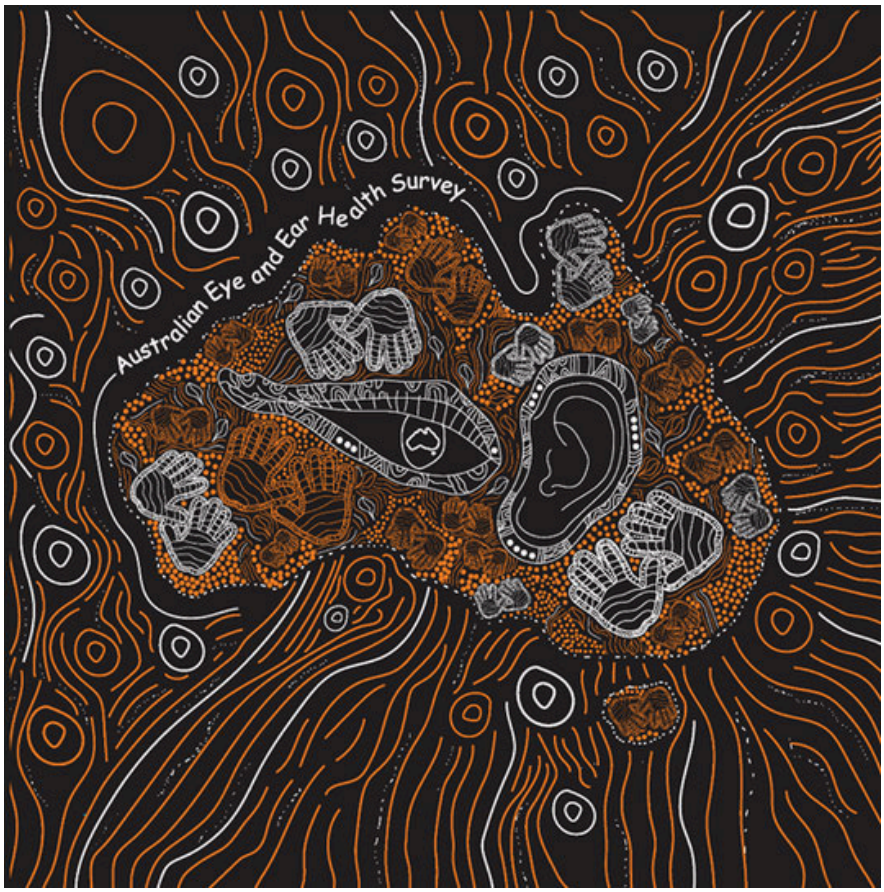
AEEHS

THE AUSTRALIAN EYE & EAR HEALTH SURVEY

A Nationwide Survey of Eye and Ear Health, Vision and Hearing Impairment in Australia



Full Report
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The Westmead Institute FOR MEDICAL RESEARCH
THE UNIVERSITY OF SYDNEY
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The George Institute for Global Health
MACQUARIE University
Brien Holden FOUNDATION

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The AEEHS logo was designed by Indigenous Artist/Graphic Designer Kyara Fernando, a Dunghutti woman from Kempsey on the Mid North Coast of New South Wales. The design that she created incorporates concepts focused on the eye, ear and the outlining of Australia to symbolically represent the vision and hearing within Australia. The hands were designed to represent the identity of the people, all people of Australia. Drawn patterns of leaves show the connection to country and provide an environmental and nature feeling, whilst the lines are a visual representation of sound, vibrations echoing through the land. The Eye and the Ear symbols from the centre of the painting/print formed concepts for the logo.

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Glossary of abbreviations used

ABS	Australian Bureau of Statistics
ACCHS	Aboriginal Community Controlled Health Service
AEEHS	Australian Eye and Ear Health Survey
AH&MRC	Aboriginal Health and Medical Research Council
AIATSIS	Australian Institute of Aboriginal and Torres Strait Islander Studies
AMD	Age-related Macular Degeneration
AMS	Aboriginal Medical Services
ASGC	Australian Standard Geography Classification
ASGS	Australian Statistical Geography Standard
BCVA	Best Corrected Visual Acuity
BMES	Blue Mountains Eye Study
CDR	Cup to Disc Ratio
CI	Confidence Interval
CVR	Centre for Vision Research
DR	Diabetic Retinopathy
FDT	Frequency Doubling Technology
HHIE	Hearing Handicap Inventory for the Elderly
HREC	Human Research Ethics Committee
IAPB	International Agency for the Prevention of Blindness
IOP	Intraocular Pressure
LEI	Lions Eye Institute
LogMAR	Logarithm of the Minimum Angle of Resolution
mmHg	Millimetres of mercury
NACCHO	National Aboriginal Community Controlled Health Organisation
NEHS	National Eye Health Survey
NHMRC	National Health and Medical Research Council

NIEHS	National Indigenous Eye Health Survey
NSW	New South Wales
NT	Northern Territory
OA	Optometry Australia
OCT	Optical Coherence Tomography
OCTA	Optical Coherence Tomography Angiography
OR	Odds Ratio
QAIHC	Queensland Aboriginal and Islander Health Council
QLD	Queensland
RA	Remoteness Area
SA	South Australia
SA	Statistical Area
SA1	Statistical Area Level 1
SA2	Statistical Area Level 2
SD	Standard Deviation
SE	Standard Error
VA	Visual Acuity
VI	Vision Impairment
VIC	Victoria
VIP	[Melbourne] Visual Impairment Project
WA	Western Australia
WAAHEC	Western Australian Aboriginal Health Ethics Committee
WHA	World Health Assembly
WHO	World Health Organisation
WIMR	Westmead Institute for Medical Research

Definitions

Age-adjustment	A statistical technique in epidemiology and demography used to allow populations to be compared when the age profiles of the populations differ
Age-related macular degeneration	A degenerative disease that affects the central area of the retina called the macula, causing it to thin and in some cases bleed, causing loss of vision
Anterior chamber angle closure	Blockage of the drainage angle of the eye, resulting in high eye pressure
Anterior segment	The front part of the eye
Auto-refractor	A machine used to provide an objective measurement of a person's refractive error and prescription for correction
Blindness	Presenting distance visual acuity <6/60 in the better eye
Cataract	A cloudy area on the lens in the eye, formed when protein in the lens becomes opaque, limiting the amount and clarity of light passing through the lens to the retina, causing poor vision.
Chalazion	A cyst in the eyelid that is caused by inflammation of a blocked gland, usually on the upper eyelid
Corneal Opacity	Scarring and opacification of the cornea (the transparent thin layer over the front of the eye)
Cotton-wool spots	Fluffy white patches in the retina caused by loss of circulation in the nerve fibre layer
Cup notching	Focal reduction in the width of the rim of the optic nerve associated with a change in the curvature of the rim in glaucoma
Cup to disc ratio	Comparison of the diameter of the central cup portion of the optic disc with the total diameter of the optic disc in assessing glaucoma
Diabetes	A metabolic disease in which there are high blood sugar levels over a prolonged period

Diabetic retinopathy	Diabetic retinopathy is a complication of diabetes that damages blood vessels inside the retina at the back of the eye causing bleeding and swelling. It commonly affects both eyes and can lead to vision loss if it is not treated
Drusen	Yellow or white accumulations of material in the retina, associated with normal ageing and age-related macular degeneration
Fovea	The central pit of the macula in the retina responsible for sharp central vision
Fundus	The interior surface of the eye opposite the lens that includes the retina, optic disc, macula, fovea, and posterior pole
Geographic atrophy	Damage to the deepest cells of the macular in the advanced stage of dry age-related macular degeneration
Glaucoma	A group of eye diseases in which the optic nerve at the back of the eye is slowly destroyed. In most people this damage is due to an increased pressure inside the eye - a result of blockage of the circulation of aqueous, or its drainage. In other patients the damage may be caused by poor blood supply to the vital optic nerve fibres, a weakness in the structure of the nerve, and/or a problem in the health of the nerve fibres themselves
Hard exudates	Yellow spots on the retina, resulting from lipid deposits as part of macular oedema or after it subsides in diabetic retinopathy
Hearing impairment	Hearing impairment was determined as the four-frequency pure-tone average of audiometric hearing thresholds at 500, 1000, 2000 and 4000Hz, with hearing impairment defined as hearing thresholds >25dB hearing level (dB HL).
Intraocular pressure	The fluid pressure inside the eye
Intra-retinal microvascular abnormalities	Abnormal branching or dilation of existing blood vessels (capillaries) within the retina that act to supply areas of insufficient blood supply in diabetic retinopathy
Macular oedema	Build-up of fluid in the macula
Micron	One millionth of a metre
Mydriatic	Pertaining to or producing pupil dilation

Neovascularisation	Proliferation of blood vessels in tissue not normally containing them, or proliferation of blood vessels of a different kind than usual in tissue
Neuro-retinal rim thinning	Thinning of the rim of the optic nerve in glaucoma
Optic atrophy	Damage to the optic nerve resulting in a degeneration or destruction of the optic nerve
Optical Coherence Tomography	A non-invasive means of scanning the retina and optic disc using infra-red imaging, providing high resolution cross-sectional images of these structures
Optic disc	The point of exit for the optic nerve leaving the eye
Perimeter	An instrument for measuring the extent and characteristics of a person's field of vision
Pterygium	An overgrowth of tissue with blood vessels that grows from the conjunctiva (the thin membrane that covers the white of the eye) onto the cornea (the clear central part of the eye)
Pure tone audiometry	Standardised hearing test that measures an individual's hearing thresholds across a range of frequencies using pure tones delivered through headphones. It helps determine the softest sounds a person can hear at various pitches and is commonly used to diagnose the type and severity of hearing loss.
Refractive error	A condition in which light that passes through the front of the eye fails to focus precisely on the retina. It causes long-sightedness or short-sightedness and difficulties changing focus
Stratified sampling	A type of sampling method in which the population is divided into separate groups, called strata, from each of which a probability sample is selected
Stye	An infection of the glands at the base of the eyelashes
Tonometer	A device that measures the fluid pressure in the eye
Trachoma	A contagious infection of the conjunctiva and cornea, characterised by the formation of granulations and scarring and caused by the bacterium *Chlamydia trachomatis*

Trachomatous Trichiasis	Ingrowth or introversion of the eyelashes caused by trachoma infection
Tropicamide	A drug that induces pupil dilation
Tympanometry	Objective test that evaluates the movement of the eardrum (tympanic membrane) in response to changes in air pressure within the ear canal. It helps assess middle ear function and can identify issues such as fluid behind the eardrum, ear infections, or eustachian tube dysfunction.
Van Herick grading	A test using a slit lamp that measures the anterior chamber depth to estimate the risk of anterior chamber angle closure
Venous beading	Saccular bulges in the wall of a vein resulting from inadequate blood supply
Video otoscopy	A procedure that uses a specialised camera (video otoscope) to visually examine and capture images or video of the ear canal and eardrum. It allows for real-time viewing and documentation of ear health.
Vision impairment	Presenting distance visual acuity <6/12 in the better eye
Visual field	The total area in which objects can be seen in the side (peripheral) vision as you focus your eyes on a central point

Foreword to the Australian Eye and Ear Survey

Full and Summary Reports from the Australian Eye and Ear Health Survey, 14 July 2025, are now complete. This Survey owes its origins to the first nationwide eye health survey conducted during 2015 and 2016, the National Eye Health Survey (NEHS).

