochon Remi, et al (2023), Introducing Speech Audiometry in Albanian Language, *Clinical Reviews and Case Reports*, *2*(6); **DOI:**10.31579/2835-7957/038

Abstract

There are no validated speech audiometry lists of words in Albanian. The aim of this study was to create and evaluate lists of words for children and young adults with normal hearing.

In total, 20 lists of 10 spondaic dissyllabic words were created, taking into account the idiosyncrasies of the Albanian Language. Eighty-three (83) young adults and eighty-six (86) children were included in this study from November 2018 to November 2019. For each patient's ear the difference between the Speech Recognition Threshold (SRT) and the Pure Tone Average threshold (PTA) was calculated to analyse if the value was less or equal to 7 dB in order to validate the 20 wordlists.

The psychometric function slope of the resulted speech audiometry graph was also calculated to compare it with the ones of other Indo-European languages.

The difference between the SRT and PTA was 3.2 +/- 2.1 dB in adults and 3.3 + /- 2.4 dB in children. A value ≤ 7 dB was observed in 93 % of adults and 92% of children. The psychometric function slope was 7.3%/ dB in adults and 7.9%/ dB in children, similar to those found in other Indo-European languages.

Speech audiometry in the Albanian Language can now be performed using the lists defined in the present study.

Keywords: speech audiometry; albania; audiology; pediatrics

Introduction

Listening is a function of the perception of an acoustic signal and at the same time it realizes its identification.

Vocal audiometry plays a crucial role in assessing hearing capacity and assessing the possibility of speech recognition by the human hearing apparatus.

Vocal audiometry is an examination, a test, used to diagnose hearing problems. It requires an implication not only of the neurosensory apparatus of hearing, but also, the knowledge of the spoken language, and the culture associated with a particular language as it is based on a list of specific words.

The first studies on vocal audiometry were done by a monk (L'Abbé ROUSSELOT, 1886-1924).

In the middle of the 20th century, first wordlists were created in English (Hudgins & Hawkins, 1947), in French (Fournier, 1951; Lafon 1964), in Italian (Azzi Bocca Pellegrini, 1950), in Russian (Aleksandrowski, 1998), in Polish (Skarzynski, 2004).

In the clinical practice of auditory balance, there are two forms of vocal audiometry: vocal audiometry for adults and vocal audiometry for children. This is due to the different spoken vocabulary used by these two age groups.

In adults, vocal audiometry is a more sensitive and accurate indicator than tonal audiometry in various auditory pathologies, such as "immediate deafness" or neurological pathology.

Vocal audiometry is an irreplaceable tool for the auditory examination of a patient who wants to use a hearing prosthesis.

In children, vocal audiometry is used to:

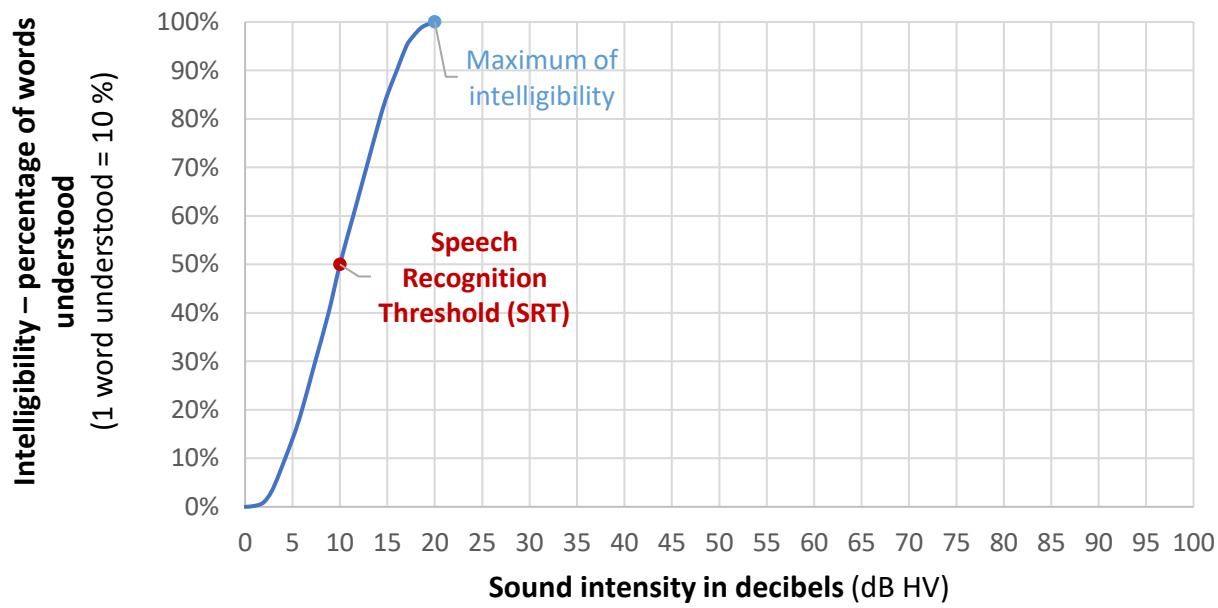
- assess the child's ability to repeat words and his/ her communication development

