AUDITORY EVALUATION OF STROKE SURVIVORS: VALIDATING A LOW-COST SCREENING PROTOCOL

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Outline

- Background to the study
- Gap in knowledge
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- Conclusion
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Background

- Auditory impairment is the most common sensory disability in the world,
- According to WHO, more than 430 million adults have disabling hearing loss
- Adult-onset auditory impairment is the third leading cause of disability in world
- Auditory impairments exerts a very significant impact on functional ability at personal, social, and occupational levels.
- It may lead to job loss, difficulty in securing employment, stigmatization and neglect.

Background

- Stroke is the commonest neurological disorder in adults and a leading cause of medical coma, neurological disability and placement in long-term care.
- Stroke is also the second most common cause of death globally.
- It is predicted that Sub-Saharan Africa will account for the majority of stroke cases worldwide by the year 2030.
- The region will also have the greatest case fatality of stroke patients.

Background

- Stroke is the leading cause of disability in the elderly.
- Stroke survivors often experience depreciation in their QoL and often require long term care.
- Post-stroke disability has a profound impact on patients and their families and imposes a significant burden on society and healthcare expenditures.
- A third of stroke survivors are functionally dependent on others one year after stroke onset.

Background

- Auditory impairment occurs in association with stroke, and it may be seen in up to 80% of stroke survivors.
- Auditory impairment can hinder patient care and rehabilitation.
- Comparison of age-related hearing loss with age-matched normal hearing controls showed higher prevalence of stroke in individuals with hearing loss while the odds ratio for an association between hearing loss and stroke was OR= 1.72 .
- There is higher risk of sudden sensorineural hearing loss among stroke patients; this risk increases in the first year of follow-up.

Background

- Post-stroke rehabilitation programs are designed to help patients become more independent but auditory impairment can hinder communication between patients and healthcare providers leading to unsuccessful rehabilitative programs and poor functional outcomes and cause patients to become socially withdrawn.
- Sub-Saharan African countries have very limited resources for acute care and rehabilitation of stroke patient
- This limited rehabilitation efforts can be frustrated by undetected and/or late detection of auditory impairment in stroke survivors.

Gap in knowledge

- There is significant underestimation of post-stroke auditory impairment.
- Hence, the true prevalence of auditory impairment in stroke survivors is still unknown.
- The underestimation of post-stoke auditory impairment may be due to its “silent” nature unlike symptoms, such as dysphasia, motor function loss, or visual deficits.
- Thus, there less intentional examination for auditory impairment in the patient.
- In addition, routine hearing screening protocol cannot be easily foisted on stroke survivors.

Gap in knowledge

- Existing guidelines for management of stroke survivors,[14] stress the management of motor impairments and cognitive abilities.[13]
- Guidelines related to screening, assessment, and rehabilitation of auditory impairment in stroke survivors are limited and lack appropriate sophistication.
- Moreover, there is insufficient data in the sub-Saharan population to adequately plan for audiological interventional programs that will improve functional outcome in stroke survivors.

Gap in knowledge

- Superficial evaluation is often insufficient to make accurate diagnosis of auditory impairments.
- However, providing comprehensive audiological assessment to all stroke patients in Sub-Saharan Africa will be costly, time-consuming and impracticable.
- Therefore, there is need for a protocol to identify auditory impairment in stroke survivors in a cheap, reliable and swift manner.
- Currently, there is no such validated protocol widely adopted and used in Sub-Saharan Africa.

Study goals

- The primary objective:
- Validation of a low-cost hearing screening protocol for early identification of peripheral auditory impairment in stroke survivors.
- Secondary objective:
- Validation of hearing screening questionnaires in the local language

Methods

- This is a cross-sectional study of diagnostic accuracy using sensitivity and specificity in stroke survivors
- Informed written consent will be obtained from all study participants who will be recruited within 3–12 months post-onset of stroke.
- The 3–12-month time point is when auditory impairments are expected to be stable.

Methods

- Inclusion criteria:
- Adults aged ≥18 years with clinical stroke and neuroimaging confirmation with CT or MRI scan done within 10 days of symptom onset.
- Exclusion criteria:
- Stroke survivors with cognitive impairments, severe aphasia, significant psychiatric illnesses, other neurological disorders (apart from stroke), and severe concurrent medical illnesses.

Screening tools

- Smartphone hearing screening app: hearWHO.
- Questionnaires to capture deficits in auditory perception accompanying hearing loss will also be used.
- The modified Amsterdam Inventory Auditory for Disability and Handicap (AIADH) questionnaire: The AIAD has 28 questions and assesses auditory disability in five key domains: intelligibility of speech in noise; intelligibility of speech in quiet; auditory localization; recognition of sound; detection of sound.
- Pass is defined as AIAD scores ranging from 64 to 84 (no disability), and fail is defined as a total score of <64.