Vision 2020 Australia had the foresight to call for a second survey to assess whether progress had been made in reducing the frequency and impact of vision impairment. This survey was funded by the Australian Government Department of Health, Disability and Ageing. We are most grateful for this funding, which has enabled the Eye Survey to proceed to completion. We are also grateful for funding of the hearing component of the survey by the Martin Lee Centre for Innovations in Hearing Health, Macquarie University.

The project team, led by Dr Richard Kha, the first author of these reports, together recently with Ms Mayuri Indrakumar, Ms Michelle Fu and Ms Oonagh Macken recently in the field, worked with extraordinary discipline and enthusiasm, to complete the examination of 4,519 Australians, living at 30 randomly selected sites across the six states and two territories. As well as building on the vision impairment data generated by the NEHS, this new survey added advanced ophthalmic imaging to define eye conditions in much greater detail than possible in the first survey. It has also added assessment of hearing loss, the second key sensory impairment, as the first nationwide survey of this key disability.

Dr Richard Kha, A/Prof Gerald Liew and Dr Gary Low have been the key contributors to the writing of these reports, with help from other principal investigators, Prof Lisa Keay, Prof Bamini Gopinath, Dr Tim Fricke, Ms Colina Waddell, and others including Dr Yasemin

Kapucu, Dr George Burlutsky, Ms Oonagh Macken, Ms Eleanor Yang and A/Prof Andrew White.

Finally, I need to personally thank the 4,519 Australians who voluntarily donated their time and enthusiasm to be questioned and examined in the survey, as well as all the other staff and collaborators, too many to list here individually, who have worked tirelessly on the survey over the last 3 years.

Key scientific reports will be developed from these data for international publication, and it is hoped that these contributions will further grow our knowledge about the eye and ear health of the Australian community.

Prof Paul Mitchell AO, MBBS, MD, PhD, FRANZCO, FRACS, FRCOphth, FAFPHM

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Executive Summary

The Australian Eye and Ear Health Survey (AEEHS) is a nationwide survey of sensory impairment, eye, ear, and general medical health of Australians sampled from 30 selected sites from all 6 Australian States and 2 Territories. The survey utilised stratified, multi-stage random cluster sampling to select recruitment sites and was conducted between August 2022 and March 2025. Over this period, 18,145 homes were door-knocked, with a response rate of 73.7% achieved. The survey recruited a total of 4,519 participants for the eye survey, of whom 617 (13.6%) were Indigenous and 3,902 (86.4%) were non-Indigenous. For the hearing survey, 3,573 of the 4,519 eye study participants were recruited, of whom 461 (12.9%) were Indigenous and 3,112 (87.1%) were non-Indigenous.

The main findings of the AEEHS are:

Eye Health Findings

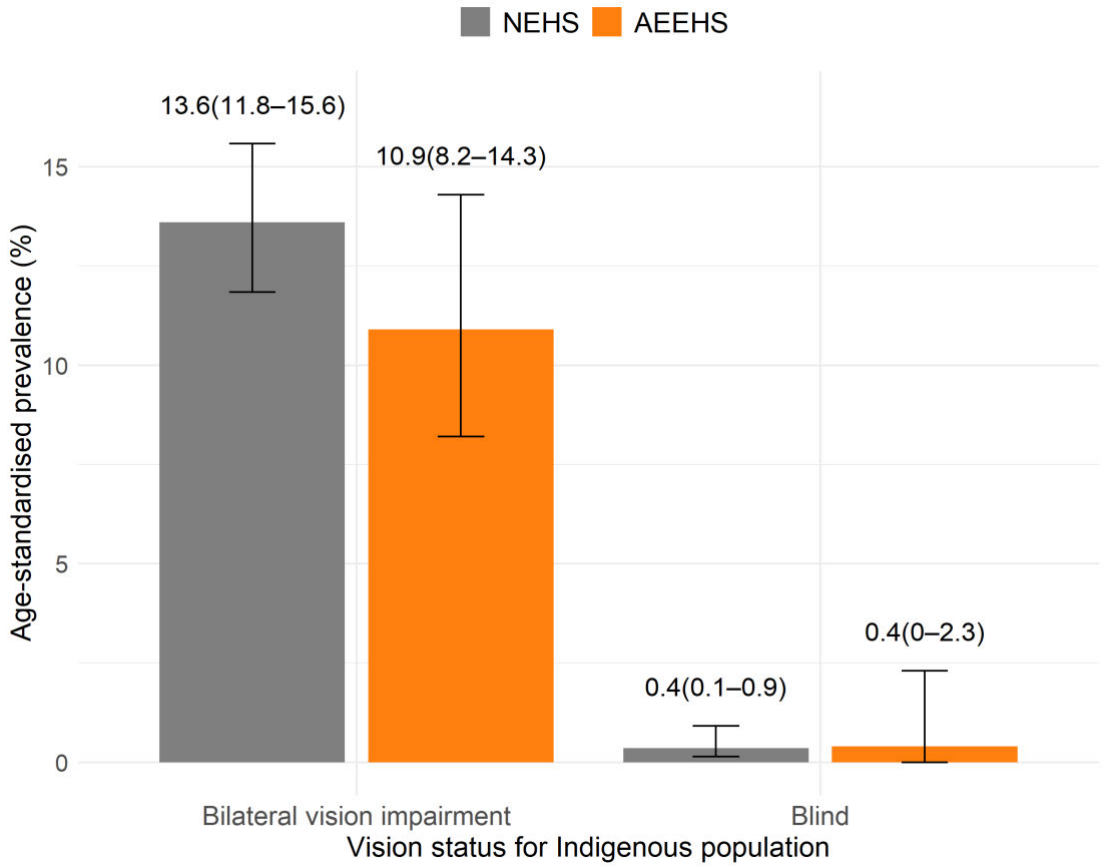
- The crude prevalence of presenting bilateral vision impairment (presenting visual acuity of <6/12-6/60 in the better eye) in the AEEHS was 2.3 times higher among Indigenous (11.0%) compared with non-Indigenous (4.7%) Australians, while the prevalence of presenting bilateral blindness was similar among Indigenous (0.2%) and non-Indigenous (0.2%) Australians, respectively. The total prevalence of vision impairment and blindness in the combined sample was 5.6% and 0.2% respectively.
- After age-standardisation to the Australian population (Census 2021), the age-standardised prevalence of bilateral vision impairment remained similar at 10.9% for Indigenous participants, and decreased to 3.8% for non-Indigenous participants,

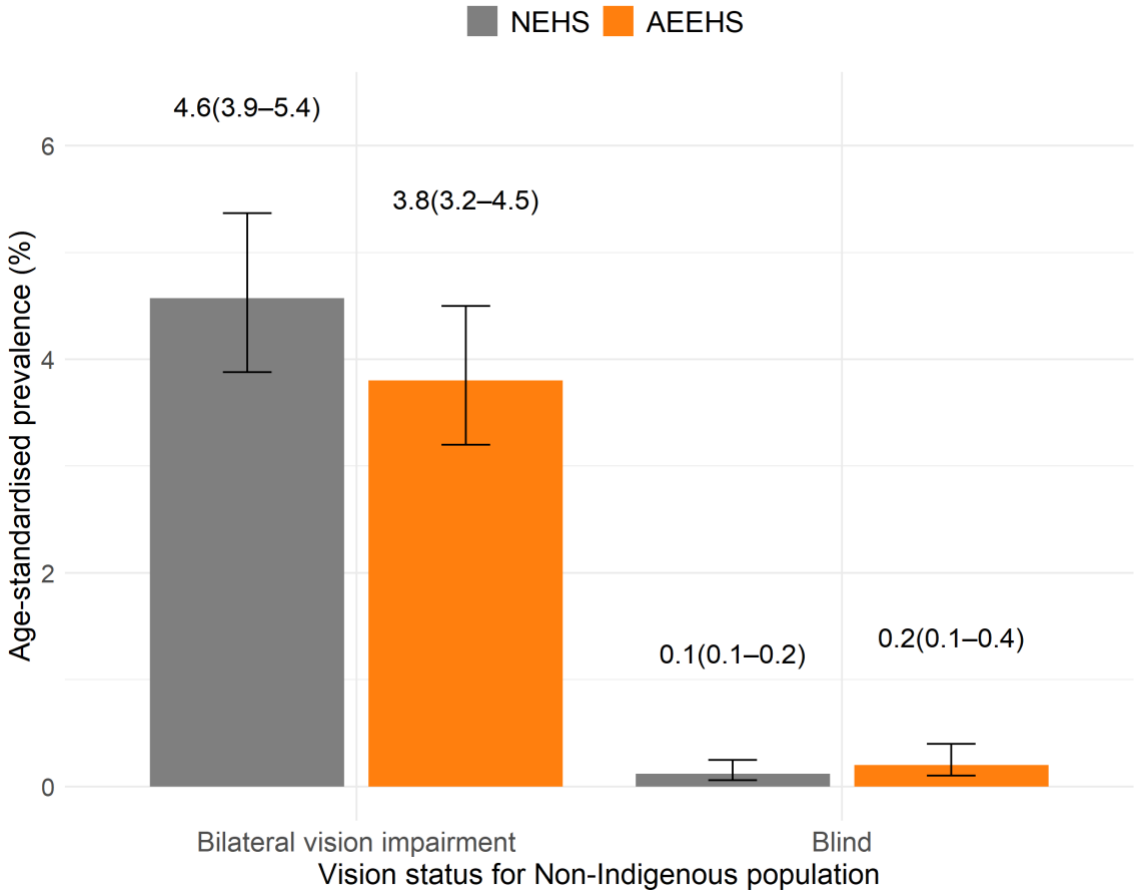
resulting in an almost 3-fold higher age-standardised prevalence of bilateral vision impairment for Indigenous participants. The age-standardised prevalence of vision impairment in the total sample was 5.1%.