- help in deciding if an "auditory rehabilitation" or an auditory prosthesis is necessary (in case we are dealing with a child with significant hearing loss)
- make it possible in a concrete and visual way for the child's parents to understand the lack of the child's ability to hear and understand a word or phrase
- help in a concrete way in choosing the type of hearing prosthesis (conventional device or cochlear implant)

The purpose of speech audiometry is to assess the intelligibility, which is the ability to perceive and process speech, by understanding and repeating correctly a specific list of words. This test, which is frequently associated with pure tone audiometry, helps to better qualify hearing impairment.

The patient is presented with different lists of ten words (disyllabic) at different sound intensities, for each ear. The results of the vocal audiometry is then represented on a graph for each ear with the sound intensity in decibels (dB) on the abscissa, and the percentage of words understood on the ordinate. The curve takes on a sigmoid shape in healthy subjects. One of the most fundamental measures in speech audiometry is the Speech Recognition Threshold (SRT). It is defined as the lowest level in dB HL at which an individual can correctly identify 50% of the words (« Guidelines for Determining Threshold Level for Speech », 1988). As for the maximum of intelligibility, it is the highest point on the curve. **(Figure 1)**

FIGURE 1 : Theoretical normal speech audiometry graphic



Familiarity, homogeneity and standardisation are critical elements to consider when creating lists for speech audiometry evaluations. Because the purpose of SRT testing is to measure the auditory threshold for speech, the words selected as stimuli should be as familiar as possible (Hudkins & Hawlins, 1947, Jahner et al, 1994; Young et al, 1982)

Objectives

The first goal of this study was to create 20 lists of 10 words each, dealing with the following criteria:

- dissyllabic words with 4 or 5 phonemes
- familiar to each age group (adults or children)
- auditory and grammatically homogenous
- phonetically different in spectral analysis.
- almost all the phonemes of the language must be represented in a list of 10 words, taking into consideration the occurrence of these phonemes in the Albanian Language.
- each syllable must be pronounced at the same intensity (spondaic words).

The second goal of the study was to evaluate these lists of words in the Albanian Language in a sample of children and adults with normal hearing, by comparing SRT and PTA. Indeed, to validate these lists, the difference between SRT and PTA thresholds (average 500, 1000, 2000, 4000 Hz) must be less than or equal to 7 or 10 dB (Teplitzky et al, 2009).

Some Characteristics of The Albanian Language

The Albanian Language contains 36 letters: 7 vowels and 29 consonants, of which 9 are digraphs. A letter represents a phoneme. Most of the syllables are "open syllables CV" (starting with a consonant - C - followed by a vowel - V). 92% of words start with a consonant. 67% of words end with a vowel.

The phoneme « ë » is used in about 29% at the end of words, but it is a deaf phoneme and as such it is not used (only spondaic words are chosen).

The average length of a word in Albanian is 1.8 syllables / 4 phonemes.

Vowels are rare at the beginning of a word; only 8.02% of words start with them, while 91.98% of words start with consonants (digraph or not).

The selected words are always used in the nominative form (Prominent form).

The phonetic principle is the basic principle of orthography of the Albanian Language not only because in the Albanian Language words are written as they are pronounced, but also for because the phonetic principle corresponds to the morphological principle of the word.

Materials and Methods

Twenty lists of ten words were created, meeting the criteria mentioned in the "OBJECTIVES" paragraph and the idiosyncrasies of the Albanian Language (**Figure 2**). Thus, all words started with a consonant, and no word ending with the phoneme « ë » was selected since it is a deaf phoneme.

