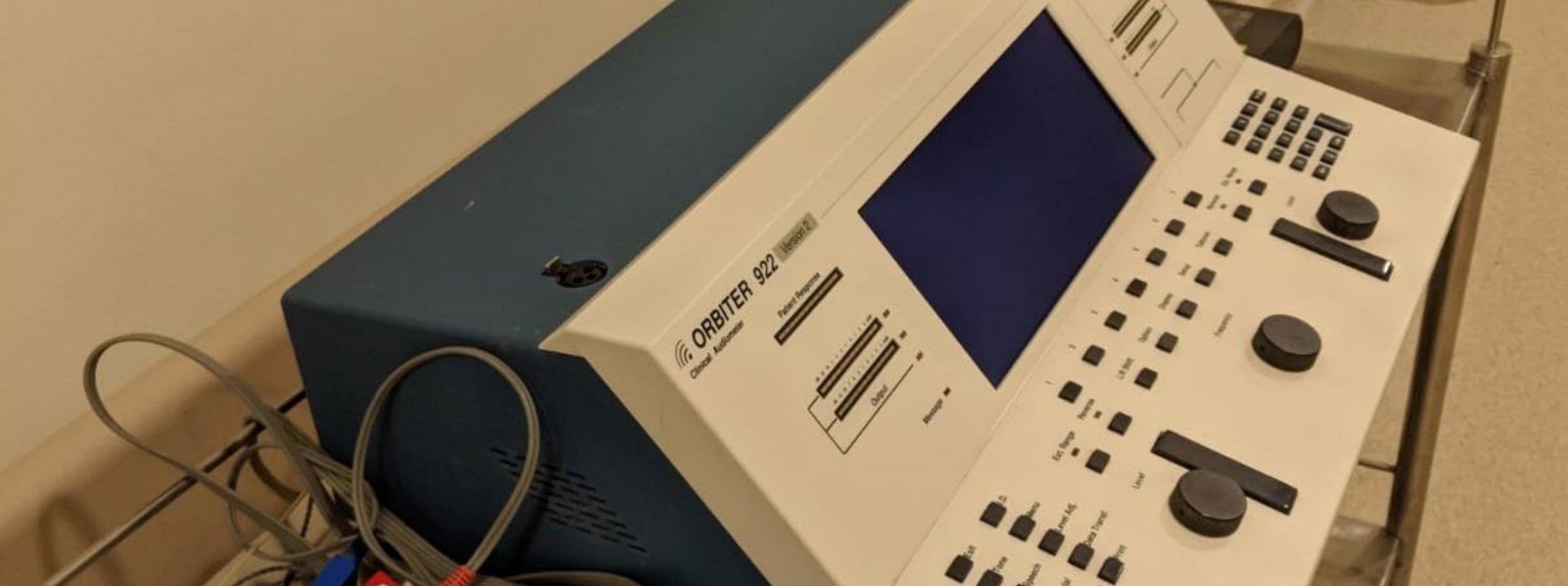


RESEARCH PRESENTATION

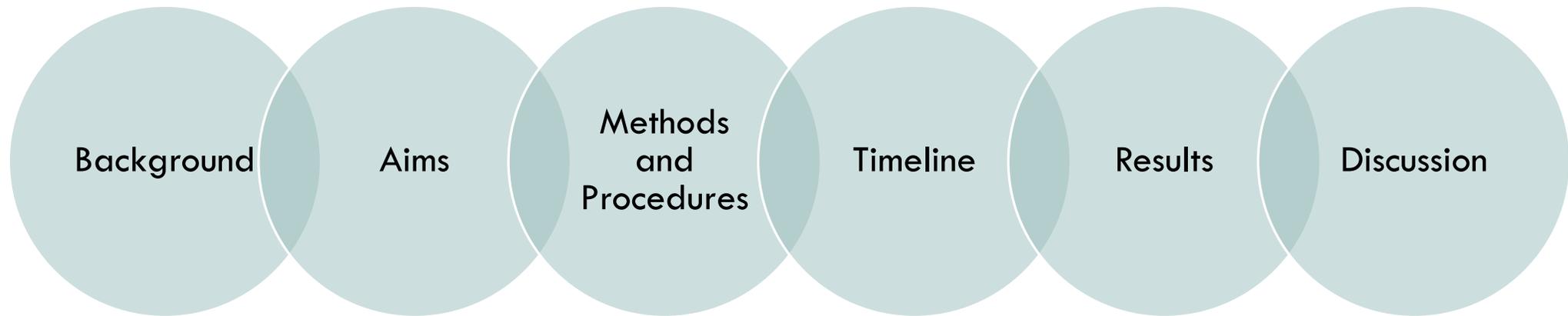
Cohort 3
Angeline Teo Yi Ling



A STUDY ON HEARING LOSS IN STROKE PATIENTS AND A NON-STROKE SINGAPORE ELDERLY POPULATION

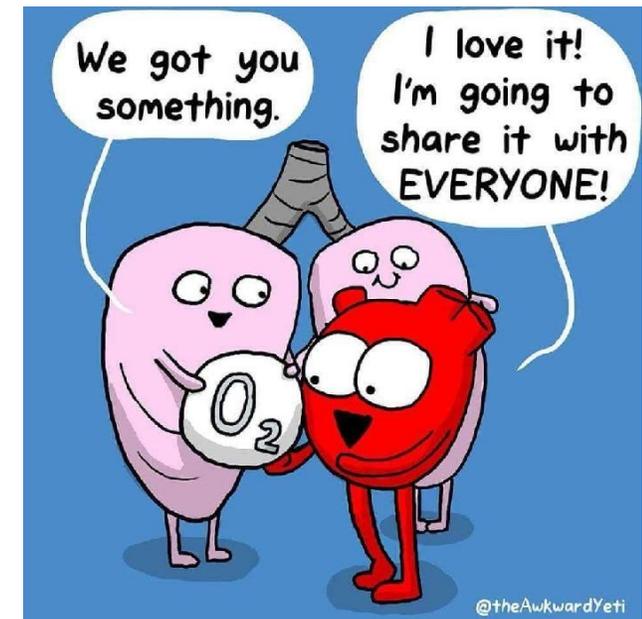
