

Development and Validation of Libyan Accent Bi-Syllabic and Monosyllabic Speech Perception Test in Adults: Data from Zagazig University

Soha Abdelraouf Mekki¹, Elham Magdy Hassan², Amel Faraj Ali Dayhum¹, Dalia Helal Galhom¹

Departments of ¹Audio-vestibular Medicine Unit E.N.T. and

²Phoniatrics E.N.T., Faculty of Medicine, Zagazig University, Egypt

*Corresponding author: Amel Faraj Ali Dayhum, Mobile: (+20)01028430091, E-mail: amola272017@gmail.com

ABSTRACT

Background: The purpose of this study was to develop and verify the test materials for a speech perception testing for adults in Libya. Such materials are useful for administering speech evaluations to native Arab adults who speak with a Libyan accent.

Objective: This study is a component of a larger initiative to prepare and validate the speech materials for the Arabic-speaking community in Libya.

Methods: In this cross-sectional study, two lists of bisyllabic (spondees) words and monosyllabic phonetically balanced words were constructed. The two selected 100- bisyllabic and monosyllabic word lists were presented to 120 normal hearing participants with the age range of 18 to 50 years. Tests of validity and reliability were conducted to assure the suitability of this material for the speech recognition test and speech discrimination score (SRT and SDS).

Results: The two developed Libyan word lists (SRT and SDS) showed high face and content validity, kappa P-value was <0.001 with high significant, Cronbach's alpha coefficient was 0.82, 0.71 for the (SRT and SDS) respectively, and intra-class correlation coefficients reliability ($p < 0.001$) were also statistically significant.

Conclusion: The data analysis shows that the SRT of both Libyan and Egyptian lists have high degree of validity and reliability. Meanwhile, SDS of Libyan accent list is of higher statistical significance than Egyptian list. As a result, the scale's development of the Libyan accent has strong psychometric characteristics, making it suitable for usage in the Libian region.

Keywords: Speech audiometry, SRT (bisyllabic), SDS (monosyllabic) of arabic Libyan accent.

INTRODUCTION

Speech audiometry, which measures a person's capacity for understanding and processing speech, is regarded as a standard audiological evaluation since it enables us to distinguish between the sounds, words, and syllables spoken by the speaker ⁽¹⁾. The effect of hearing loss on a person depends on how much their ability to understand speech is impacted ⁽²⁾.

Improvement in speech perception is seen to be one of the main objectives of treating hearing impairment. The rehabilitation method is effectively chosen, planned, carried out, and evaluated using speech audiometry ⁽³⁾.

Variable speech audiometry testing has been created and enhanced during the past 50 years to evaluate various speech characteristics, such as speech reception thresholds (SRT), which checks the validity of pure-tone test findings. Meanwhile, speech discrimination score (SDS) is useful in the differential analysis of the auditory system's lesion location ⁽⁴⁾.

According to ASHA, the SRT is the minimal hearing threshold at which a person can recognize 50% of the spoken information. SRT testing is reliable in its agreement with pure-tone threshold ⁽⁵⁾.

The SDS is considered an essential component of speech audiometry. It assesses a person's capacity to accurately understand and repeat a list of phonetically presented words when they are offered at a pleasant supra-threshold level ⁽⁶⁾. SDS is done employing phonetically or phonemically balanced sets of single-syllable words. It is measured in form of correct

percentage either at a level close to the SRT or the mean of the pure tone thresholds ⁽⁷⁾.

SDS has been developed for several languages and dialects. However, for the Arabic language, a few attempts have been made to develop a standardized Arabic test that can reliably be used beyond specific country ⁽⁸⁾.

To our knowledge, this is the first study in Zagazig University Hospitals for development of speech audiometry by Libyan accent including bisyllabic and monosyllabic of SRT and SDS respectively. Hence, this study was conducted in order to improve the audiological assessment of Libyan patient.

Topics and Approaches:

This cross-sectional research was carried out and verified at the Libyan organization as a form of test development study, in primary care unit.