Another criteria taken into consideration is that each wordlist contains all frequencies of the Albanian Language. A special software program (Sound spectral analysis; AUDACITY programs) allowed for acoustic analysis of spondaic words and made it possible to find the words with equal phonetic value in Albanian Language. (**FIGURE 3**)

Each list contains 10 words (one word = 10% on the intelligibility scale).

	List 1	List 2	List 3	List 4	List 5	List 6	List 7	List 8	List 9	List 10
Adults	Pinca Vëndi Lëngu Kafsha Bari Pyka Dhëmbi Fuçia Demi Kocka	Pragu Tulla Gishti Peshku Busti Krimbi Porta Plaga Trungu Vesa	Njolla Dëngu Truri Forma Klubi Tregu Lakra Brazda Kushti Bloza	Lista Peshku Plaku Muri Gjesti Qëngji Shkëmbi Gjoksi Shuli Veshka	Kashta Shkalla Kllapa Pisha Vepra Mushka Varka Birra Plumbi Pushka	Grimca Lënda Kisha Gjuha Cungu Gozhda Zemra Brumi Pirgu Basti	Tanku Djathi Bota Motra Kocka Predha Trari Bluza Vajza Dushi	Gjalpi Supi Gjëza Brryli Vrima Shansi Salla Posta Shega Lisi	Fshati Shtegu Filmi Shtypi Delja Ngjyra Gripi Sherri Kafja Kyçi	Koka Derri Rrushi Bregu Deti Sheshi Banka Viçi Sofra Xhami
Children	Balli Syri Gjuri Lufta Goma Kali Babi Puna Libri Darka	Veza Mami Dora Buka Lecka Boja Kosi Luga Furça Topi	Lapsi Shoku Thesi Vula Goja Trimi Lulja Pasta Tymi Rrota	Çanta Treni Kënga Dera Gjumi Noti Pleshti Rrufa Ferra Pema	Pula Buza Mali Xhaja Gjeli Burri Gota Vapa Kolla Dielli	Gjyshi Leshi Macja Zogu Bora Rrypi Luani Pjata Dreka Gruri	Kripa Gjaku Shala Xhaxhi Thika Krahu Toka Drita Guri Dimri	Veshi Triko Lumi Qeni Nata Gryka Forca Shteti Lodra Fshesa	Shkolla Çifti Pulla Fusha Pika Kati Princi Nëna Miku Koha	Llampa Torta Shkopi Fiku Supa Barku Sharra Xhepi Këmba Pylli

Figure 2: The 20 wordlists created

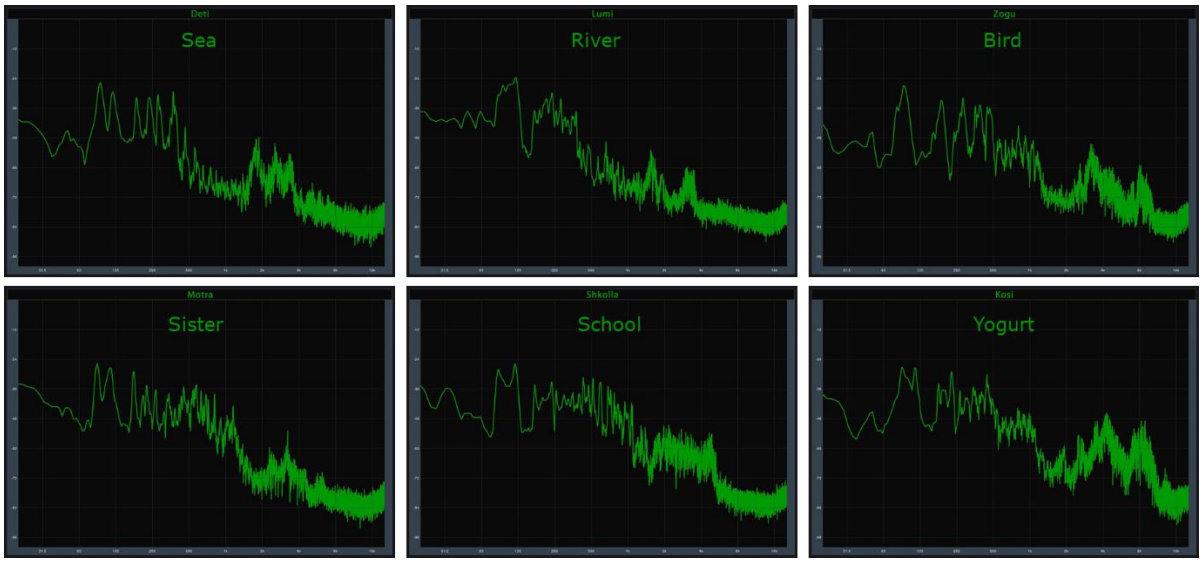


Figure 3: Sound spectral analysis of some selected words from the lists (translated)

From November 2018 to November 2019 we included 83 adults aged 18 to 25 years old and 86 children aged 5 to 14 years old with no otological story. They were all of Albanian origin and all spoke Albanian.