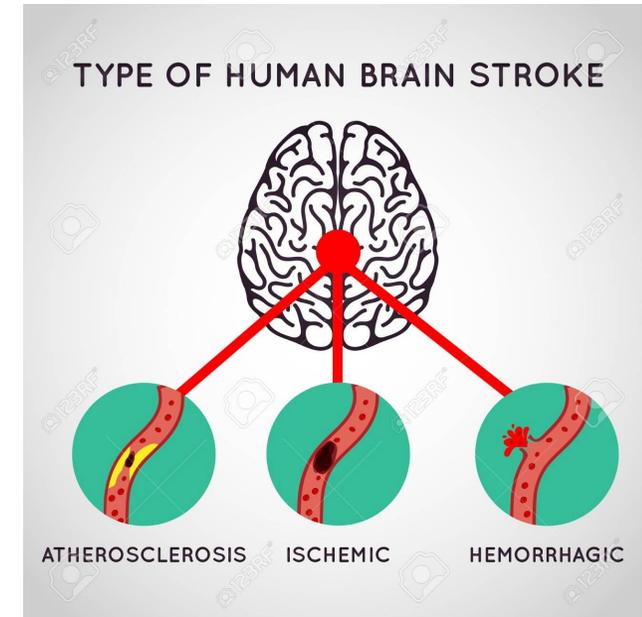
Supervised by:
Dr Jenny Loo Hooi Yin
Dr Raymond Seet

OVERVIEW



BACKGROUND

- Stroke refers to a **disruption of blood supply to the brain**
- Second leading cause of death globally in 2015