- These age-standardised prevalences are lower than the age-standardised prevalences reported in the National Eye Health Survey[1,2] (NEHS, 13.6% in Indigenous and 4.6% in non-Indigenous participants, respectively), suggesting there may be a small reduction in the prevalence of bilateral vision impairment among both Indigenous (-2.7%) and non-Indigenous Australians (-0.8%) over the intervening 8-9 years between the two studies. Despite this absolute reduction in bilateral vision impairment, the gap remained similar, with 3-fold higher rates in Indigenous compared to non-Indigenous Australians.
- Using the World Health Organisation (WHO) definition of moderate vision impairment (presenting visual acuity <6/18-6/60 in the better eye), the crude prevalence of moderate bilateral vision impairment was 1.9% in Indigenous Australians and 0.5% in non-Indigenous Australians. After age-standardisation, the prevalence increased to 2.4% in Indigenous Australians and remained similar at 0.4% in non-Indigenous Australians. Compared to the NEHS,[1,2] this represents an approximately 50% reduction in moderate vision impairment prevalence in both Indigenous (4.6% to 2.4%) and non-Indigenous (1.0% to 0.4%) Australians. Nonetheless, the prevalence of moderate vision impairment was still 6 times greater in Indigenous Australians than in non-Indigenous Australians.
- The age-standardised prevalence of bilateral blindness was higher among Indigenous Australians (0.4%) compared to non-Indigenous Australians (0.2%). This has

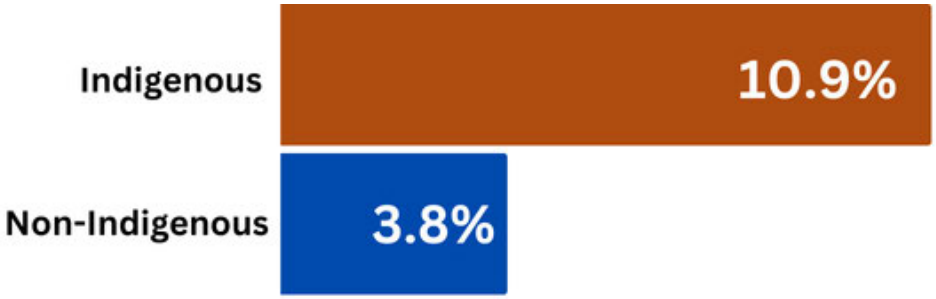
remained similar compared to the NEHS[1] (0.4% for Indigenous, 0.1% for non-Indigenous Australians).

- The prevalence of combined bilateral vision impairment and blindness was highly age-dependent, with the highest rates in older Australians. Among Indigenous Australians, the prevalence of bilateral vision impairment/blindness increased with age from 9.8% among those aged 50-59 years, to 19.6% in those aged 80+ years. Among non-Indigenous Australians, the prevalence started lower at 2.1% in those aged 50-59 years, and increased more gradually with age, reaching 11.7% in those aged 80+ years.

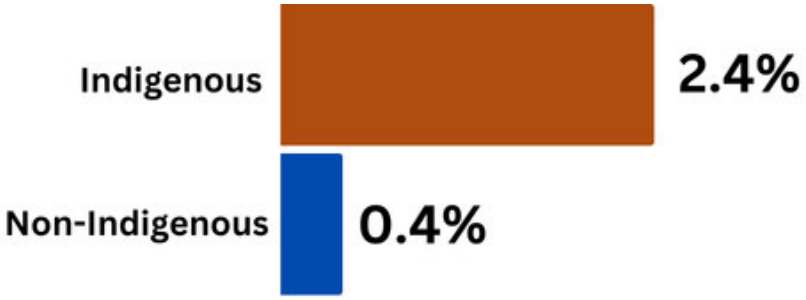

NEHS
AEEHS
13.6(11.8–15.6)
10.9(8.2–14.3)
0.4(0.1–0.9)
0.4(0–2.3)
Age-standardised prevalence (%)
15
10
5
0
Bilateral vision impairment
Blind
Vision status for Indigenous population


NEHS
AEEHS
4.6(3.9–5.4)
3.8(3.2–4.5)
0.1(0.1–0.2)
0.2(0.1–0.4)
Age-standardised prevalence (%)
6
4
2
0
Bilateral vision impairment
Blind
Vision status for Non-Indigenous population

There has been a small reduction in rates of vision impairment in both Indigenous and non-Indigenous Australians, but a substantial gap remains*.

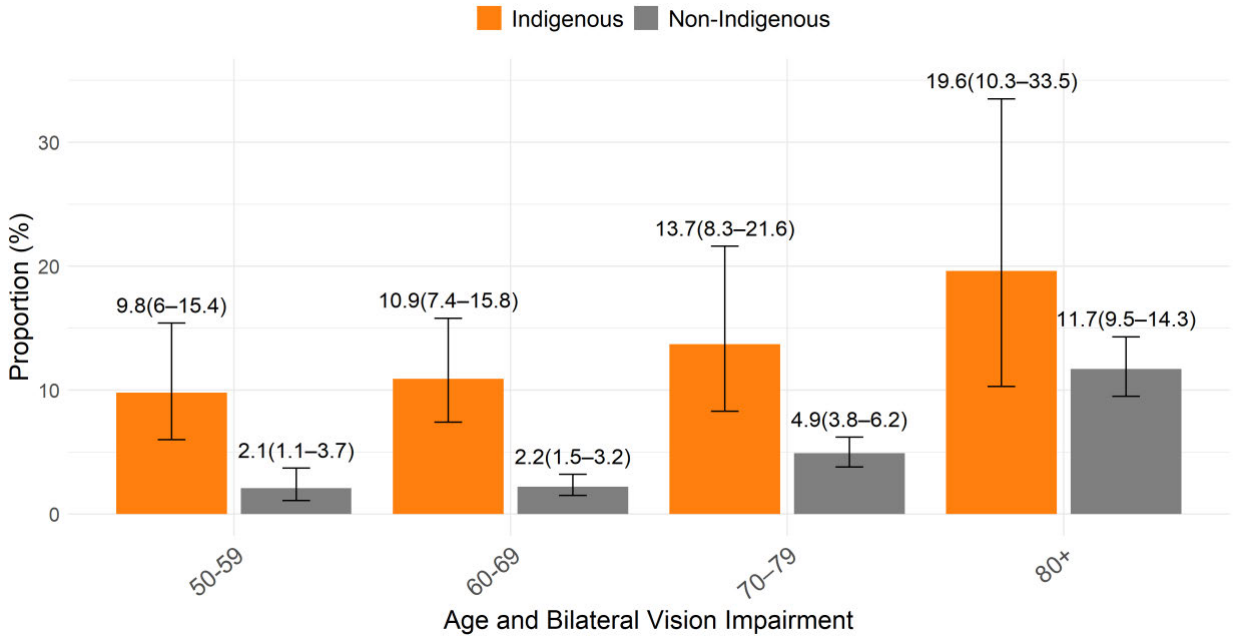


The prevalence of vision impairment was
3x higher in Indigenous Australians
compared to non-Indigenous Australians



The prevalence of moderate vision impairment was
6x higher in Indigenous Australians
compared to non-Indigenous Australians

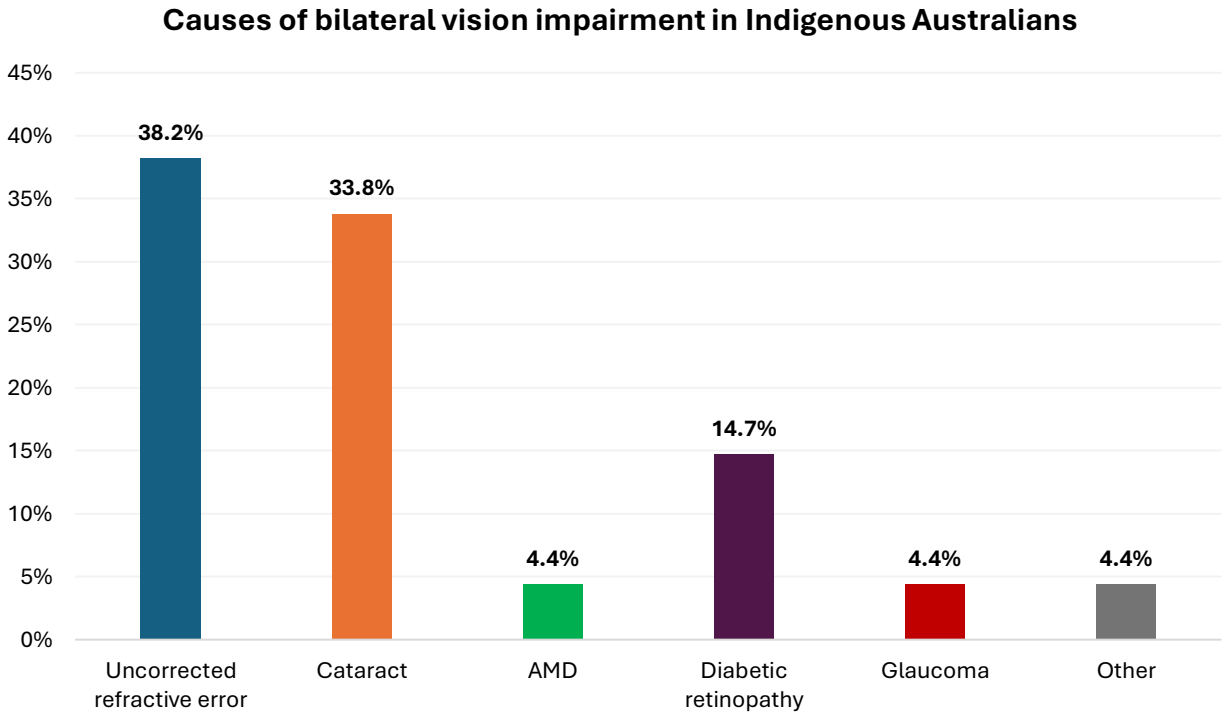
*Among Indigenous and non-Indigenous Australians aged 50 years and over