Screening tools

- The Hearing Handicap Inventory for Elderly (HHIE) questionnaire[30]: The HHIE is a self-assessment questionnaire of hearing handicap comprising 25 items.
- If the total score ≤ 16, then no hearing disability was identified; if the total score was 17 or more, the subject was considered to have a hearing disability.

Validation of AIADH in Yoruba language

- The questionnaire was adapted from English to Yoruba language using a “backtranslation” method
- The phases of back-translation method are:
- (i) direct translation from source to target language;
- (ii) re-translation of the document back to the source language by an independent party and
- (iii) comparisons of the similarity of the original and re-translated versions in the source language.

Validation of AIADH in Yoruba language

- The translated questionnaire was administered to native speakers in a population exposed to loud noise
- Pure Tone Audiometry was also done for the study participants

Measures of hearing thresholds in dB HL (average across 0.5, 1, 2 and 4 kHz)

	Study (n=151)	
	Better	Worse
Mean	24.27	30.69
Minimum	2.00	5.00
Maximum	73.00	100.00

Hearing functions (ICF) with the corresponding hearing disability factors of the AIADH.

Hearing function (according to ICF)	Factor structure of the AIADH or basic hearing disabilities	Cronbach's alpha for the AIADH
Speech discrimination	Intelligibility in quiet	0.641
Speech discrimination	Intelligibility in noise	0.818
Sound discrimination	Distinction of sounds	0.804
Sound detection	Detection of sounds	0.754
Sound localization / sound lateralization	Auditory localization	0.793

Scale analysis

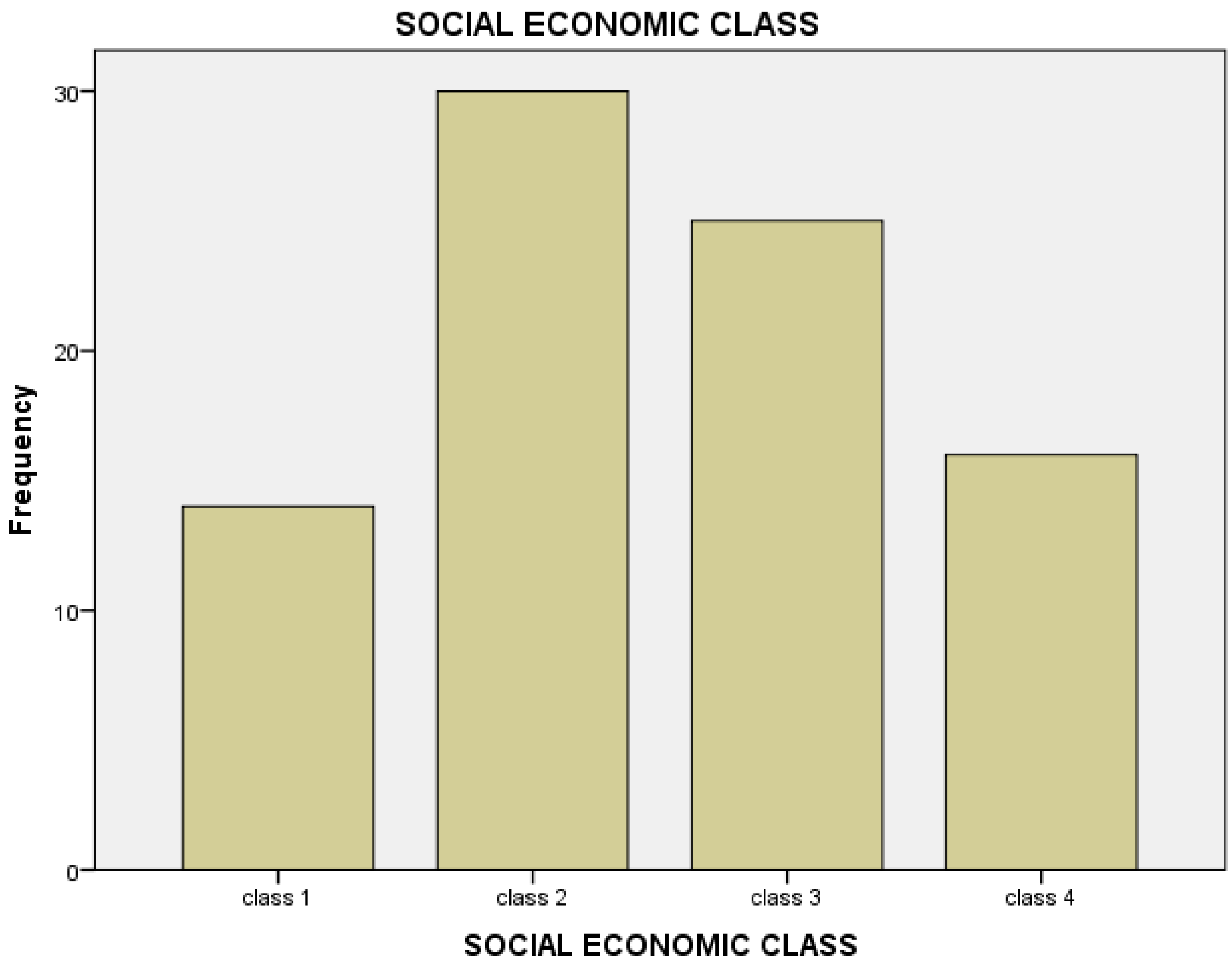
Parameters	Score	Score
Cronbach’s alpha	**0.950**	**0.903**
Guttman Split half	**0.968**	
Alpha for part 1	**0.891**	
Alpha for part 2	**0.911**	