- In Singapore, stroke is the fourth leading cause of death
- Stroke can affect all levels of the auditory system, leading to a hearing and/or processing impairment



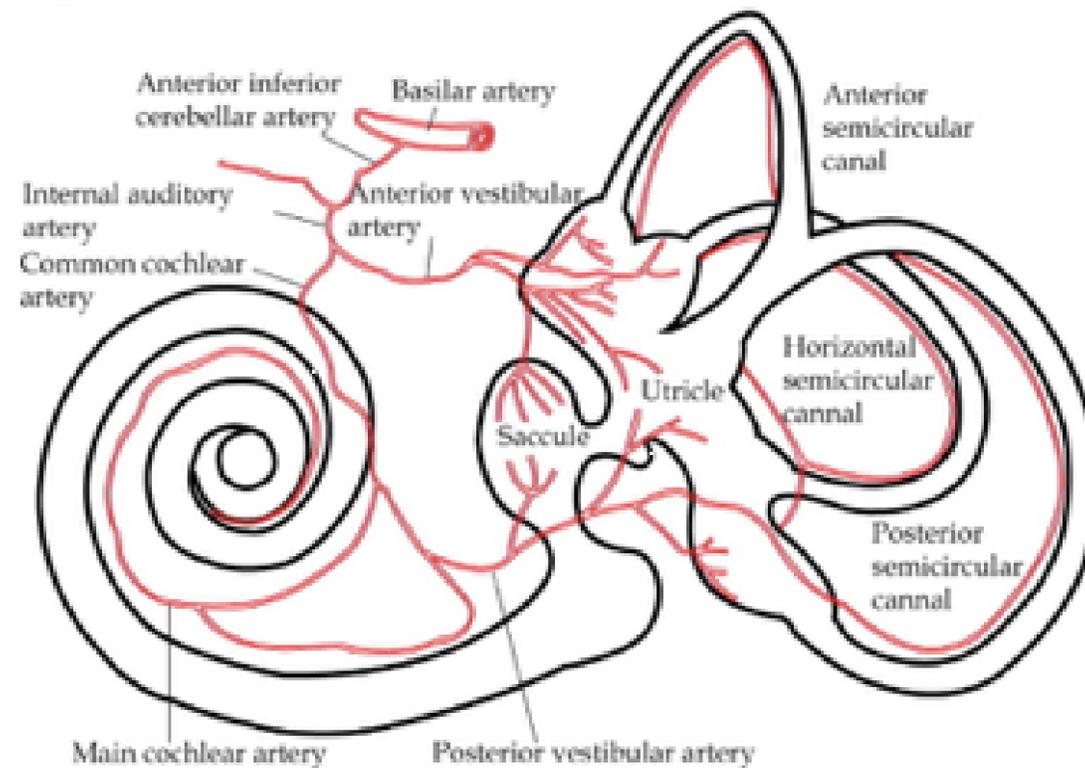
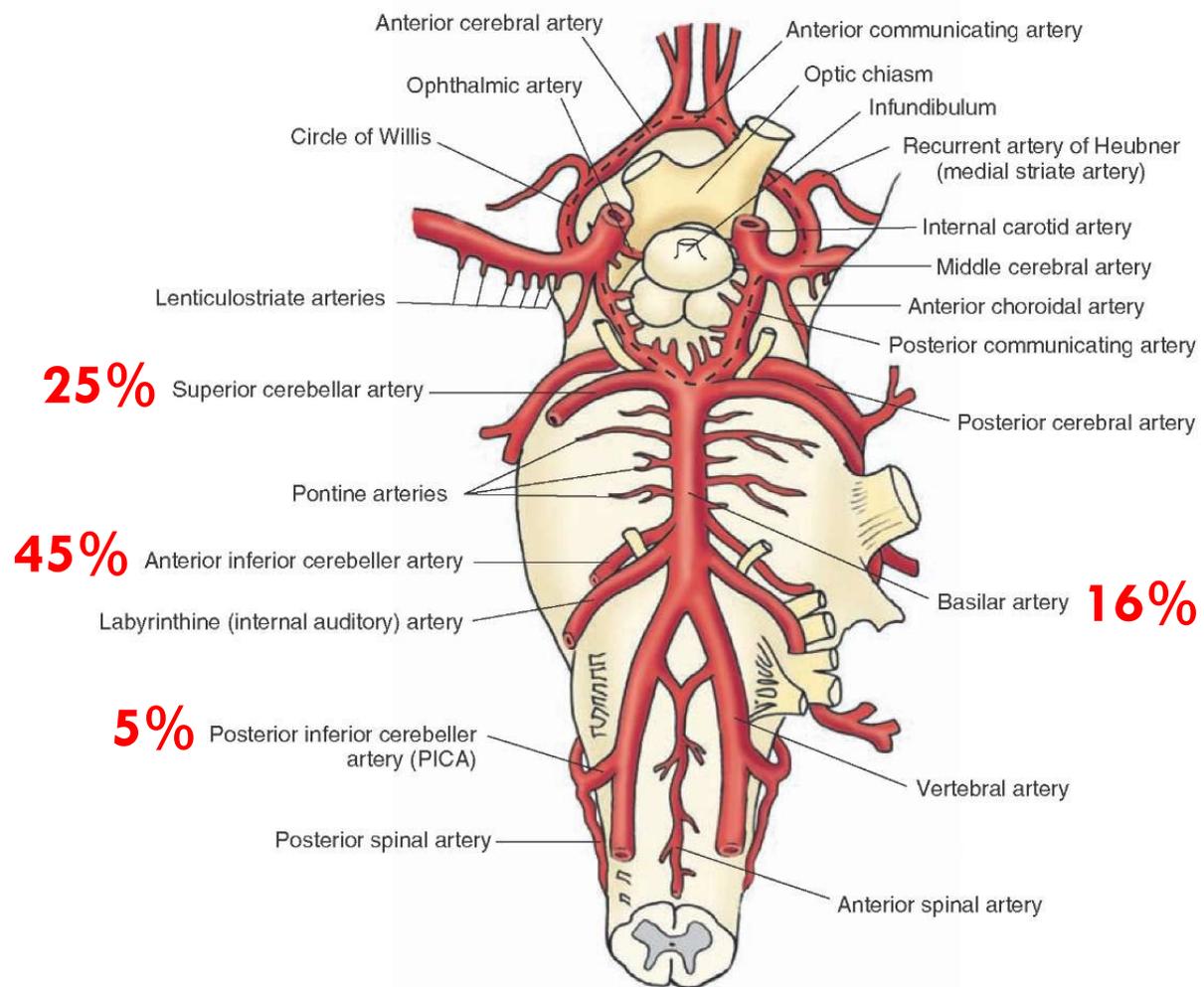