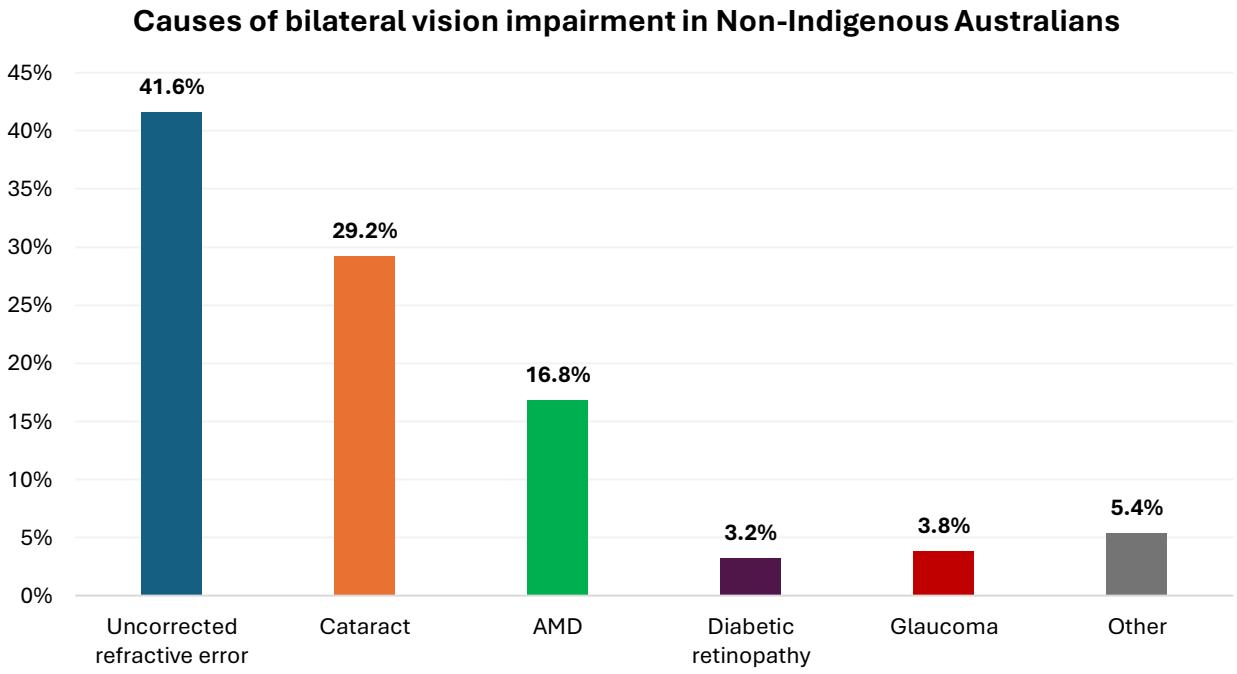


In every age group, the prevalence of bilateral vision impairment was

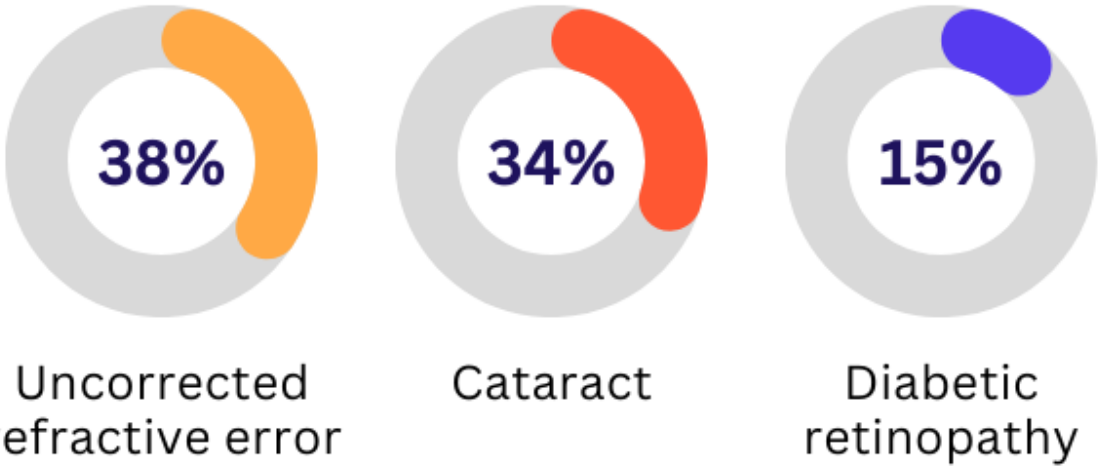
2-5x higher in Indigenous Australians compared to non-Indigenous Australians

- The main causes of presenting bilateral vision impairment were similar in Indigenous and non-Indigenous Australians. These were, among Indigenous Australians, uncorrected refractive error (38.2%), cataract (33.8%), diabetic retinopathy (14.7%), age-related macular degeneration (AMD, 4.4%), glaucoma (4.4%), and other causes, including retinal vein occlusions and inherited retinal dystrophies (4.4%). Among non-Indigenous Australians, the main causes were uncorrected refractive error (41.6%), cataract (29.2%), AMD (16.8%), glaucoma (3.8%), diabetic retinopathy (3.2%), and other causes (5.4%).
- The relative importance of each cause was similar for Indigenous and non-Indigenous Australians, except for diabetic retinopathy, which was more prevalent in Indigenous Australians, likely due to higher diabetes prevalence, and AMD, which was more prevalent among non-Indigenous Australians. This was partly due to the relatively younger age of the Indigenous participants.
- Age had a major impact on the causes of presenting combined bilateral vision impairment/ blindness in both Indigenous and non-Indigenous participants. Cataract and AMD were the main causes of bilateral vision impairment in older (70+ years) Australians, while diabetic retinopathy was more common in younger Australians. However, Indigenous participants with bilateral vision impairment/ blindness from glaucoma (mean age 67.7 years) and uncorrected refractive error (63.0 years) were younger than non-Indigenous participants with glaucoma (80.9 years) and uncorrected refractive error (74.0 years).


Causes of bilateral vision impairment in Indigenous Australians
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
38.2%
33.8%
4.4%
14.7%
4.4%
4.4%
Uncorrected refractive error
Cataract
AMD
Diabetic retinopathy
Glaucoma
Other

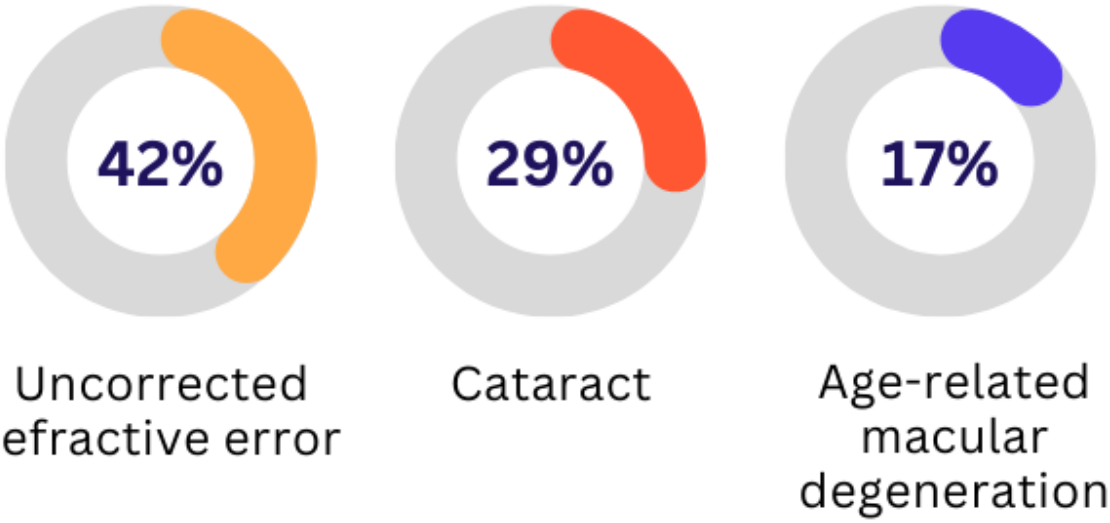

Causes of bilateral vision impairment in Non-Indigenous Australians
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
41.6%
29.2%
16.8%
3.2%
3.8%
5.4%
Uncorrected refractive error
Cataract
AMD
Diabetic retinopathy
Glaucoma
Other