SUBJECTS AND METHODS

Constructing an item:

Expert audio-vestibular medicine consultants created the test items and phoniatic specialist from the Zagazig University reviewed the international and Arab studies on SRT and SDT tests. Additionally, the entire list of roughly 200 renowned words was used to create substitute word lists that were equivalent to the original exam bisyllabic and monosyllabic words from the Libyan Arabic dialect. The target was to find two (SRT and SDS) lists, each list consisting of 100 bisyllabic (spondee) words and 100 monosyllabic (PB) words suitable for adults aged between 18 and 50 years.

In the study, words from books, papers, the news, and other spontaneous discussions were chosen at random. Each list consisted of words selected by phonetic specialist with explanation of the difference in phonemes between Egyptian and Libyan accent in five phonemes, which were (/θ/, /ð/, /d^h/, /ð^h/ q/). The words were classified into words with one consonant vowel consonant (CVC) syllable, words with one consonant vowel consonant-consonant (CVCC) syllable, and words with one consonant-consonant vowel consonant syllable (CCVC). 100 items made up the final test items, which were then broken into four lists of 25 each. For the test, two lists were authorised for use in adults between the ages of 18 and 50 were chosen.

A total of 120 adults participated in this cross-section study. They were recruited from ENT Unit, at the Primary Care Unit in Tripoli. The participants had an age range of 18 - 50 years, normal hearing threshold (pure-tone average [PTA] ≤ 25 dB HL), healthy external ear, and normal middle ear functions.

Before the research began, the recommended methods were deemed to adults who met the inclusion criteria mentioned below. Full history taking regarding personal and past medical history for otological and family history and otological examination to exclude external or middle ear diseases were done.

Inclusion criteria: matched-age adults of both sexes, between the ages of 18 and 50. Normal hearing of 250 through 8000 Hz (≤25 dBHL), with otological examination, tympanometry, and acoustic reflex thresholds demonstrated normal middle ear functions.

Exclusion criteria: adults with hearing loss and otorhinolaryngologic disease (otitis media, eustachian tube dysfunction, nasal obstruction, etc).

Methodology:

Participants of study group were subjected to:

- 1- I. A fundamental audiological assessment included:
 - 1- Pure tone and speech audiometry, utilising the two-channel diagnostic audiometer (GSI AudioStar Pro, China).
- 2- Immittancemetry using immittance meter (AudioStar Pro).
 - I. Assessment of speech audiometry (SRT and SDS) by Egyptian lists first and after that by newly developpe Libyan lists
 - II. Estimation of the validity of the developed Libyan lists.

A pilot study was performed to assess face validity by determining potential problems with the layout of the items. The words of Libyan lists were presented to 20 adults with normal hearing of both genders. The aim was to obtain their feedback so that any confusing or unclear words/phrases were rephrased.

In addition, the clarity and easiness of words and the rability of response were checked. The response was inspected and showed that two items had very high response rates (> 96%) for words by Libyan lists.

The Libyan lists for SRT and SDS were developed by expert AVM consultants and supervised by expert phonetic physician.

Test presentation:

Since monitored live voice is more appropriate for the examined sample, this test was provided utilising it. Before each of the words, a "say the word" carrier phrase was employed. The presentation volume was tuned to the level of speech that each adult found most comfortable. GSI AudioStar Pro. The subject wore a single TDH-50P headset as the stimulus words were delivered from the audiometer through it. Each subject underwent testing in a sound booth with two walls. The audiometer was calibrated following ANSI standards ⁽⁹⁾.

Ethical consent:

The study was authorised by Zagazig University's Ethical Institutional Review Board (IRB Number: ZU-IRB#9309). All study participants provided written informed permission after being informed of our research's goals. The Declaration of Helsinki for human beings, which is the international medical association's code of ethics, was followed during the conduct of this study.