Figure retrieved from <http://what-when-how.com/neuroscience/blood-supply-of-the-central-nervous-system-gross-anatomy-of-the-brain-part-1/>

Figure retrieved from Kim & Lee, 2009

BLOOD SUPPLY TO THE INNER EAR

BACKGROUND

- Previous research has identified a **strong association between stroke and hearing loss**
- Reports on the **increased risk and prevalence of hearing loss in stroke patients** as compared to a general elderly population
- Audiovestibular loss as a warning sign for an impending stroke



SINGAPORE



- General lack of awareness on hearing loss in stroke patients
- No locally conducted studies measuring the hearing levels of stroke patients
- No clinical practice guidelines to identify hearing loss in stroke patients
- Rehabilitation emphasis mostly placed on motor and cognitive abilities
- Stroke patients undiagnosed for hearing loss can face more challenges regaining their functional ability post-stroke

AIMS

1. Measure the prevalence and severity of hearing loss in stroke patients and a non-stroke elderly population
2. Make age-adjusted comparisons of the prevalence and severity of hearing loss between stroke patients and a non-stroke control group
3. Raise the awareness of hearing impairment in stroke patients

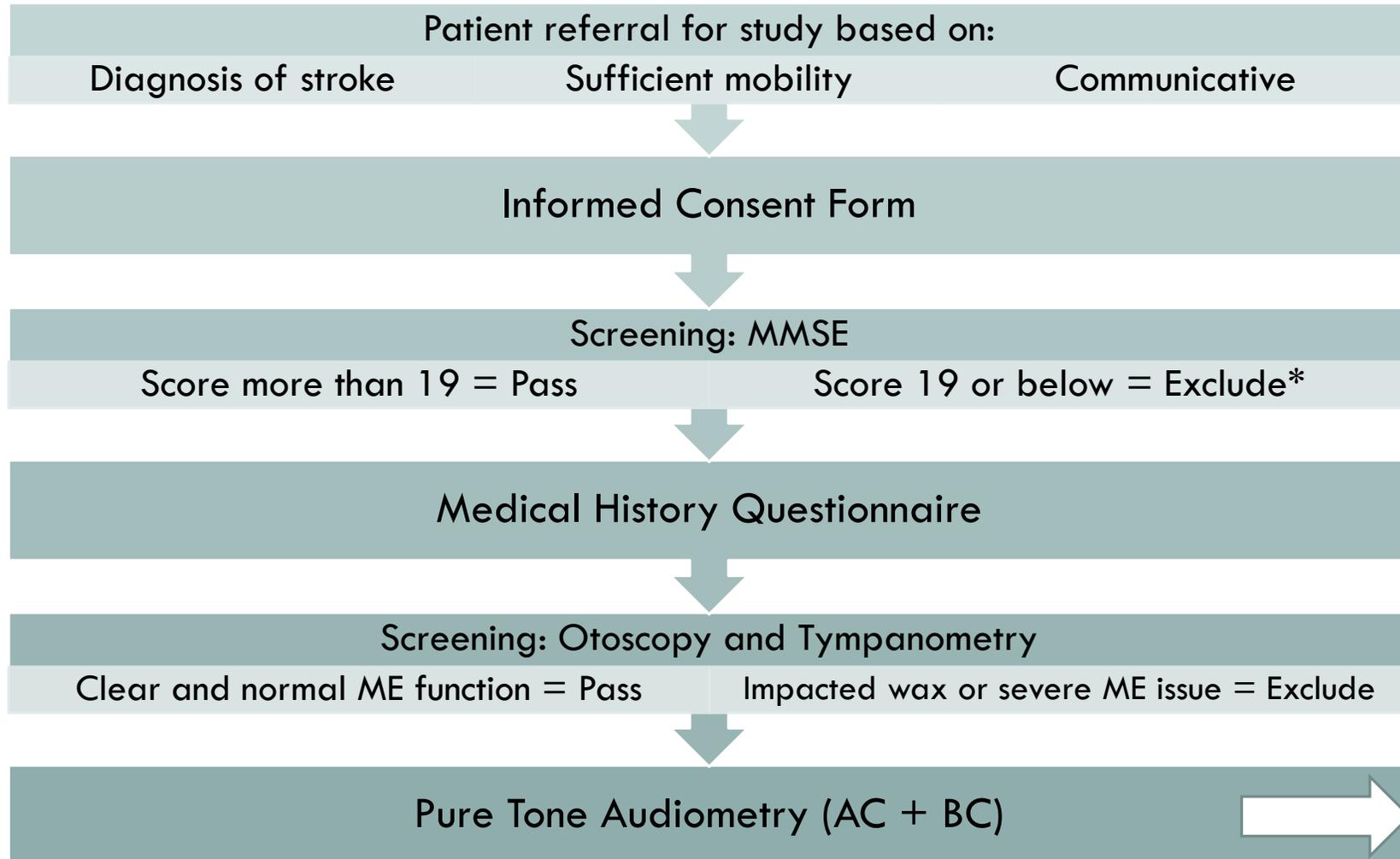


METHODS AND PROCEDURES



- Recruitment of subjects using convenience sampling method and specific inclusion/exclusion criteria
- **Stroke group:** 80 stroke patients from NUH (mostly ward 57)
 - Age range: 33 to 92 years
- **Control group:** 59 control subjects from the general public (Singaporean, no stroke, 50 to 85 years old, never worn hearing aids before)
 - Age range: 50 to 84 years