Indigenous Australians aged 50+



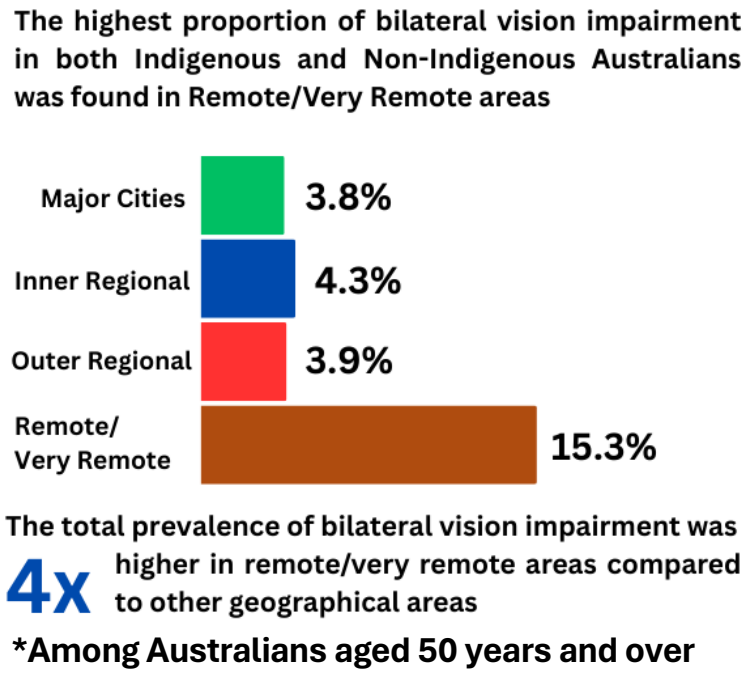
The leading causes of bilateral vision impairment in Indigenous Australians were: (1) uncorrected refractive error, (2) cataract and (3) diabetic retinopathy

Non-Indigenous Australians aged 50+

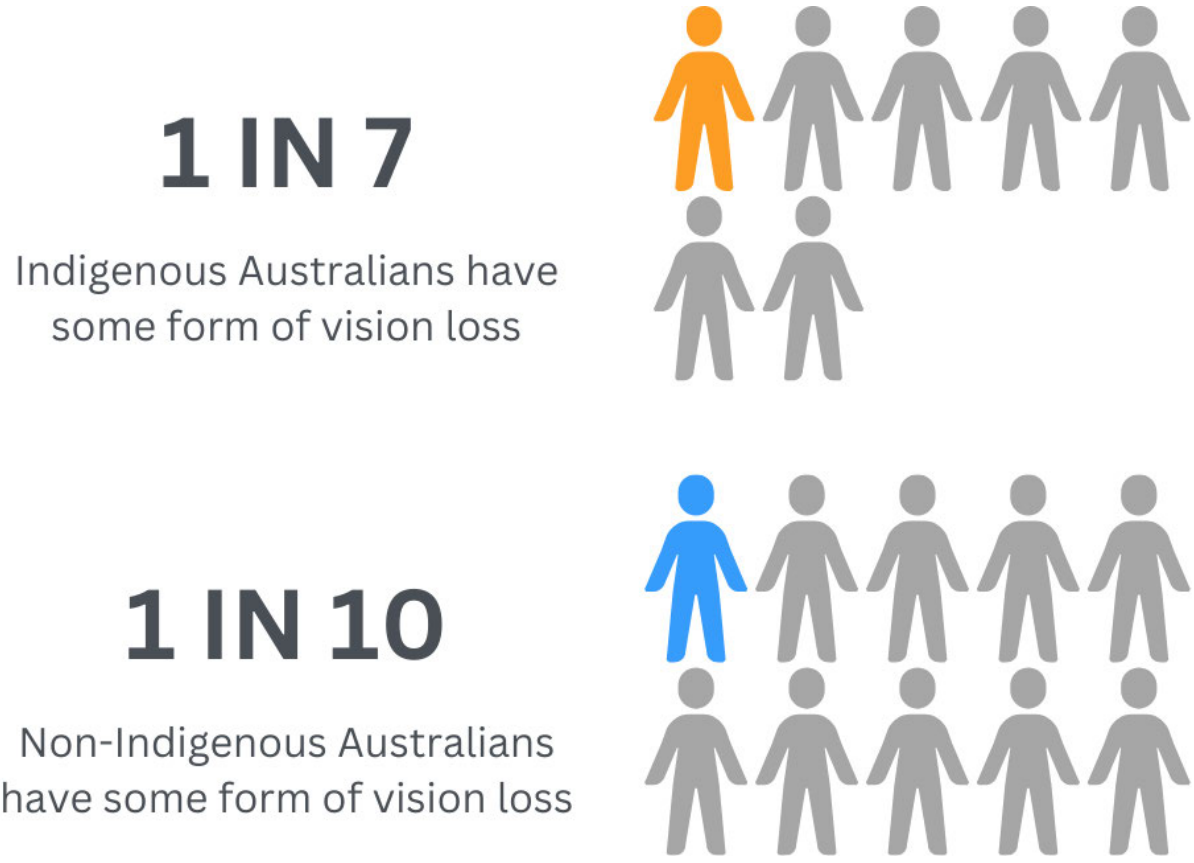


The leading causes of bilateral vision impairment in Non-Indigenous Australians were: (1) uncorrected refractive error, (2) cataract and (3) age-related macular degeneration

- Compared with data from the NEHS,[1,2] there was a considerable reduction in the proportion of bilateral vision impairment in both Indigenous and non-Indigenous Australians attributable to uncorrected refractive error, from 63.4% and 61.7% respectively, in NEHS, down to 38.2% and 41.6% respectively, in AEEHS. There was a corresponding increase in the proportion of bilateral vision impairment attributable to cataract, AMD, diabetic retinopathy and glaucoma in both Indigenous and non-Indigenous Australians.
- Most bilateral vision impairment/ blindness in both Indigenous and non-Indigenous Australians was found in Remote/Very Remote geographical settings (age-standardised prevalence 15.8% and 11.4% respectively), while the lowest rates were found in Outer Regional areas for Indigenous Australians (6.3%), and in Inner Regional areas for non-Indigenous Australians (1.8%). For the total sample, the prevalence of bilateral vision impairment in Remote/Very Remote geographical settings (age-standardised prevalence 15.3%) was approximately 4 times greater than in all other geographical areas.



- The age-standardised prevalence of unilateral vision impairment and blindness was 6.7% and 1.1% in Indigenous Australians and 4.9% and 1.5% in non-Indigenous Australians, respectively. These rates of unilateral vision impairment and blindness were similar among both Indigenous and non-Indigenous Australians.
- The total prevalence of any vision loss (bilateral or unilateral vision impairment or blindness) was 14.5% among Indigenous, 10.3% among non-Indigenous, and 9.8% overall for all Australians aged 50 years and over. This points to the considerable impact of vision impairment in the Australian population, with 1 in 7 Indigenous and 1 in 10 non-Indigenous older Australians affected and requiring some sort of vision remedial therapy.



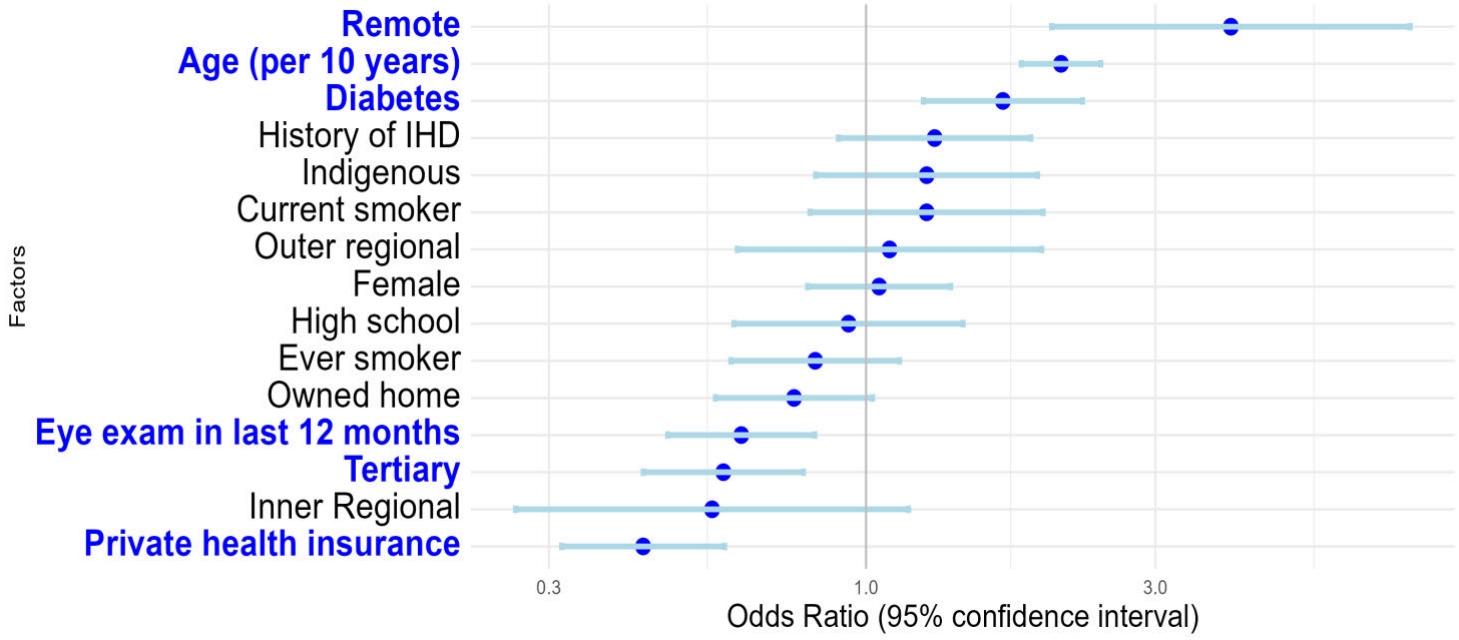
***Among Indigenous and non-Indigenous Australians aged 50 years and over**