Examination of the external auditory channel and tympanic membrane was normal for all subjects. Tympanometry was normal for all subjects (Tympanometry type A). They all had normal tonal hearing, which corresponds to an average loss of less 26 dB hl from 250 to 8000 Hz (Silman & Silverman's classification system) or less than 20 dB SPL.

All subjects or their legal representatives gave their written consent.

We used the following equipment: a type 1 of Audiometer (IEC 60645-1; IEC 60645. Type A) INTER ACOUSTICS AD229b calibrated in October 2018, a SENNHEISER HDA 200 type headset, a standard audiometric booth (ambient noise < 30dBA) and an INTERACOUSTIC AT225 type tympanometry. The dissyllabic words were recorded and digitized on CD and USB stick in the Albanian State Radio Studios by an Albanian native speaker.

The CD player used was the PANASSONIC SA PMX80.

The speech audiometry test was performed using the top-down method, every 3 dB, with the created wordlists. In order to achieve the vocal curve, each patient heard and repeated 7 wordlists per ear, all independent and different.

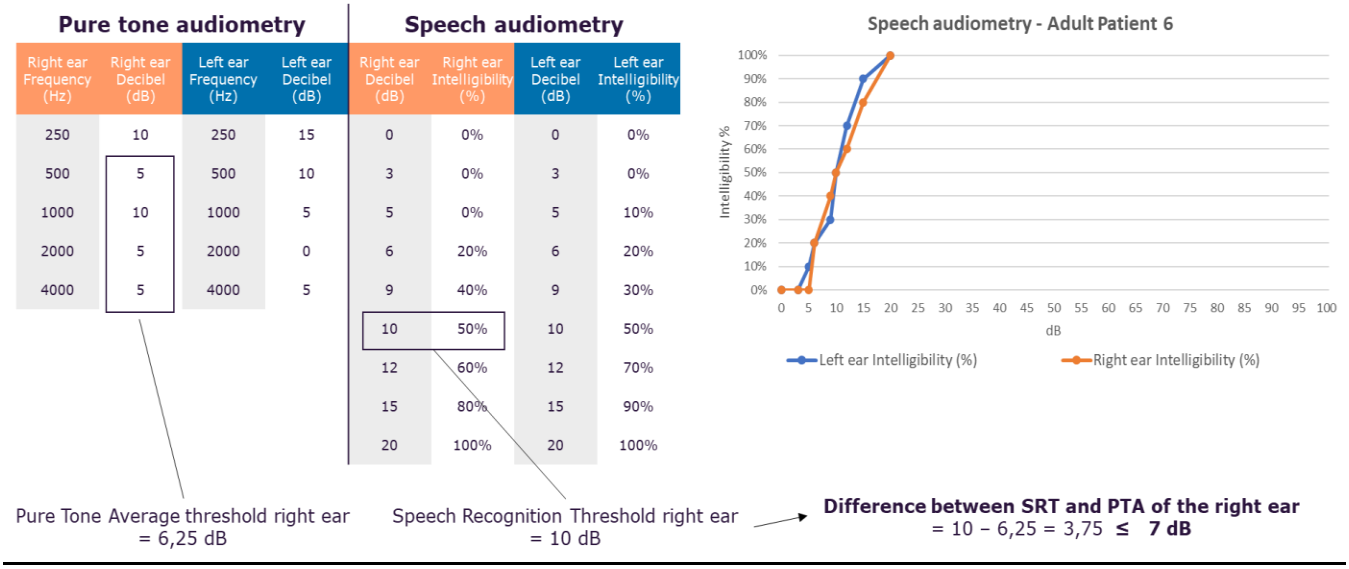
The test duration was approximately 35 min: 10 minutes of pure tone audiometry, 5 minutes of tympanometry and 20 min of speech audiometry.

For each subject and for each ear, we calculated the absolute value of the difference between SRT and PTA thresholds. The PTA thresholds were

obtained by calculating the average of the tonal thresholds at frequencies 500 Hz 1000 Hz, 2000 Hz and 4000 Hz.