RECRUITMENT PROCESS

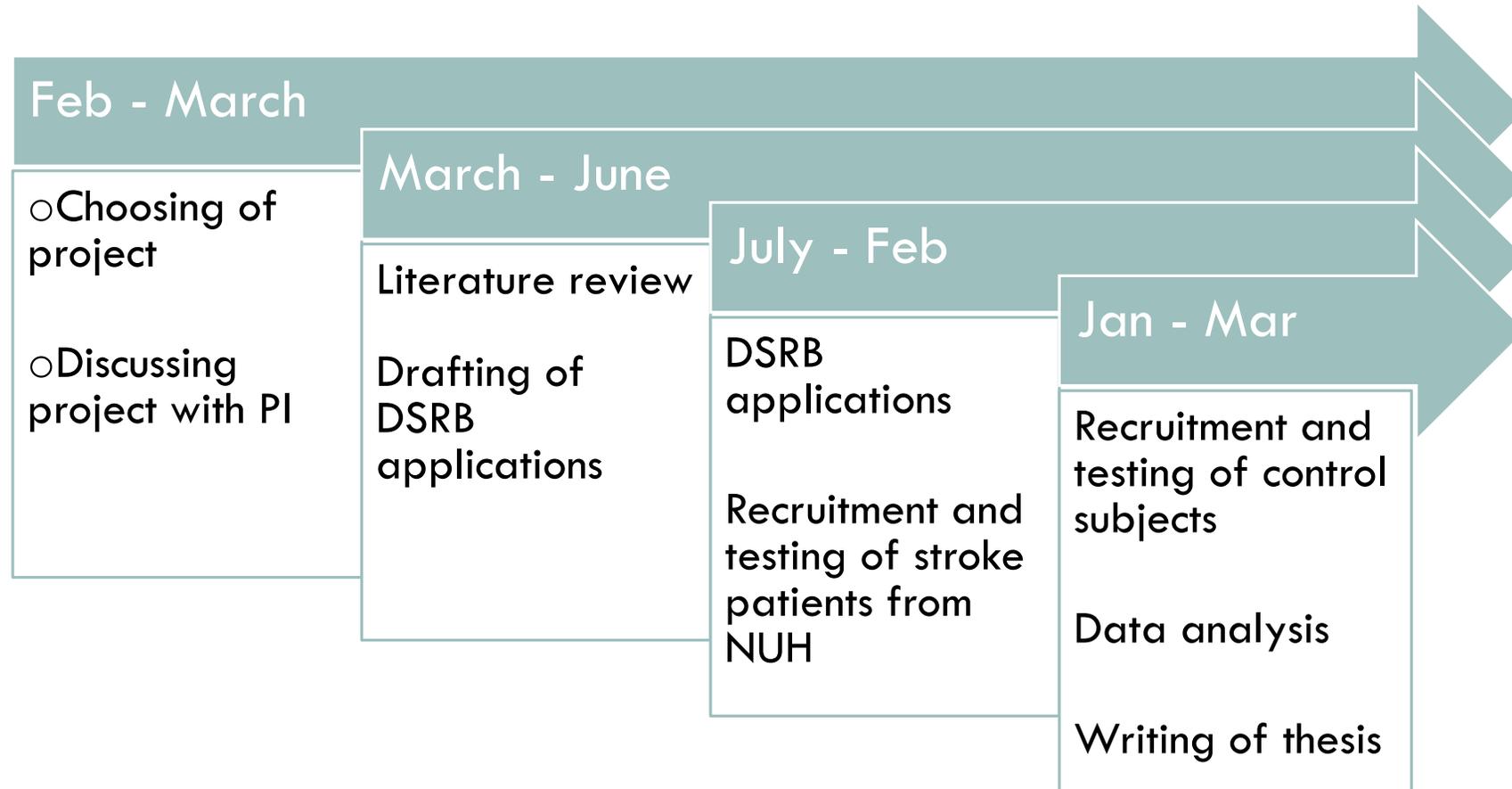


Offer referral to ENT if worse than mild hearing loss

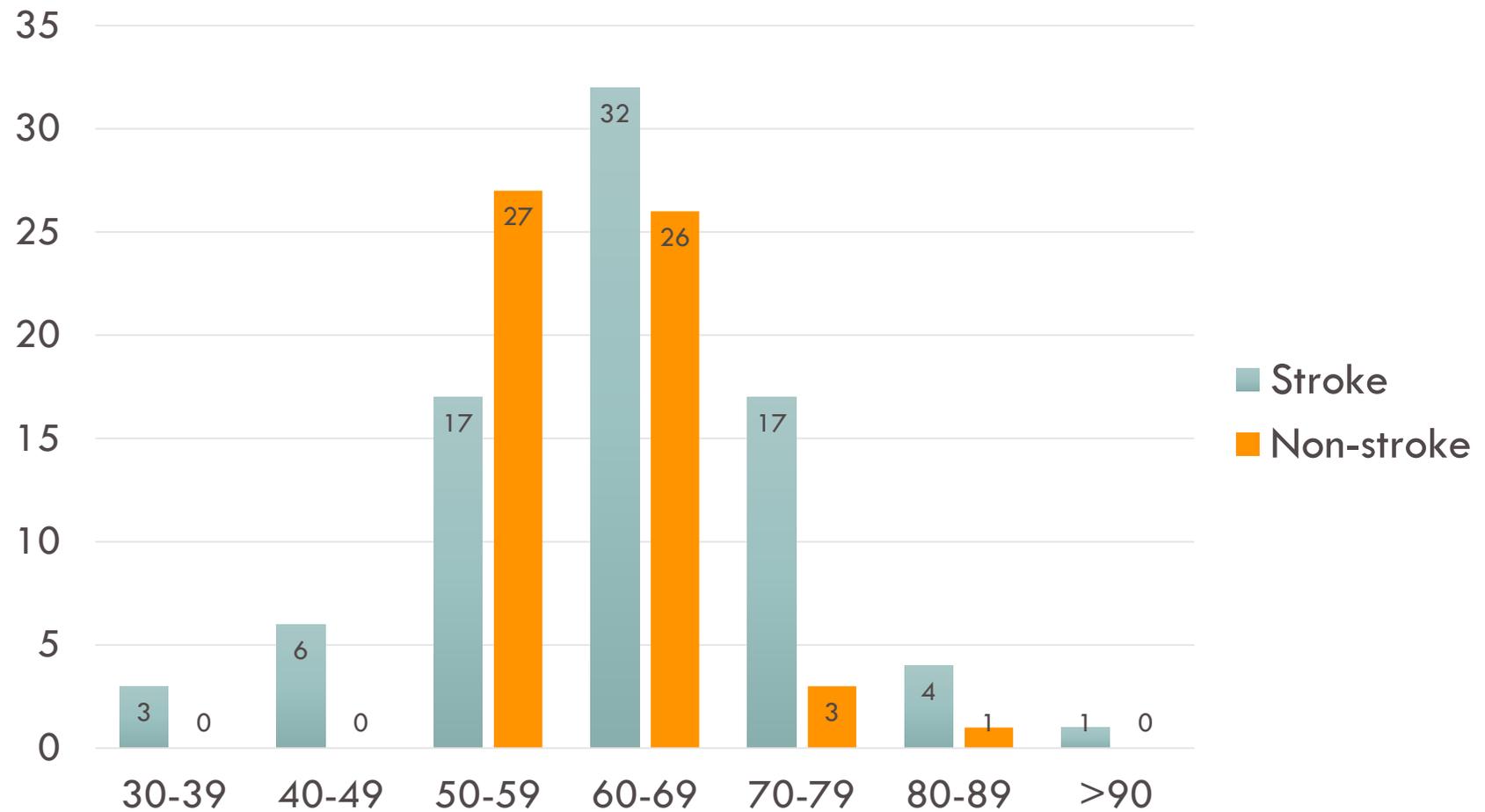
DATA COLLECTION

- Medical history questionnaire (hearing hx, noise exposure hx, stroke hx)
- Stroke location, TOAST (stroke mechanism), NIHSS (stroke severity)
- Age, Gender, MMSE score
- Tympanometry bilaterally
- PTA bilaterally (Air conduction thresholds at 250Hz, 500Hz, 1kHz, 2kHz, 3kHz, 4kHz, 6kHz, 8kHz)

PROJECT TIMELINE



RESULTS: AGE DISTRIBUTION



RESULTS: PREVALENCE OF HEARING LOSS

- Pure tone average: average of AC thresholds across the frequencies 500 Hz, 1 kHz, 2 kHz and 4 kHz
- Degree of hearing loss based on WHO classification