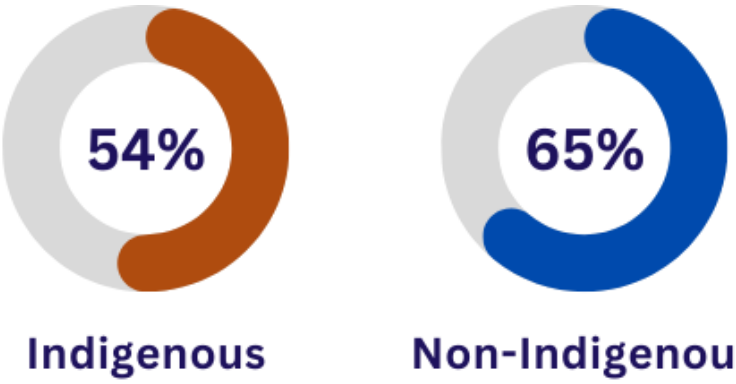
- The cataract surgery coverage rate was 87.6% among Indigenous and 95.8% in non-Indigenous Australians. This represents a considerable improvement in cataract surgery coverage for both groups since the NEHS[1-3] (61.5% for Indigenous and 87.6% for non-Indigenous Australians, respectively), as well as a substantial closing of the cataract surgery coverage gap between the two groups from 26.1% in NEHS to 8.2% in AEEHS. Similarly, there has been an improvement in refractive error coverage in both Indigenous (83.3% to 90.3%) and non-Indigenous (93.7% to 96.8%) Australians,[4] which may help explain the reduction in vision impairment and changes in the relative importance of uncorrected refractive error.
- The total effective cataract surgery coverage rate was 85.3%. The effective cataract surgery coverage rate was greater for non-Indigenous (87.4%) compared to Indigenous participants (70.5%). The total effective refractive error coverage rate was 94.4%. The effective refractive error coverage rate was greater for non-Indigenous participants (95.2%) compared to Indigenous participants (87.0%).
- The National Health and Medical Research Council (NHMRC) recommends that Indigenous persons with diabetes have an eye examination each year, and for non-Indigenous persons, every 2 years.[5] In the AEEHS, 54% of Indigenous participants complied with this recommendation, compared with 65% of non-Indigenous participants. These rates are slightly lower than those found in the NEHS[6] (64% for Indigenous, 78% for non-Indigenous), and may partly reflect the effect of the COVID-19 pandemic, which prevented and delayed in-person health screening.
- **In multivariable regression analyses, living in remote or very remote settings, increasing age, and presence of diabetes were identified as factors increasing the likelihood of bilateral vision impairment or blindness. Remoteness was the**

strongest risk factor. Having an eye examination in the last year, higher education level and private health insurance were associated with a lower likelihood of bilateral vision impairment or blindness. Such "protective" factors suggest likely benefit from earlier diagnosis and treatment for eye conditions. Many such factors are modifiable, suggesting areas where health promotion initiatives could be better targeted.

- **After adjusting for these factors, risk of vision loss associated with Indigenous status attenuated considerably, suggesting that a component of the increased risk for bilateral vision impairment or blindness among Indigenous participants in the AEEHS could be explained by their remoteness, their greater diabetes prevalence and socio-economic disadvantage. Addressing these factors could contribute significantly to closing the gap.**

Multivariable adjusted risk factors for bilateral vision impairment or blindness, in all participants. Factors with odds ratios and 95% confidence intervals that are fully over 1.0 are associated with an increased risk, while those fully below 1.0 are associated with a reduced risk; those that include 1.0 are not significant.



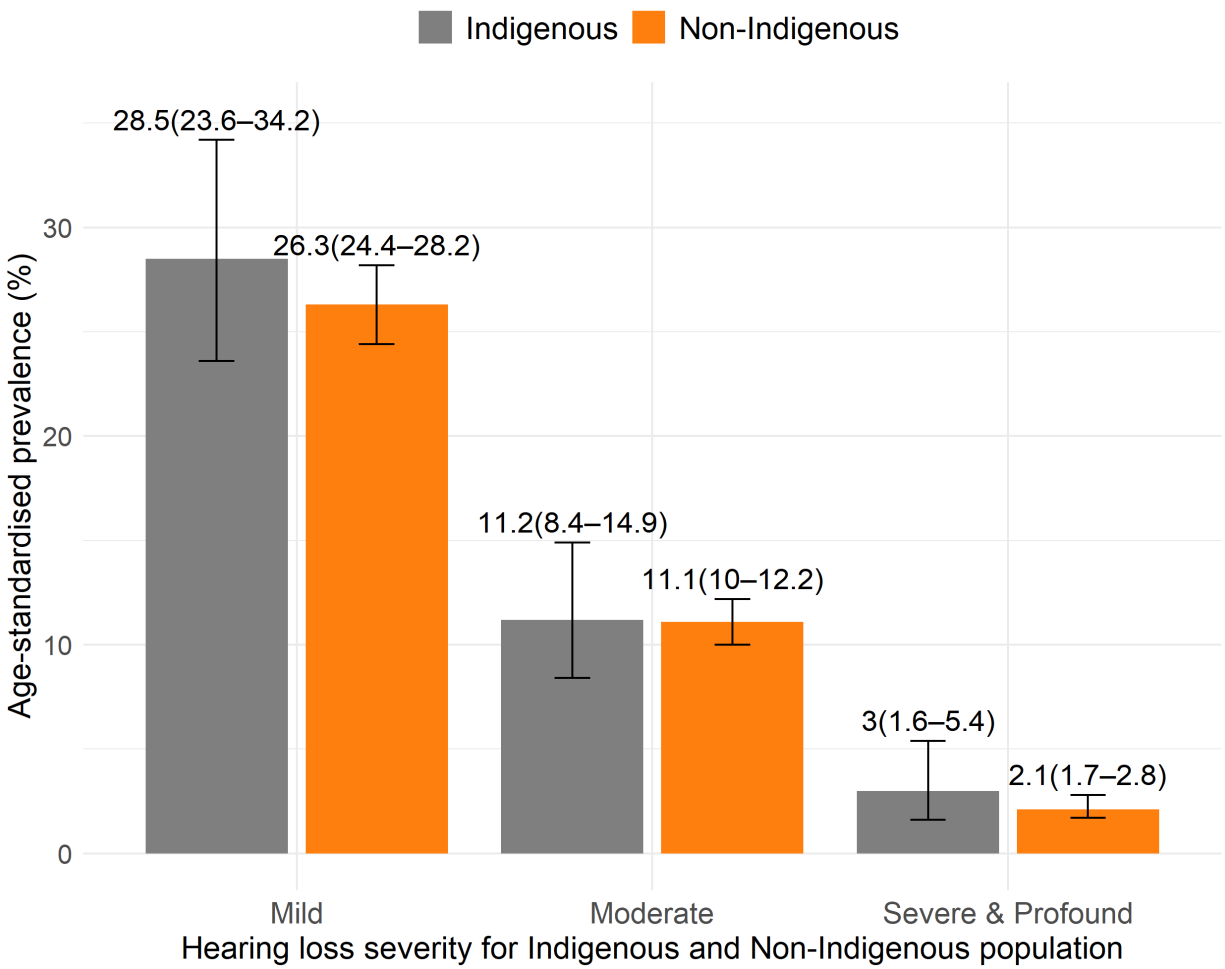


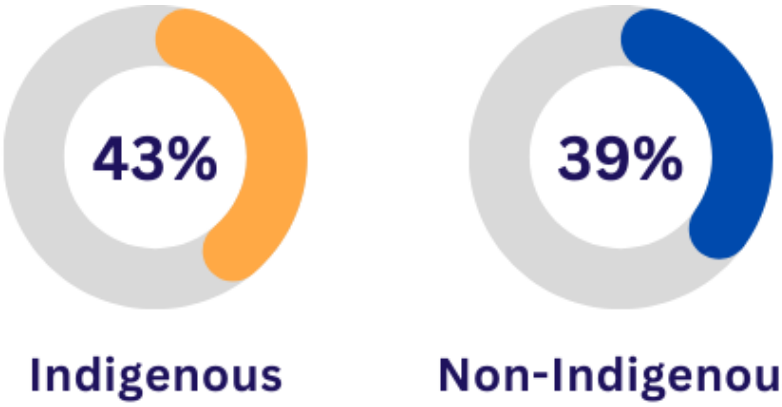
54% of Indigenous participants and 65% of Non-Indigenous participants complied with the NHMRC recommendations for eye examinations (every year for Indigenous; every 2 years for non-Indigenous)

***Among Australians aged 50 years and over**

Ear Health Findings

- Most individuals with hearing impairment had mild (n = 1137) or moderate (n = 563) impairment in the better ear. However, a smaller proportion (n = 107) had severe to profound (>60 dB HL) hearing impairment, highlighting that hearing loss in the community spans a wide severity spectrum and that a one-size-fits-all approach is likely inadequate. The diverse range of hearing impairment severity necessitates individualised treatment pathways, educational resources, and support systems tailored to the degree of loss and its functional impact.
- The crude prevalence of any bilateral hearing impairment (hearing impairment >25 dB HL in the better ear, over a 4-frequency average) in the AEEHS was 50.6% and was similar among Indigenous (49.0%) and non-Indigenous (50.8%) Australians. After age-standardisation to the Australian population (2021), the age-standardised prevalence of any bilateral hearing impairment decreased to 42.8% for Indigenous participants and decreased to 39.4% for non-Indigenous participants (p = 0.337), suggesting a similar age-standardised prevalence of bilateral hearing impairment among Indigenous and non-Indigenous participants.
- When stratified by the level of hearing impairment as determined by the 4-frequency average of the better ear, 28.5% of Indigenous participants had mild (>25 to 40 dB HL) bilateral hearing impairment, 11.2% had moderate (41 to 60 dB HL) bilateral hearing impairment, and 3.0% had severe or profound (>60 dB HL) bilateral hearing impairment. By comparison, among non-Indigenous participants, 26.3% had mild, 11.1% moderate, and 2.1% had severe bilateral hearing impairment. These rates do not differ statistically.