Testing for validity and reliability:

Crucial elements of validity and reliability testing were conducted to examine the word lists for the Libyan accent of speech were valid and reliable. The face validity, content validity were determined for validity. For internal consistency, the Kappa test and Cronbach's alpha have all been established.

The scale's dependability was evaluated using Cronbach's alpha. The coefficients were estimated, and results above 0.70 were deemed to be acceptable ⁽¹⁰⁾. The scale's convergent validity was utilised to assess the construct validity with the intention of confirming the relationships between individual items and overall ⁽¹¹⁾. The scale's exterior consistency was examined. during the pilot study by test retest validity to assess language and terms of the scale, participants were twice asked to respond to the scale (one in Egyptian language and the other in Libyan) and correlation was computed between responses from the first and second occasions ⁽¹²⁾.

Statistical analysis

The collected data were coded, processed and analyzed using the SPSS (Statistical Package for Social Sciences) version 22 for Windows® (IBM SPSS Inc, Chicago, IL, USA). Data were tested for normal distribution using the Shapiro Wilk test. Qualitative data were represented as frequencies and relative percentages. Chi square test (χ^2) was used to calculate

difference between two or more groups of qualitative variables. Quantitative data were expressed as mean ± SD (Standard deviation). Independent samples t-test was used to compare between two independent groups of normally distributed variables (parametric data). P value < 0.05 was considered significant.

RESULTS

120 adults were involved in the research, their general characteristics are shown in **table (1)**.

Table (1): General characteristics of the studied group

Variables	Studied group N=120			
	Minimum	Maximum	Mean	S.D
Age (years)	18	50	34.2	8.54
	Number		%	
Sex:				
Male	29		24.2	
Female	91		75.8	

All subjects in the study had type (A) tympanogram. **Table (2)** shows the acoustic responses in both ears with regard to the pure tone across all frequencies when hearing is normal sensitivity at all frequencies, **table (3)**.

Table (2): Acoustic reflex results at different frequencies among studied group

Acoustic reflex		Studied group N=120			
		Minimum	Maximum	Mean	S.D
500 dB	RT ear	80	110	98	8.94
	LT ear	80	110	101.5	9.33
1000 dB	RT ear	90	110	99	7.18
	LT ear	90	110	100.5	8.26
2000 dB	RT ear	90	110	99.5	7.59
	LT ear	90	110	97	7.33
4000 dB	RT ear	90	110	101	7.18
	LT ear	90	110	101.5	7.45

Table (3): Audiometry results (PTA) at different sound frequencies among studied group

PTA		Studied group N=120			
		Minimum	Maximum	Mean	S.D
250 dB	RT ear	10	20	14.8	4.47
	LT ear	10	20	15	4.54
500 dB	RT ear	10	20	15.25	3.79
	LT ear	10	20	14.56	4.01
1000 dB	RT ear	10	20	15.28	4.47
	LT ear	10	20	14.75	3.43
2000 dB	RT ear	10	20	13.75	4.25
	LT ear	10	20	14.03	3.77
4000 dB	RT ear	10	20	14.25	4.06
	LT ear	10	20	14.22	4.13
8000 dB	RT ear	10	20	14.13	4.62
	LT ear	10	20	14.39	4.38

The SRT of right ear shows a high statistically significant excellent agreement between Libyan and Egyptian syllables (P<0.001). Regarding SRT level of right ears, both syllables agreed among 48 cases at level 10, 32 cases at level 15 and 36 cases at level 20. The difference was only among 6 cases (4.2%), so calculated Libyan SRT sensitivity was 95% (**Table 4**).

Table (4): Difference between Libyan and Egyptian syllables SRT level of RT ear among studied group

SRT		Studied group N=120		X ²	P
		Libyan	Egyptian		
Levels	10	51 (42.5%)	46 (38.3%)	0.442	0.802 NS
	15	33 (27.5%)	36 (30.0%)		
	20	36 (30.0%)	38 (31.7%)		

The SRT of left ear shows a high statistically significant excellent agreement between Libyan and Egyptian syllables (P<0.001). Regarding STR level of left ears, both syllables agreed among 51 cases at level 10, 30 cases at level 15 and 33 cases at level 20. The difference only was among 8 cases (6.7%) so calculated Libyan SRT sensitivity was 93.3% (**Table 5**).