Comparative illustration of AIADH measures of reliability and their different cross-cultural adaptations

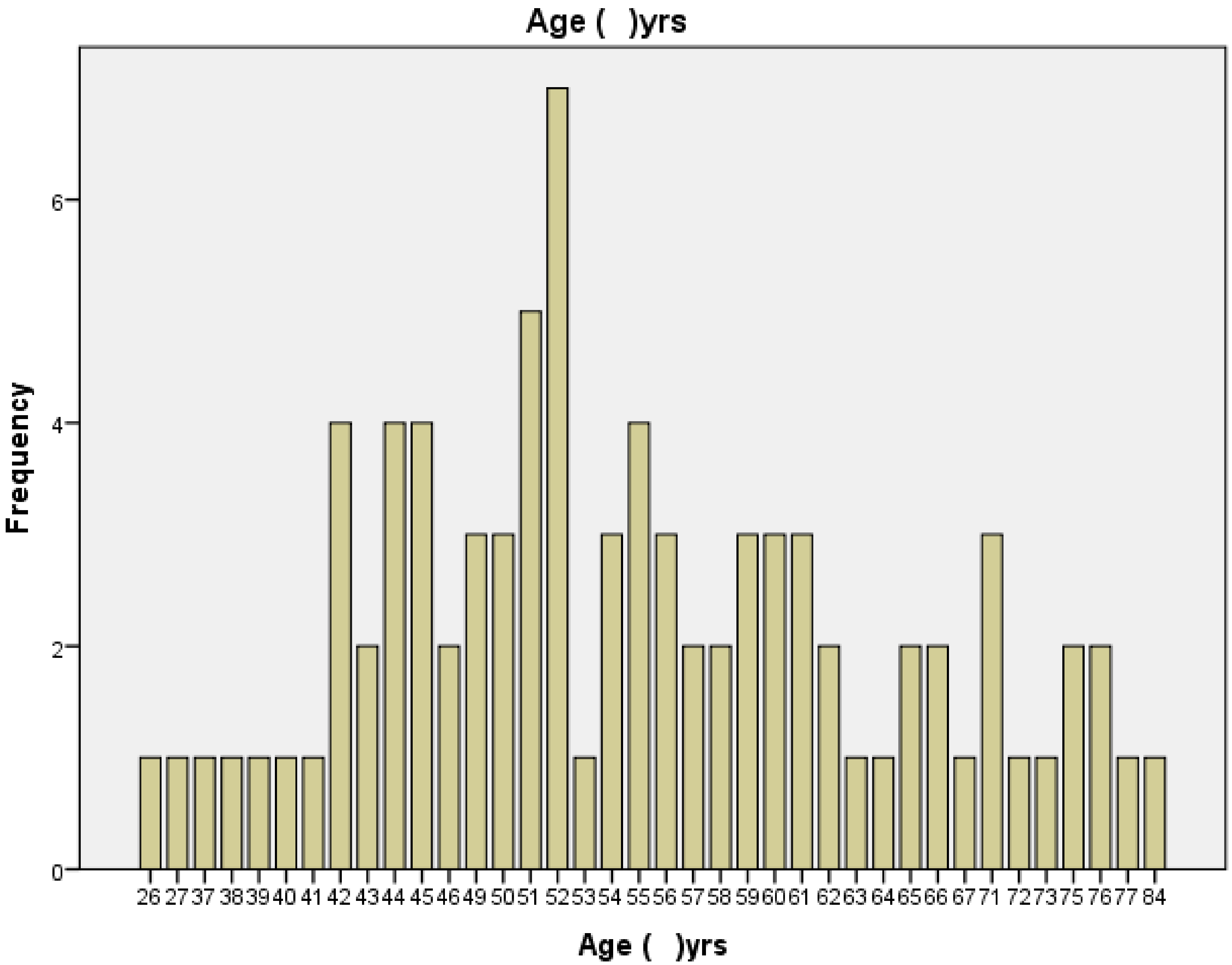
	AIADH					
	Original	Swedish	Cantonese	Spanish	Portuguese	Yoruba
Croncbach's alpha value						
Inventory	-	-	0.96	0.97	0.94	0.95
Sound detection	0.77	0.77	0.85	0.84	0.88	0.75
Sound localization	0.88	0.88	0.89	0.87	0.90	0.79
Sound discrimination	0.89	0.89	0.91	0.89	0.88	0.80
Intelligibility in quiet/ Speech perception in quiet	0.85	0.85	0.86	0.83	0.89	0.64
Intelligibility in noise/ Speech perception in noise	0.81	0.81	0.90	0.84	0.88	0.82
Guttman split half						
Total	-	-	-	0.97	0.87	0.968
Part 1	-	-	-	0.94	0.82	0.891
Part 2	-	-	-	0.94	0.72	0.911