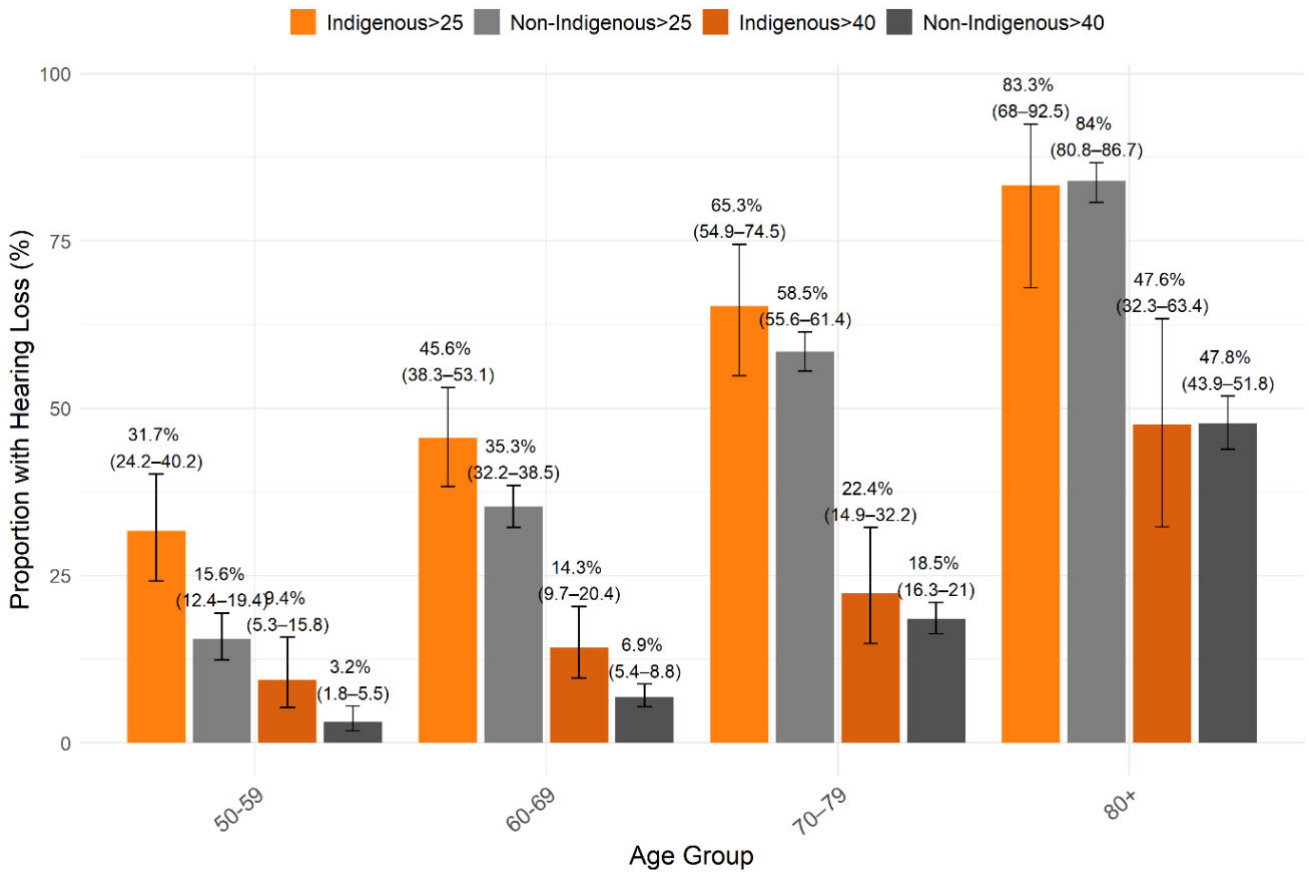


Around 40% of Australians have some form of bilateral hearing impairment. The age-standardised prevalence of all levels of hearing loss was similar among Indigenous and non-Indigenous Australians.

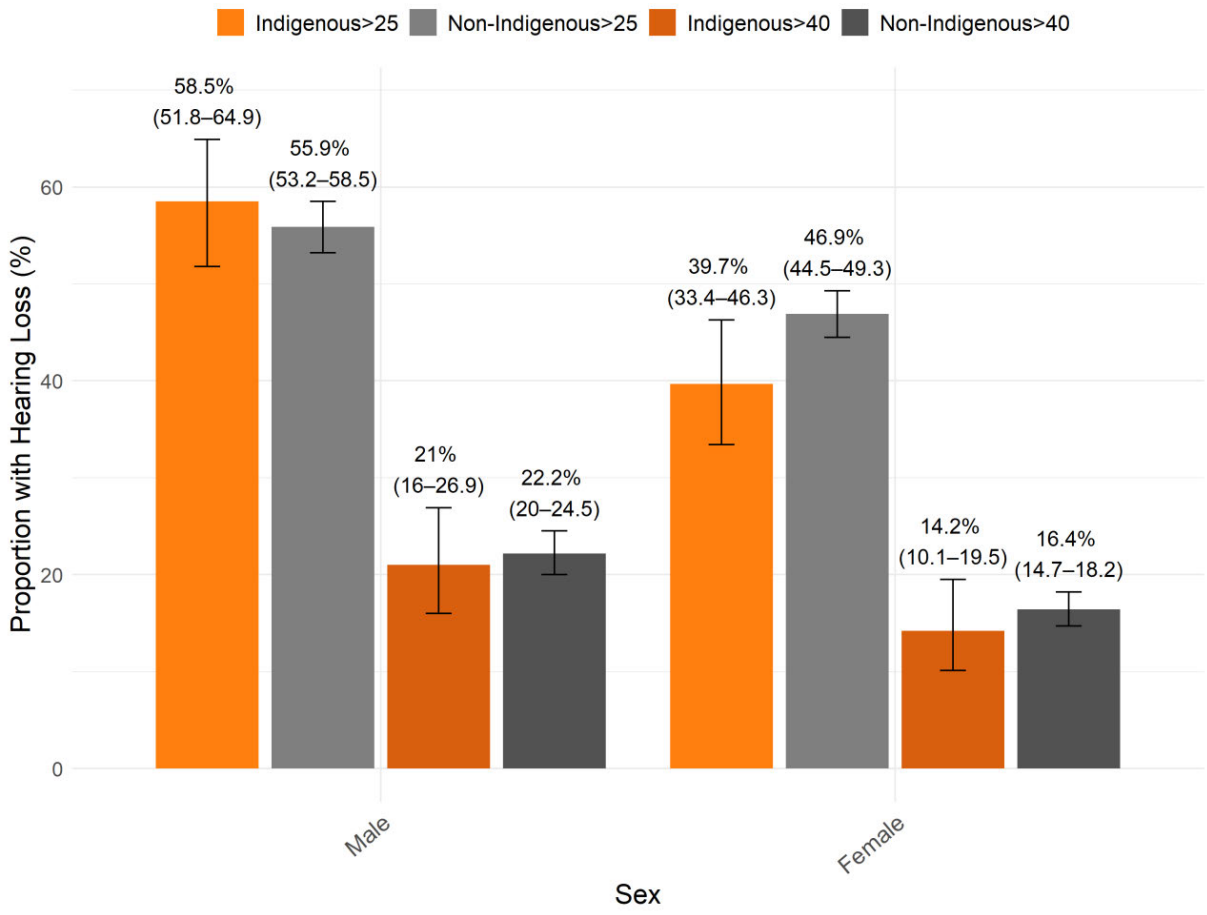
***Among Indigenous and non-Indigenous Australians aged 50 years and over**

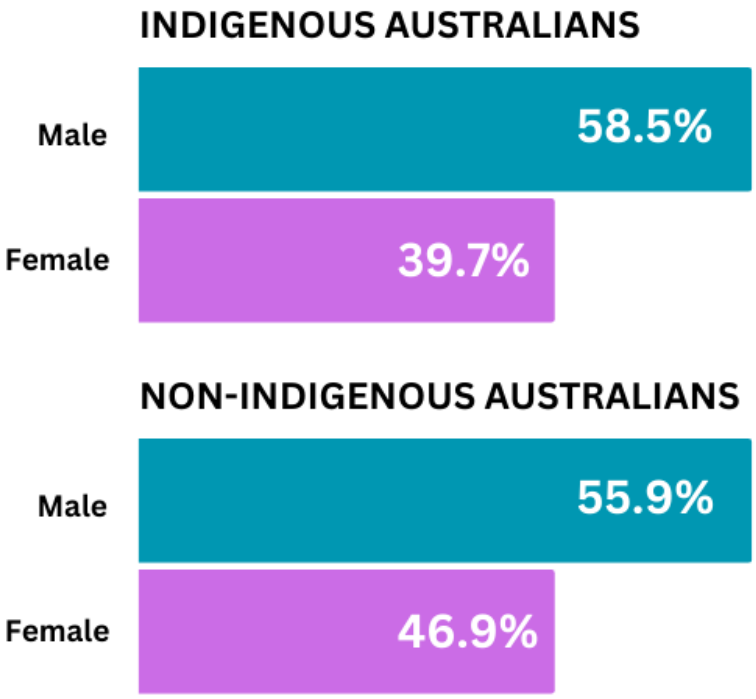
- The age-standardised prevalence of moderate or worse bilateral hearing impairment was only marginally greater among Indigenous participants (14.3%) than in non-Indigenous participants (13.2%), in persons aged 50 years or older, overall, 14.2%. This difference was not significant. Around 1 in 7 older Australians have moderate or worse bilateral hearing impairment, a level likely to reflect frequent hearing disability.
- The prevalence of bilateral hearing impairment was highly age-dependent, with the highest rates in older Australians. Among Indigenous Australians, the prevalence of any (>25 dB HL) bilateral hearing impairment increased substantially ($p<0.0001$) from 31.7% in those aged 50-59 years, to 45.6% (60-69 years), 65.3% (70-79 years) and 83.3% (80+ years). Among non-Indigenous Australians, the prevalence of any bilateral hearing impairment also increased exponentially ($p<0.0001$) from 15.6% in those aged 50-59 years, to 35.3% (60-69 years), 58.5% (70-79 years) and 84.0% (80+ years). The prevalence of bilateral hearing impairment was higher by 12%-100% among Indigenous participants compared with non-Indigenous participants in every age group except those aged 80+ years, where the prevalence was similar.
- The prevalence of any bilateral hearing impairment was considerably higher in males than females, for both Indigenous (58.5% vs 39.7%) and non-Indigenous participants (55.9% vs 46.9%).
- The prevalence of combined moderate, severe and profound hearing impairment (**>**40 dB HL in the better ear), among younger Indigenous participants was 3x higher than in similarly aged non-Indigenous participants (9.4% vs 3.2% among those aged 50-59 years). This difference narrowed to 2x higher in the next older age group (14.3% vs 6.9% for those aged 60-69 years) and continued to narrow to 20% higher in those aged 70-79 years (22.4% vs 18.5%) but was similar in the oldest age group (47.6% vs 47.8%

in those aged 80+). This finding suggests that there may be factors that disproportionately affect younger Indigenous Australians that lead to early moderate to severe hearing impairment.