Stroke group

- **64%** had a hearing loss (51/80 subjects)
- **25%** categorized as a disabling hearing loss

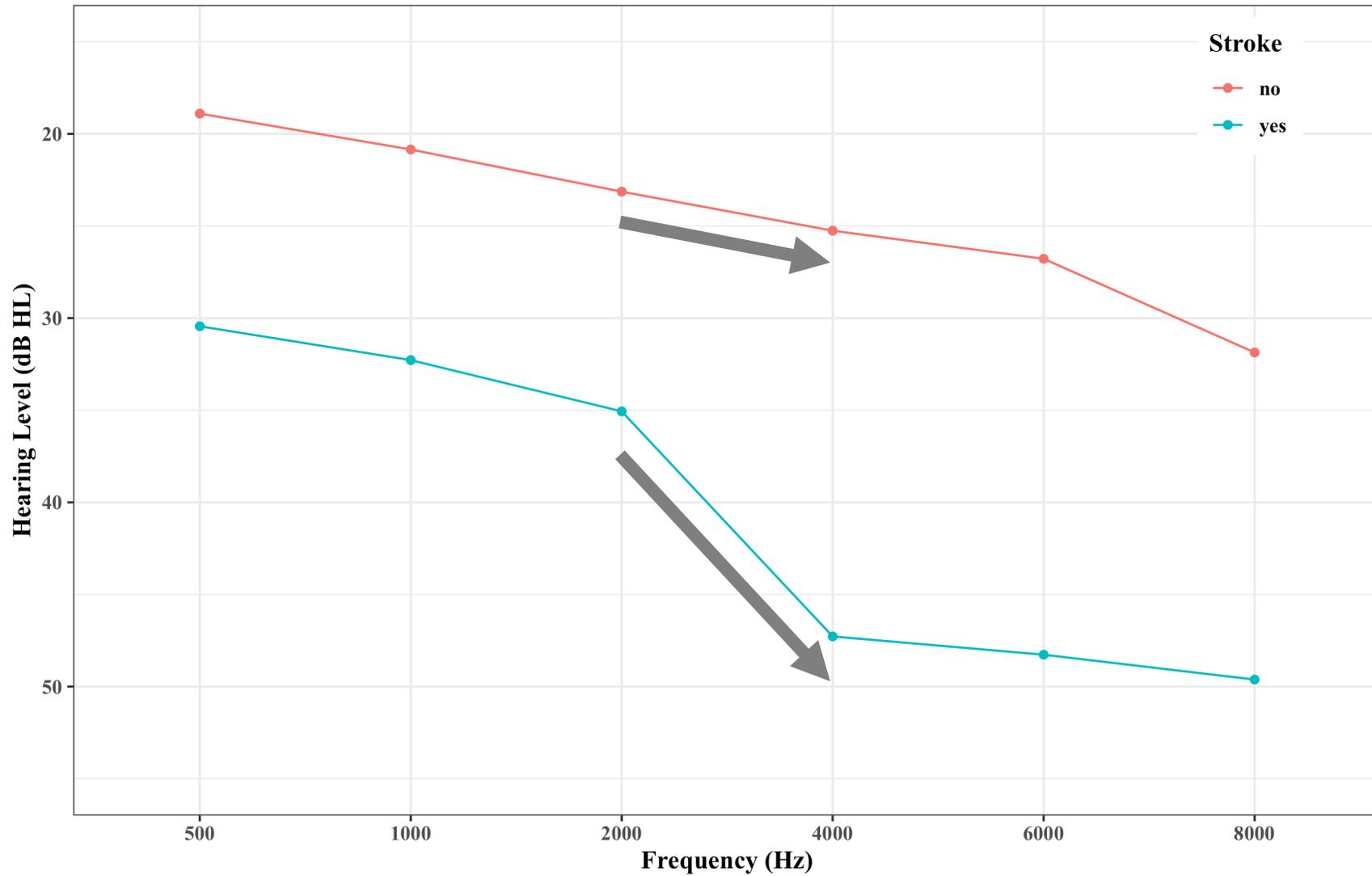
Control group

- **24%** had a hearing loss (14/59 subjects)

RESULTS: PREVALENCE OF HEARING LOSS

Degree of hearing loss	Stroke group, n (%)	Control group, n (%)
<i>Normal hearing (≤ 25 dB HL)</i>	29 (36%)	45 (76%)
<i>Mild hearing loss (26-40 dB HL)</i>	32 (40%)	14 (24%)
<i>Moderate hearing loss (41-55 dB HL)</i>	12 (15%)	0
<i>Moderately-severe hearing loss (56-70 dB HL)</i>	6 (8%)	0
<i>Severe hearing loss (71-90 dB HL)</i>	1 (1%)	0
<i>Profound hearing loss (> 90dB HL)</i>	0	0

Right ear: Age-adjusted plots comparing the weighted average hearing threshold (dB HL) across frequencies (Hz) between the stroke (blue) and control group (red)