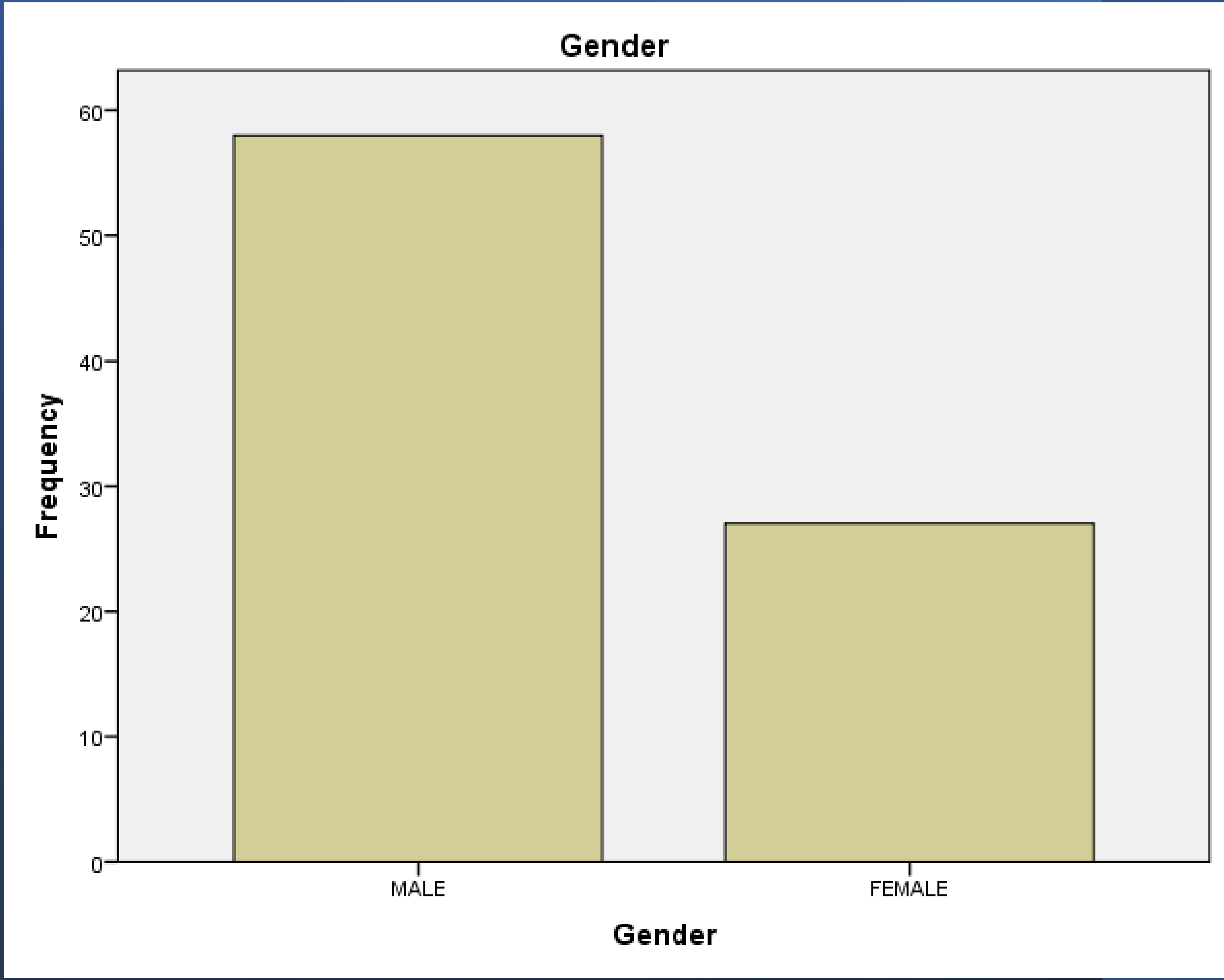
Results

- 85 patients were recruited
- Mean age: 54.6 ± 11.3 years


SOCIAL ECONOMIC CLASS
Frequency
30
20
10
0
class 1
class 2
class 3
class 4
SOCIAL ECONOMIC CLASS