Then we calculated the average of these differences within the adult population and within the pediatric population. (**Figure 4**)

Psychometric function slope (%/dB) from 20 to 80 % was also calculated on two curves corresponding to the averaging of the curves of all the ears tested within the adult group and the pediatric group.



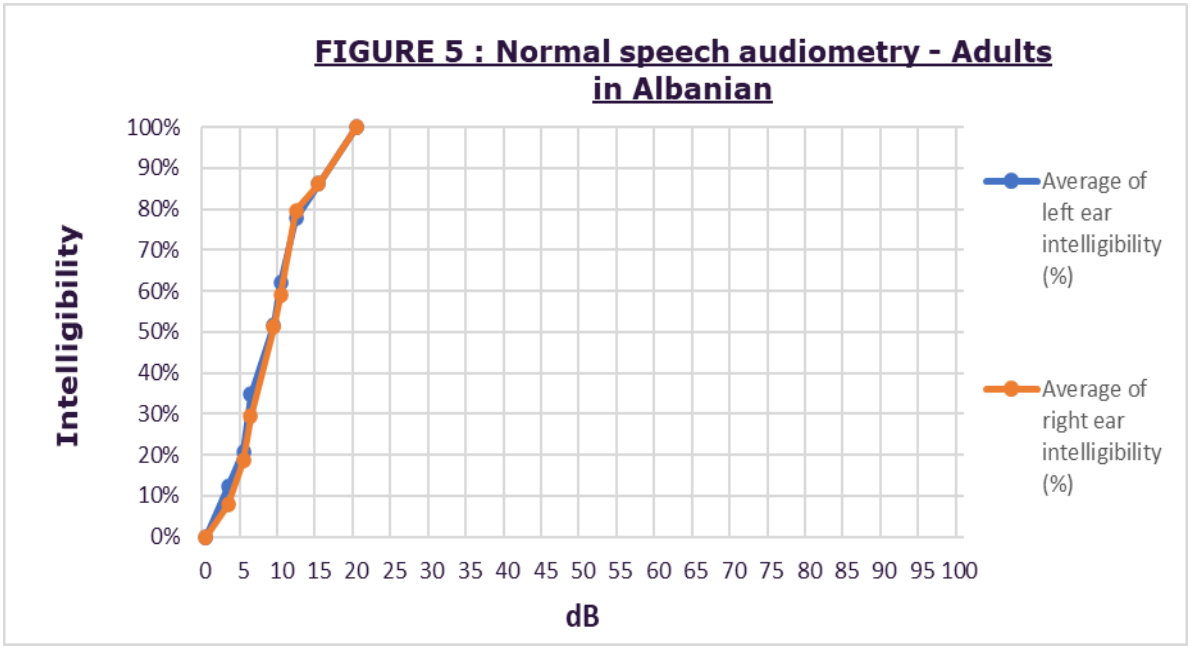
Pure tone audiometry				Speech audiometry			
Right ear Frequency (Hz)	Right ear Decibel (dB)	Left ear Frequency (Hz)	Left ear Decibel (dB)	Right ear Decibel (dB)	Right ear Intelligibility (%)	Left ear Decibel (dB)	Left ear Intelligibility (%)
250	10	250	15	0	0%	0	0%
500	5	500	10	3	0%	3	0%
1000	10	1000	5	5	0%	5	10%
2000	5	2000	0	6	20%	6	20%
4000	5	4000	5	9	40%	9	30%
				10	50%	10	50%
				12	60%	12	70%
				15	80%	15	90%
				20	100%	20	100%