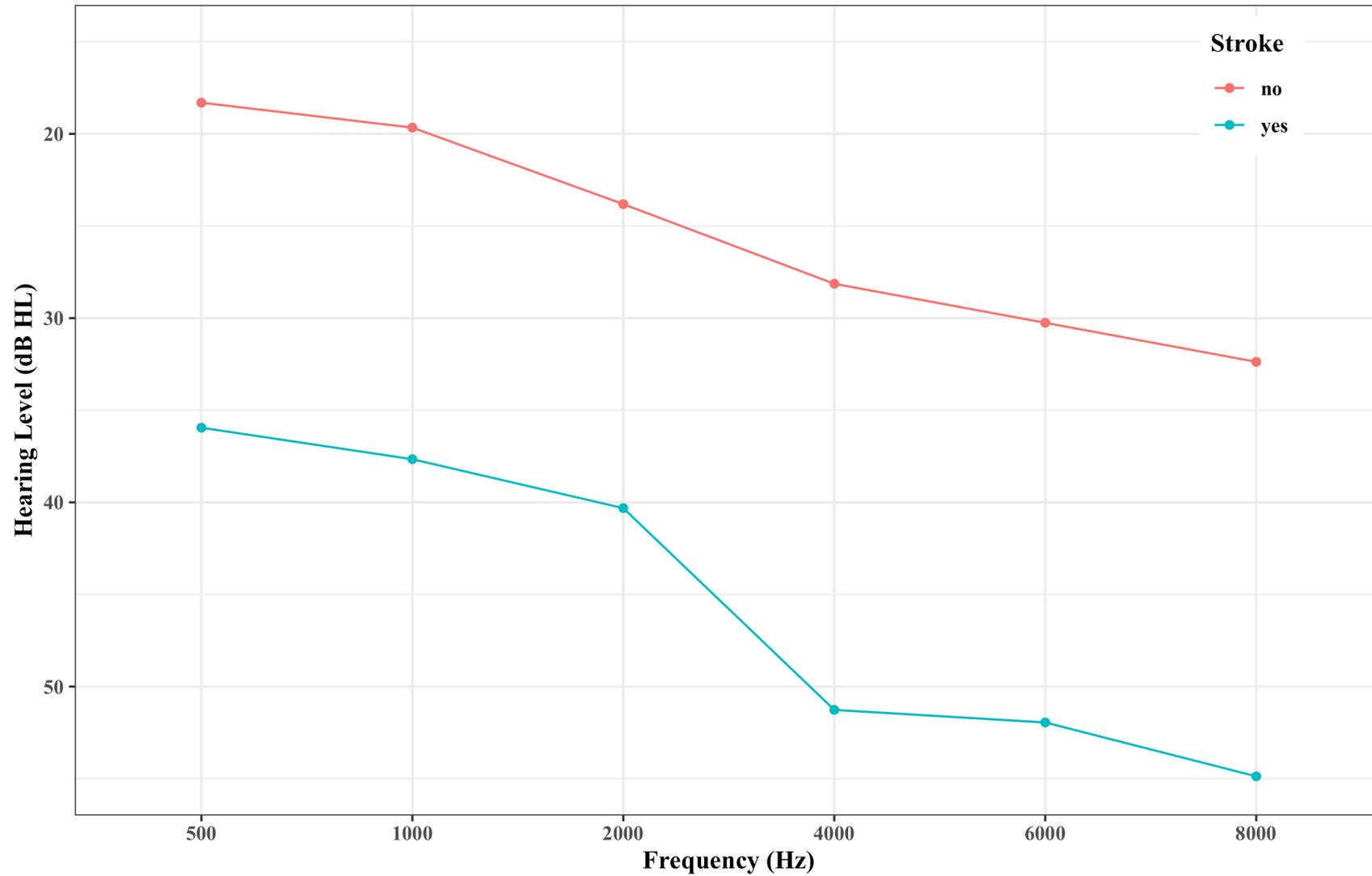


Control group

Stroke group

Right ear

Left ear: Age-adjusted plots comparing the weighted average hearing threshold (dB HL) across frequencies (Hz) between the stroke (blue) and control group (red)



Left ear

RESULTS: COMPARING HEARING THRESHOLDS

1. **Difference in average pure tone hearing threshold** between the stroke and control group was **significant** even after adjusting for age (both ears)
2. **Difference in slope of hearing loss** between the stroke and control group was **significant** even after adjusting for age (both ears)
 - Slope of hearing loss = difference between 2 kHz and 4 kHz hearing threshold
3. Chi square test indicated **significant association between hypertension and hearing loss** in the stroke group (p-value=0.01)

RESULTS: TOAST CLASSIFICATION AND HEARING LOSS

TOAST classification has five categories denoting five subtypes of ischemic stroke:

- 1) Large artery disease
 - 2) Cardio embolism
 - 3) Small artery disease
 - 4) Stroke of other determined aetiology
 - 5) Stroke of undetermined aetiology
- Investigated for any trends between stroke mechanism and lateralization with side of poorer hearing (asymmetric hearing loss if >15 dB HL)

RESULTS: TOAST CLASSIFICATION AND HEARING LOSS

TOAST	Hearing Loss		Normal Hearing, n (%)	Total (n=78)
	Asymmetrical Hearing Loss, n (%)	Symmetrical Hearing Loss, n (%)		
1	3 (12.5%)	17 (16.7%)	4 (16.7%)	24
2	5 (33%)	9 (60%)	1 (7%)	15
3	3 (15.8%)	13 (87%)	3 (15.8%)	19
4	0	1 (100%)	0	1
5	2 (10.5%)	16 (84.2%)	1 (5%)	19



In 4 out of 5 (TOAST 2) stroke patients with an asymmetric hearing loss, the side of hearing loss was contralateral to the side of stroke

RESULTS: AUDITORY MANAGEMENT

- Stroke patients with a hearing loss greater than a mild degree in at least one ear were offered an ENT referral
- 6 out of 19 subjects (31%) agreed for an ENT referral
- 6 stroke patients were already under the care of an ENT for other reasons
- 4 stroke patients had already been fitted with a hearing aid (5%)

DISCUSSION

- Co-occurrence of stroke and hearing loss has been well studied showing a strong association between the two conditions
- Multiple studies have reported a **higher prevalence of hearing loss in stroke patients** as compared to a general elderly population
- Prevalence of hearing loss reported in stroke patients is well corroborated by other similarly conducted studies done in US, Australia and Malaysia