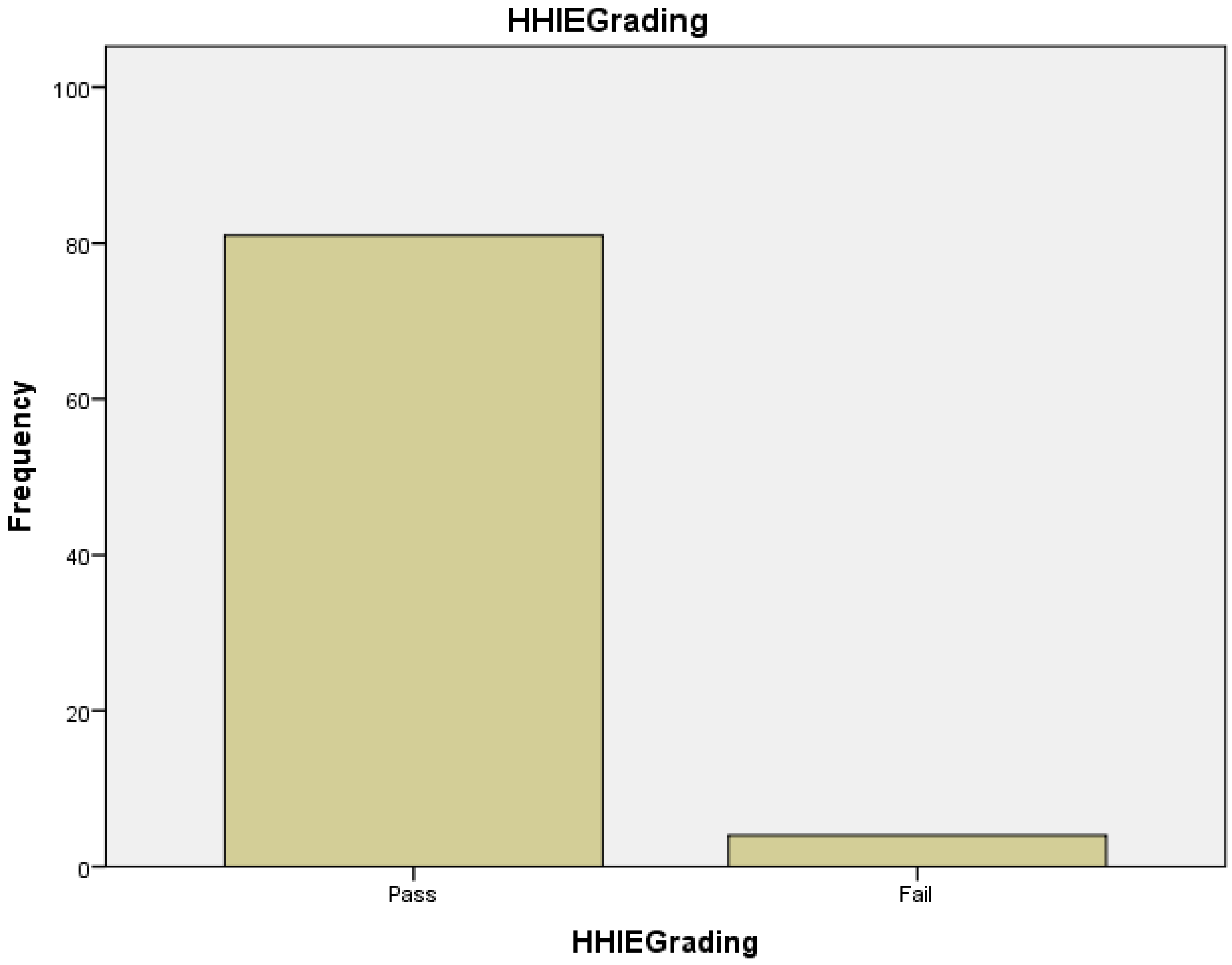
Age distribution




Gender
Frequency
60
50
40
30
20
10
0
MALE
FEMALE
Gender

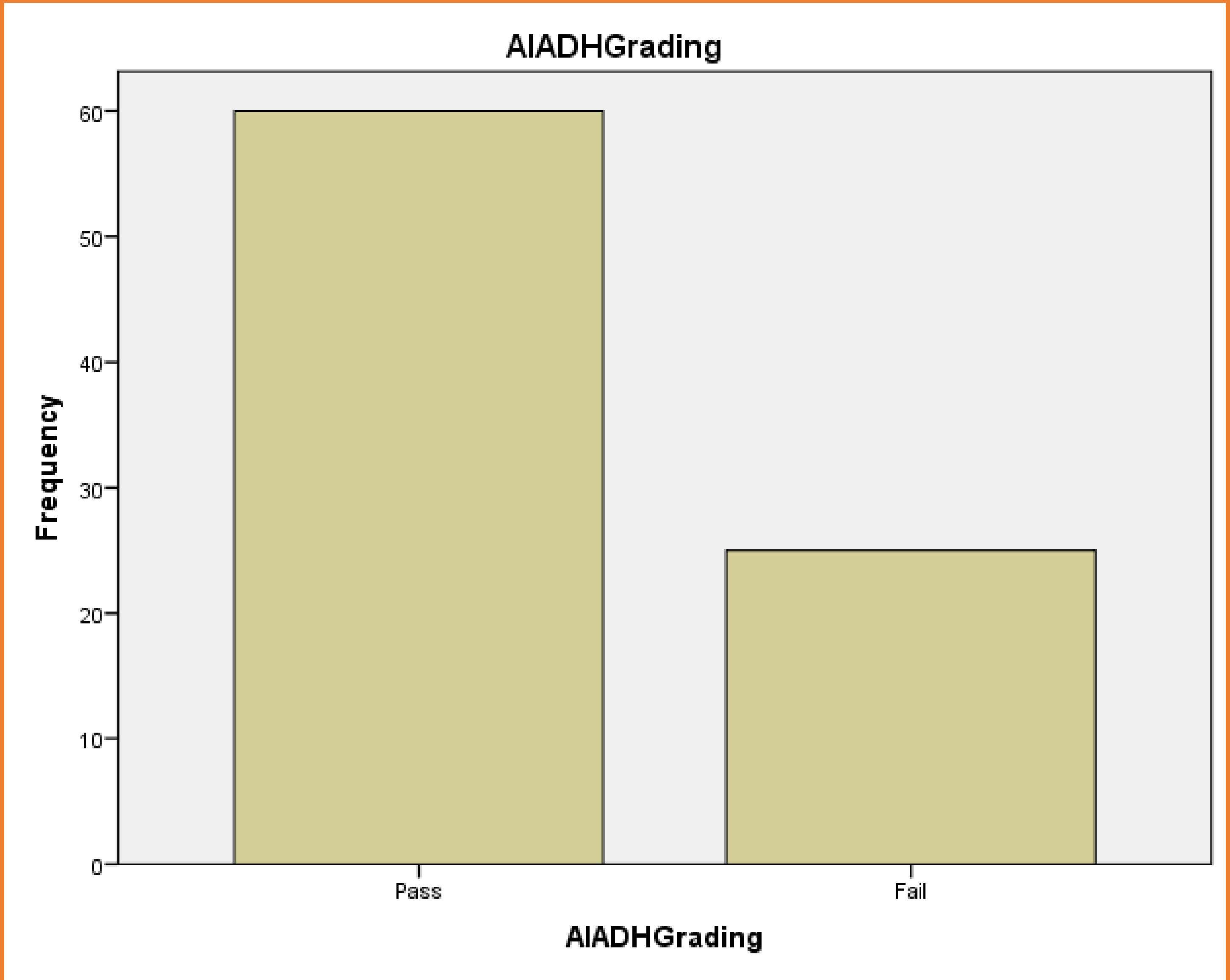
History of hearing loss

- Only one patient volunteered a history of hearing loss