Figure 4: Illustration of the speech audiometry for the adult patient 6

Results

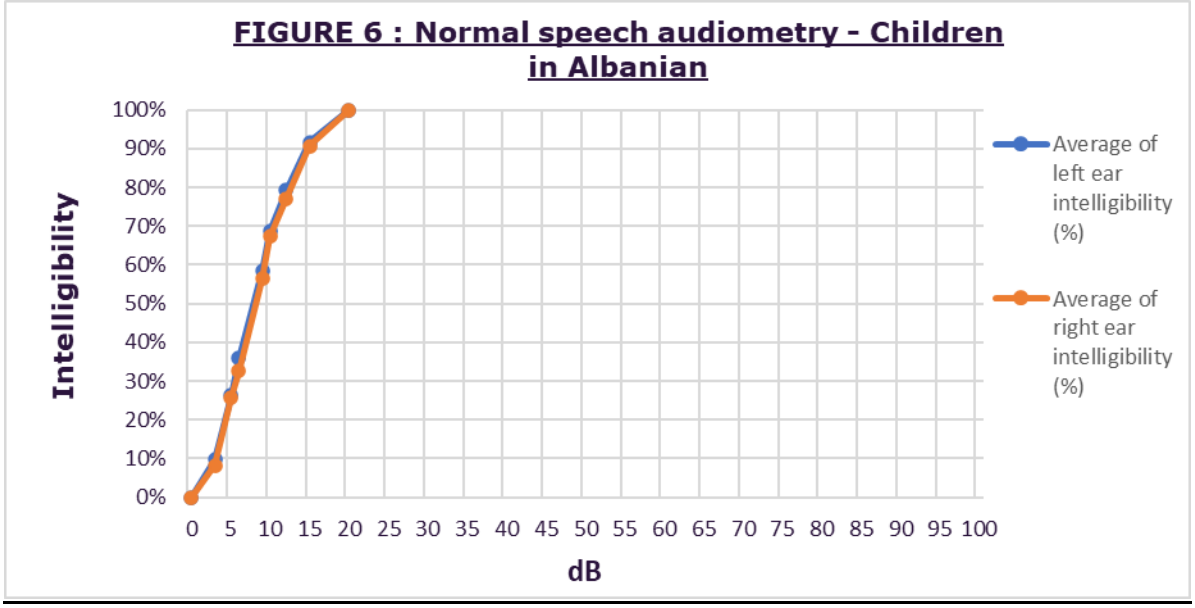
Among the 83 adults, there were 17 men and 66 women. 62 subjects were between 18 and 21 years old and 21 subjects were 22 years old or older. Of the 166 ears tested, the difference between SRT and PTA was 3.17 +/- 2.14 dB (mean+/- standard deviation). Only one ear had a difference of more than 10 dB, 10 ears had a difference between 7 and 10 dB, and 155 ears had a difference of 7 dB or less in terms of absolute value between SRT and PTA.

By averaging all the curves obtained in adults, we obtain a sigmoid: 0% at 0 dB, 50% at 9 dB, 59% at 10 dB, and 100% at 20 dB (**Figure 5**)



Among the 86 children, there were 49 boys and 37 girls. Twenty subjects were between 5 and 7 years old, 40 subjects were between 8 and 10 years old, and 26 subjects were between 11 and 14 years old. Of the 172 ears tested the difference between SRT and PTA was 3.26 +/- 2.41dB, (mean +/- standard deviation). Thirteen ears had a difference between 7 and 10 dB, and 159 ears had a difference of 7 dB, or less in terms of absolute value between SRT and PTA.

By averaging all the curves obtained in pediatric subjects, a sigmoid is obtained 0% at 0 dB, 26% at 5 dB, 50% at 9 dB, 100% at 20 dB (**FIGURE 6**). Psychometric function slope from 20 to 80% was 7.5%/ dB.



Discussion

The primary aim of the study was to develop standardized Speech Audiometry Wordlists in Albanian, that will be used in the future to better diagnose and monitor hearing and speech pathology in Albanian population (adults and children).We have been able to develop a set of Albanian dissyllabic wordlists which are homogeneous in performance with respect to audibility and psychometric function slope for subjects with normal hearing.

In other Indo-European languages, the main slopes have also been similar to those found in the present study: between 7.2%/dB, and 10%/dB in English (Hudkins & Hawkins, 194 7 ; Wilson & Strouse, 1999) between 9.8 and 10.1%/dB in Polish (Harris, 2004) between 9.7 and 11.1%/dB in Spanish (Nissen, 2005) and around 13%/dB in Italian (Puglisi and al, 2015).

To our knowledge, our work is the first dealing with the speech audiometry in the Albanian language. Since this study was performed on children and adults with normal hearing, it would be useful in the future to conduct further studies with patients with hearing loss of various levels.

Conclusion

Speech audiometry in Albanian Language can be performed with these wordlists studied in this research.

Conflict of Interest

None.

Acknowledgment

For the realization of this study we would like to give special thanks to:

- Patrick BOUAZIS, Audioprothésiste, Paris, France
- Marc BOULET, Audioprothésiste, Paris, France
- Diana XHUVANI, Consultant in strategy & management, Paris, France

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