Table (5): Difference between Libyan and Egyptian syllables SRT level of LT ear among studied group

SRT		Studied group N=120		X ²	P
		Libyan	Egyptian		
Level	10	52 (43.3%)	55 (45.8%)	0.159	0.923 NS
	15	34 (28.3%)	32 (26.7%)		
	20	34 (28.3%)	33 (27.5%)		

The SDS of Libyan syllables was statistically significantly higher than Egyptian syllables in both right ear (table 6) and left ear (table 7).

Table (6): Difference in SDS level of RT ear between Libyan and Egyptian syllables among studied group

		Studied group N=120			t-test	P
		Mean	S.D	Range		
SDS	Libyan syllables	99.53	1.481	96-110	18.25	<0.001 HS
	Egyptian syllables	95.38	2.924	92-110		

Table (7): Difference in SDS level of LT ear between Libyan and Egyptian syllables among studied group

		Studied group N=120			t-test	P
		Mean	S.D	Range		
SDS	Libyan syllables	99.51	1.51	96-110	18.51	<0.001 HS
	Egyptian syllables	95.49	2.87	92-110		

There was no statistically significant correlation of age or sex with SRT (table 8) and SDS (table 9).

Table (8): Correlation between SRT of Libyan syllables, age and sex of studied group

Variable	SRT	
	r [^]	P
Age	0.174	0.23
Sex	0.126	0.38

^Pearson correlation

Table (9): Correlation between SDS of Libyan syllables, age and sex of studied group

Variable	SDS	
	r [^]	P
Age	0.155	0.28
Sex	0.126	0.38

^Pearson correlation

The Libyan SRT's Cronbach's alpha coefficient was 0.821, showing a high level of internal consistency with high significant intraclass correlation indicating excellent reliability (table 10).

Table (10): Reliability of Libyan SRT within right and left ears and internal consistency

		P value	95% CI
Cronbach's alpha coefficient	0.821		
Intraclass correlation	0.823	<0.001 HS	0.722- 0.912

The Libyan SDS's cronbach's alpha value was 0.711, suggesting a high level of internal consistency with high significant intraclass correlation indicating good reliability (table 11).

Table (11): Reliability of Libyan SDS within right and left ears and internal consistency

		P value	95% CI
Cronbach's alpha coefficient	0.711		
Intraclass correlation	0.523	<0.001 HS	0.552- 0.825

Table (12): Monosyllabic word lists:

شيل	كف	دار	حاج
بيت	كاس	غاز	صوف
نص	مسك	ربع	خشم
برج	يد	قرش	ريح
شرق	لون	موس	غات
عم	فل	عود	ليم
قوس	سوق	هون	رب
كعك	حار	تمر	ضي
لحم	مرج	باب	زيت
ظهر	تن	ثلج	شحم
فرن	بيير	صفر	حبر
سرت	جلد	ساس	سور
فم	سعف	خس	كم
نجم	وشق	عشب	سهم
بحر	قش	مق	عرس
راس	طوب	خد	خيظ
قبر	حوض	سمن	جبل
شط	طين	بط	شال
صب	ملح	لون	عين
نور	زير	ارض	لوز
حيب	قط	حوت	ودن
شعر	كيس	خل	جد
تاج	غرب	فار	لوح
سطح	مر	نار	تل
ثين	خيل	سد	ظفر

Table (13): Bisyllabic words lists:

طاولة	مصرف	كرموس	نخلة
تفاح	ريحة	قديد	هاتف
دكان	طنجرة	شاشة	بيرو
قفطان	رقبة	نقال	لعبة
كاترو	خيار	كيكة	توتة
شرطي	زرده	شاربة	دلاع
شيشب	ورده	جلسة	حفرة
نعناع	شامبو	ترمس	باكو
جزر	ثومة	قبطون	خراص
حولي	دفتر	حصة	قرعة
قلم	بلسم	فرملة	شريط
حكة	لوحة	عالة	جهاز
ودان	سرير	قمماش	زنقة
دينار	مترد	شارع	كانون
علبة	بكرج	زبيب	ابرة
غربال	فلفل	دقيق	شاهي
فراج	ظرف	معزة	كتاب
قونة	رملة	محل	صالون
رشة	فرشة	طاسة	شيث
كرسي	شنطه	شعير	سفرة
بالطو	بطمة	خروف	دولاب
خاتم	سروال	صورة	بساط
جزر	قمر	بهار	شيشة
فوطه	سخان	نعناع	دواء
جرجير	قنديل	جامع	بازين

DISCUSSION

In this study, we aimed to develop and validate lists for bi syllabic words (SRT) and monosyllabic words (SDS) of speech perception of Libyan accent in adults.

Development and validation of SRT and SDS of Libyan accent:

There is a growing need to assess functional status among patients of different racial, economic, language and cultural attributes. The main goal of this study was to develop list that suits the accent and cultural background of the Libyan-speaking population as there is no available lists based on the Libyan accent for speech perception. Two lists; each list (100 words) for bisyllabic (SRT) and monosyllabic (SDS) were developed in Libyan accent and were validated for use in clinical settings. The newly developed Libyan lists meets the practical considerations of being easy, quick, concise, understandable and comprising perceptual, social and familiarity of speech perception in Libyan adults.

The second goal was to evaluate the validity and reliability of the lists as an assessment tool for speech perception in normal-hearing subjects. The results of the current study indicated adequate validity and reliability of Libyan lists.

Personal and audiological criteria:

A total of 120 adults participated in this study of both gender (75.8% female and 24.2% male) with an age range of 18 – 50 years (mean \pm SD: 34.2 years). All participants had normal hearing threshold (PTA \leq 25 dB HL), healthy external ear, normal middle ear functions.

Validity of the Libyan lists:

Validity is the extent to which the tool can truly measure the idea. The validation process started with subjective evaluation by face and content validity measures that were rated depending on the Libyan patients' and the professionals' judgment, respectively. Face validity evaluated the words of the lists regarding visibility, readability, suitability of the layout and clarity of the words ⁽¹³⁾. The content validity index indicated an excellent level of validity that the lists are relevant and representative of the scale construct. There was no association between the Libyan lists of both SRT and SDS with the age or gender. Previous studies provided concomitant findings for age and gender ⁽¹⁴⁾. These results indicate the suitability of the current lists for Libyan adults with normal hearing and both genders.

All participants in the current study exhibited bilateral type (A) tympanogram in all ears. Ipsilateral acoustic reflexes were comparable. Most of the participations had preserved acoustic reflexes across the 0.5, 1, 2 and 4 kHz frequencies.

Construct validity was estimated and revealed excellent agreement of SRT between Libyan and Egyptian syllables of right and left ears. In addition, the SDS in Libyan syllables was significantly higher than Egyptian syllables in both right and left ears, indicating that lists were representative of speech perception, therefore, has adequate construct validity.

Reliability of the Libyan lists:

Our results showed that the syllable of Libyan lists had a good ICR for the total scale SRT and SDS that showed Cronbach's alpha (Cronbach's alpha=0.72) coefficients of 0.82, 0.71 respectively, indicating good internal consistency with high significant intraclass correlation indicating excellent reliability.

CONCLUSIONS

The bisyllabic and monosyllabic word lists for SRT and SDS calculation in Libyan were determined accent. For usage as test materials, they offer strong validity and reliability indicators.

To complete the speech audiometry materials with a Libyan accent, two sets of 100 monosyllabic words and bi-syllabic materials have been developed. This task is crucial for the evaluation of hearing sensitivity in Libyan adults.

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