HHIEGrading
100
80
60
40
20
0
Frequency
Pass
Fail
HHIEGrading

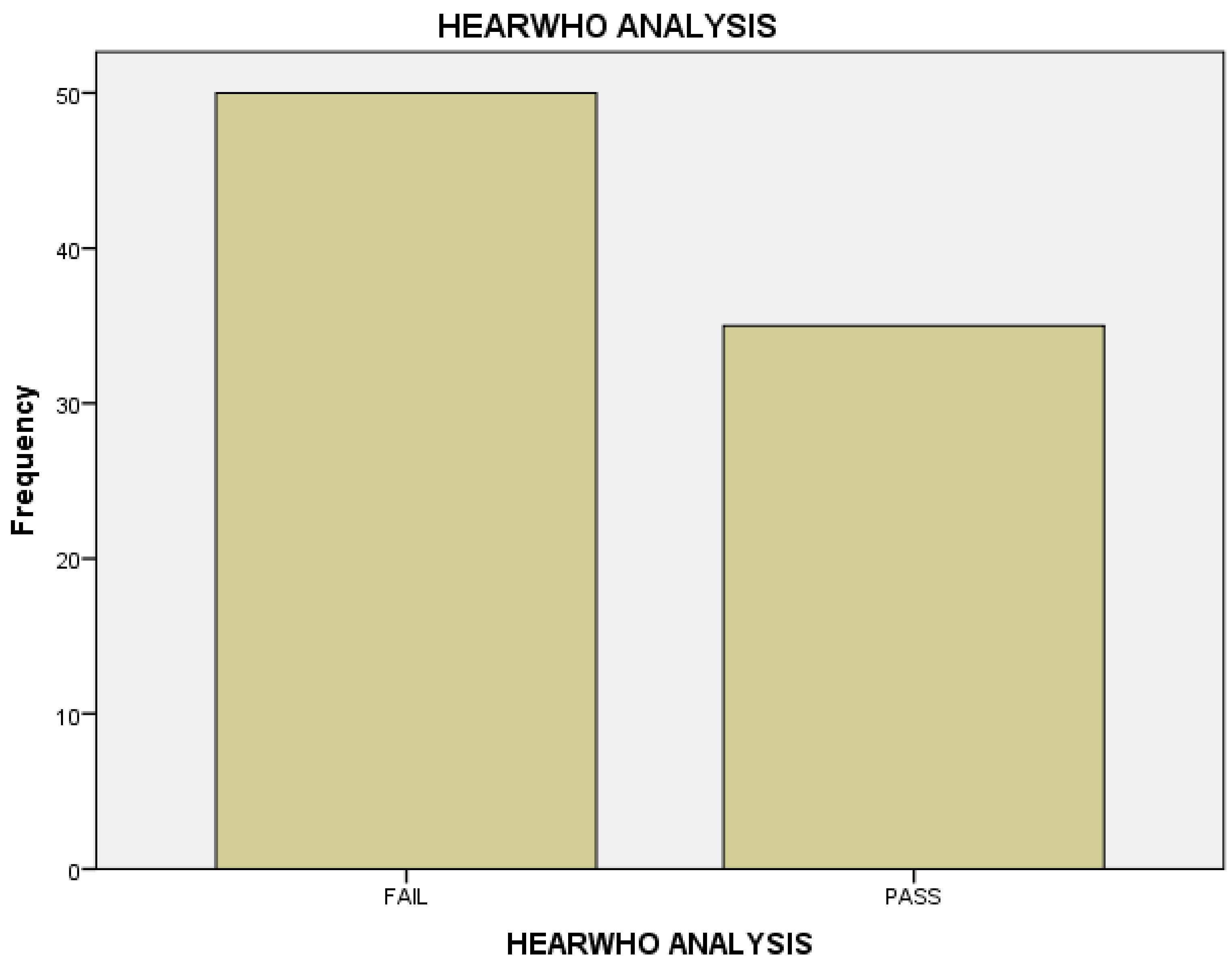
Sensitivity, specificity, positive predictive value, and negative predictive value of HHIE

		95% confidence interval		
		Lower limit	**Upper limit**	
Sensitivity	98.04%	95.09%	100.99%	
Specificity	8.82%	2.79%	14.85%	
Positive predictive value	61.73%	51.40%	72.06%	
Negative predictive value	75.00%	65.79%	84.21%	