DISCUSSION

1. Results suggest that **stroke patients are more susceptible to hearing loss especially in the high frequencies as compared to a general elderly population**
 - Possibly attributed to strong involvement between the vascular and auditory system
2. Stroke patients with hypertension more prone to hearing loss due to the additive effect on presbycusis
3. Possible hypothesis of contralateral involvement of CNS during a cardioembolic stroke

CLINICAL IMPLICATIONS



- Current clinical practice guidelines are inadequate at picking up hearing loss in stroke patients
- **Large proportion of stroke patients undiagnosed for hearing loss and not receiving appropriate auditory management**
- Stroke coupled with a hearing loss can present **more challenges during rehabilitation**
 - More frequent communication breakdowns, inability to communicate their healthcare needs, poorer functional ability post-stroke

CLINICAL IMPLICATIONS

- Low acceptance of ENT referral suggest low prioritization of hearing health among elderly population
- **Lack of awareness on significant benefits of auditory intervention**



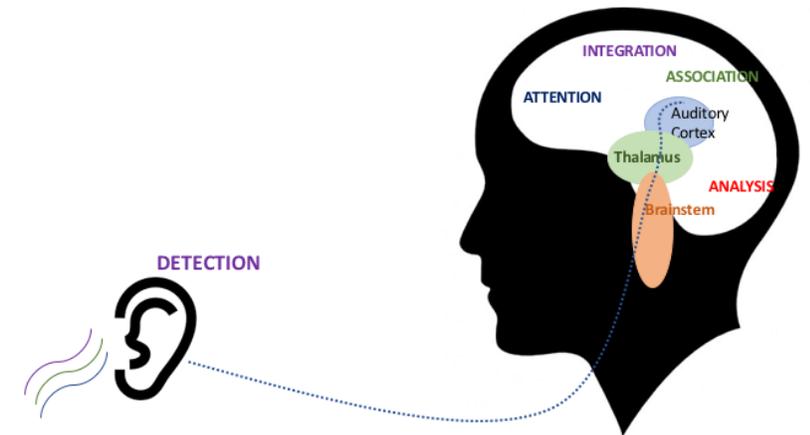
LIMITATIONS

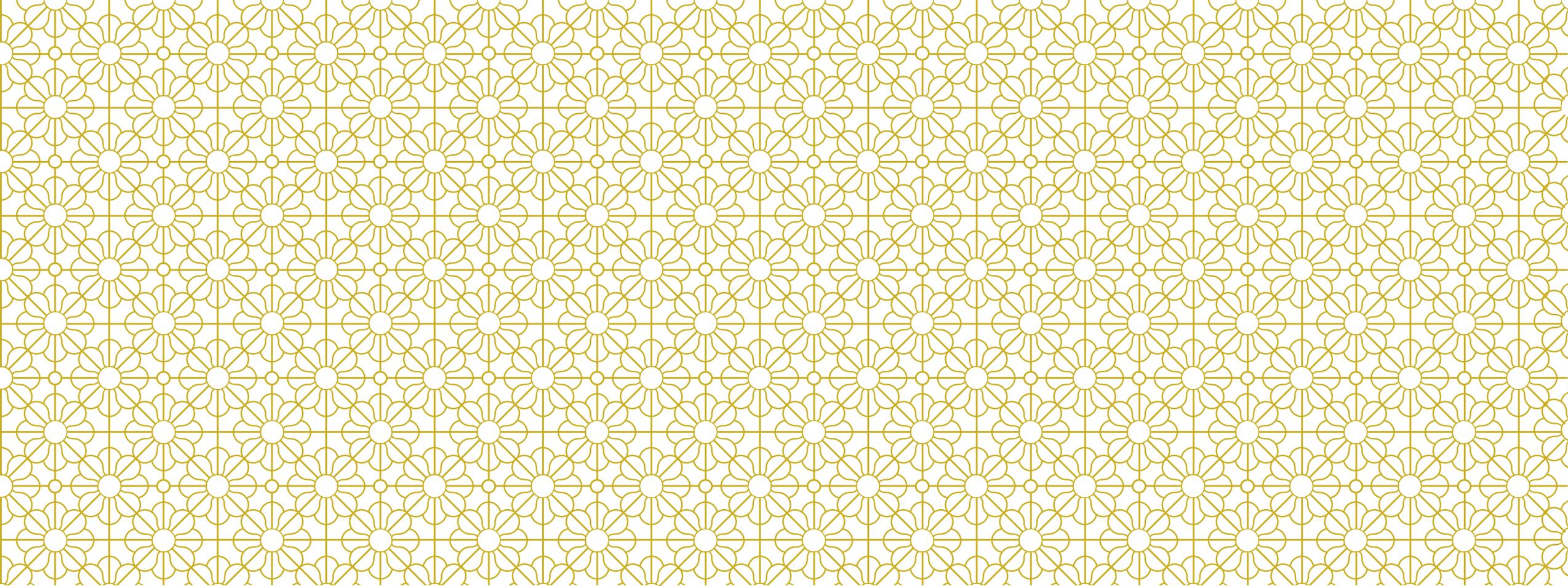
- Absence of audiometric findings prior to stroke
- More likely to recruit subjects who were healthy, communicative, mobile and compliant
- PTA only sensitive to peripheral hearing, and unable to rule out other more subtler auditory dysfunctions e.g. CAPD
- Challenges of CAPD testing in a local elderly population



FUTURE WORK

- Longitudinal cohort study to monitor hearing levels of subjects before and after the incidence of stroke
- Investigate the mechanism of stroke and hearing loss
- Investigate relationship between stroke and CAPD
- Measure the risk of stroke in a population with sudden SNHL





THANK YOU FOR YOUR ATTENTION



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