AIADHGrading
Frequency
60
50
40
30
20
10
0
Pass
Fail
AIADHGrading

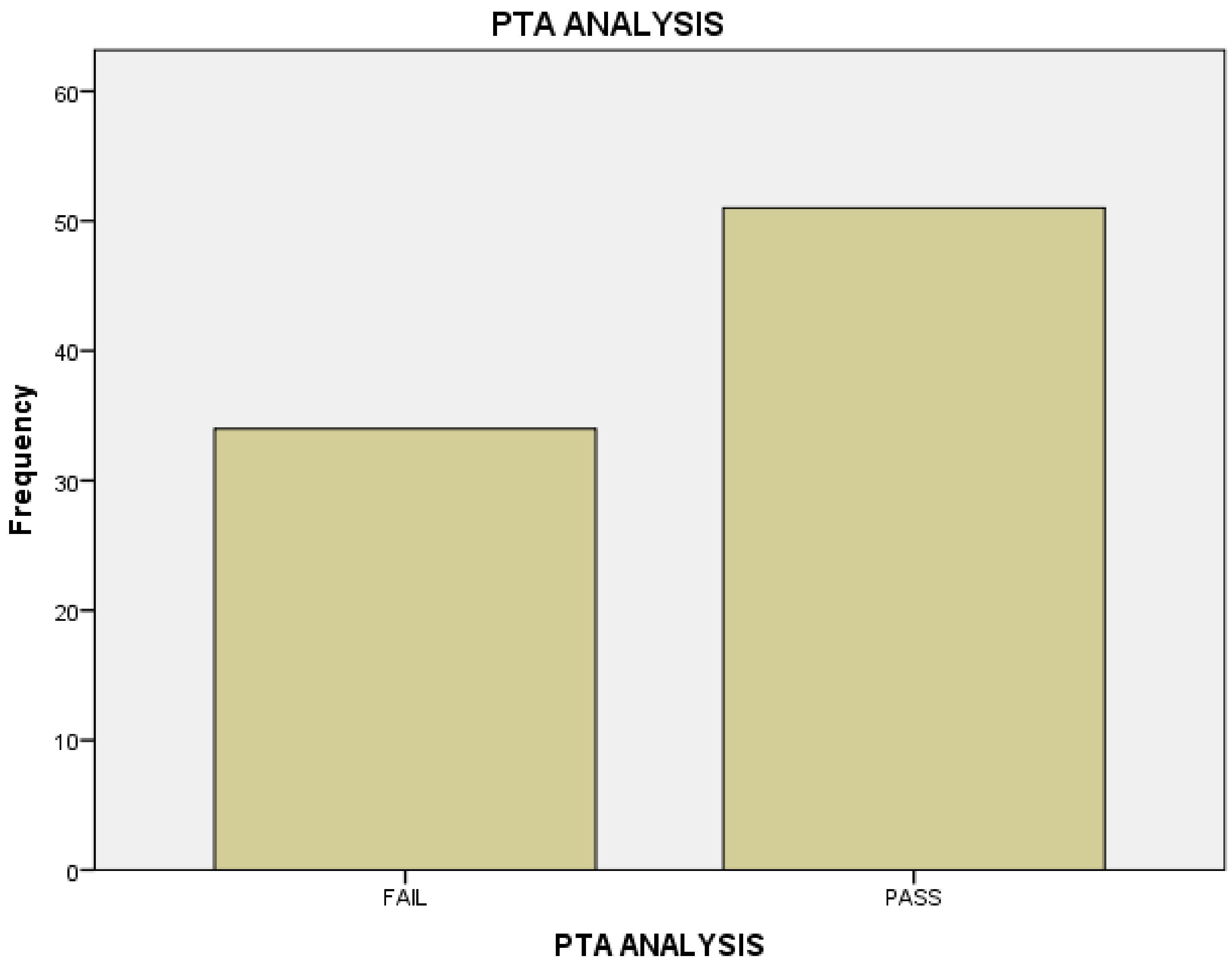
Sensitivity, specificity, positive predictive value, and negative predictive value of AIADH

		95% confidence interval		
		Lower limit	**Upper limit**	
Sensitivity	86.27%	78.96%	93.59%	
Specificity	52.94%	42.33%	63.55%	
Positive predictive value	73.33%	63.93%	82.73%	
Negative predictive value	72.00%	62.45%	81.55%	


HEARWHO ANALYSIS
Frequency
50
40
30
20
10
0
FAIL
PASS
HEARWHO ANALYSIS

Sensitivity, specificity, positive predictive value, and negative predictive value of hearWHO

		95% confidence interval	
		Lower limit	**Upper limit**
Sensitivity	68.63%	58.76%	78.49%
Specificity	100.00%	100.00%	100.00%
Positive predictive value	100.00%	100.00%	100.00%
Negative predictive value	68.00%	58.08%	77.92%


PTA ANALYSIS
Frequency
60
50
40
30
20
10
0
FAIL
PASS
PTA ANALYSIS

SEC versus hearWHO

	hearWHO						
SE class	FAIL	PASS	TOTAL				
Class 1	6	8					
	12.00%	22.86%	16.47%				
Class 2	18	12					
	36.00%	34.29%	35.29%				
Class 3	16	9					
	32.00%	25.71%	29.41%				
Class 4	10	6					
	20.00%	17.14%	18.82%				
Total	50	35					
	100.00%	100.00%	100.00%				

Conclusion

- hearWHO has the highest specificity and PPV
- The moderate sensitivity may be due to the accent used in the app
- A modified version could yield better results in subSaharan Africa
- AIADH gave good values for sensitivity, specificity, PPV and NPV
- The very low specificity of HHIE may suggest limited use in screening for auditory impairment in stroke survivors
- A combination of AIADH and hearWHO will be a good screening protocol for auditory impairment in stroke survivors

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