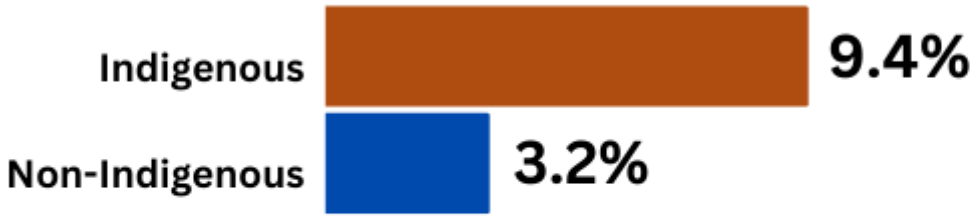
In every age group except those 80+ years, the prevalence of bilateral hearing loss was higher among Indigenous, compared with non-Indigenous Australians.



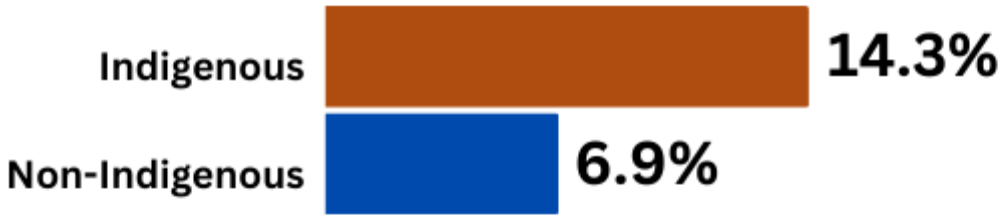


The prevalence of any bilateral hearing impairment was higher in males than in females, in both Indigenous and non-Indigenous Australians aged 50 years and older

50-59 YEAR OLD AUSTRALIANS



60-69 YEAR OLD AUSTRALIANS

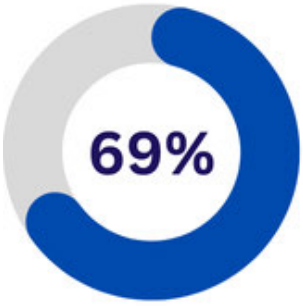


70-79 YEAR OLD AUSTRALIANS

80+ YEAR OLD AUSTRALIANS

The prevalence of combined moderate, severe and profound hearing impairment disproportionately affects younger Indigenous Australians compared to non-Indigenous Australians

- Despite frequent hearing impairment, the uptake of hearing devices remains relatively low, including by many who were clinically eligible for them. Only 69% of persons with moderate or worse bilateral hearing impairment had used a hearing aid. This suggests a potential gap between clinical need and device use, including among those who met the Australian criteria for subsidised hearing aid eligibility as outlined in the Australian Government Hearing Services Program (n=2288, 64% of total participants). This likely gap between need and use highlights a major issue of unaddressed hearing loss in the Australian population. Our findings underscore a need for targeted strategies to overcome barriers to access, affordability, and long-term hearing device use, as well as ensuring that hearing interventions reach those who stand to benefit most.



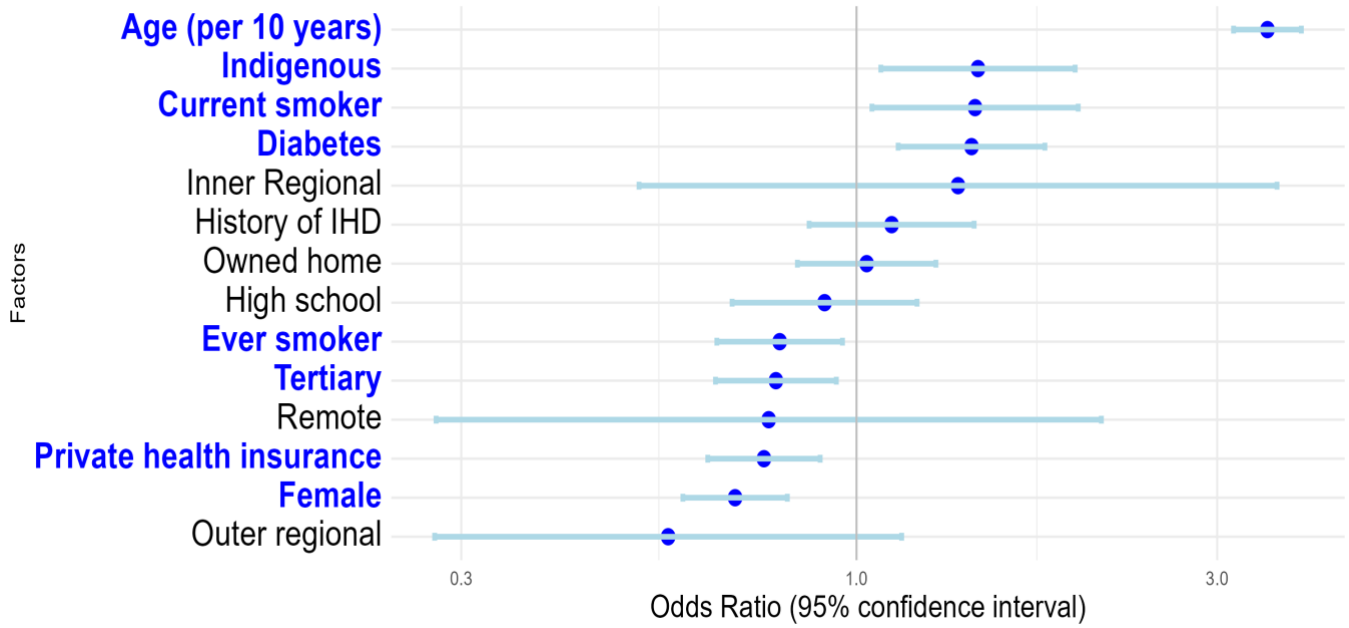
69% of Australians with moderate or worse bilateral hearing impairment used a hearing aid

***Among Australians aged 50 years and over**

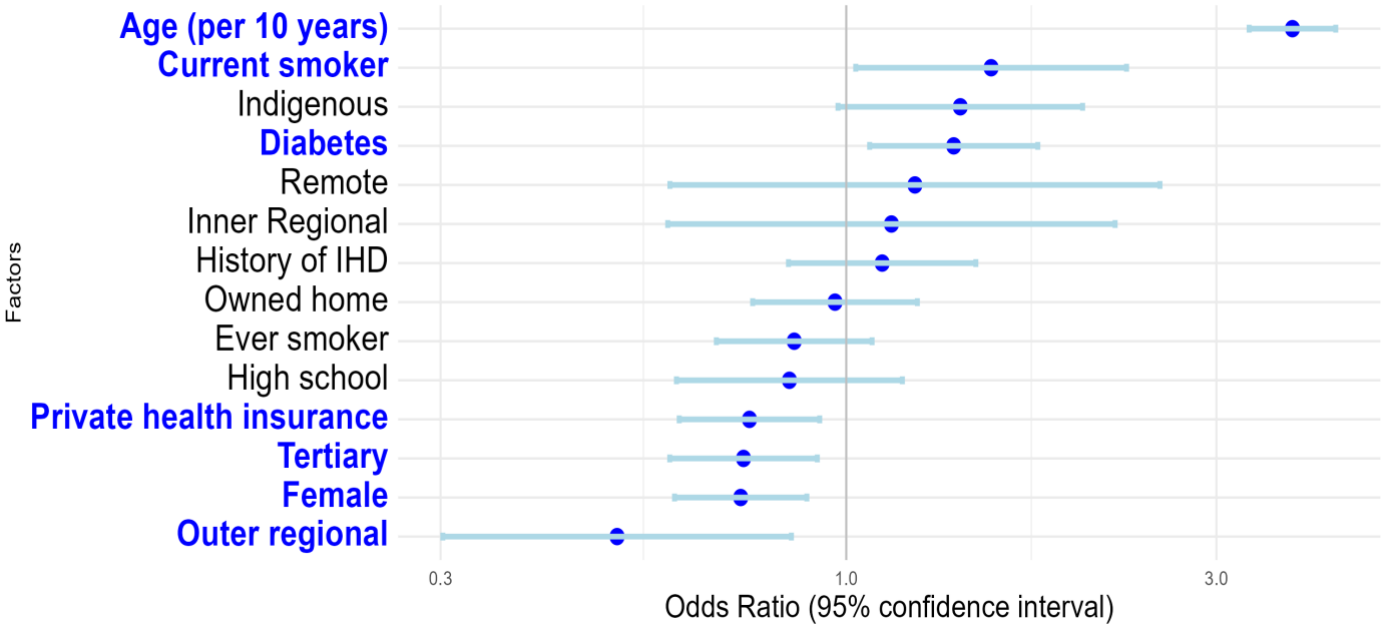
- The crude prevalence of hearing aid usage was 14.1% in Indigenous participants and 17.3% in non-Indigenous participants. After age-standardisation, the prevalence reduced and was relatively similar among Indigenous (11.3%) and non-Indigenous (11.9%) participants. 0.2% of participants reported using a cochlear implant.
- Self-reported hearing impairment was reasonably strongly associated with measured impairment, with around 80% of those with moderate or worse impairment reporting hearing difficulty. Indigenous participants, however, were more likely to report

problems with their hearing for more than 10 years and were less likely to have spoken to a professional about their hearing loss. This suggests the need for improved education in Indigenous communities about the benefits of hearing assessment.

Multivariable adjusted risk factors for any hearing loss (>25 dBHL, better ear), in all participants. Factors with odds ratios and 95% confidence intervals that are fully over 1.0 are associated with an increased risk, while those fully below 1.0 are associated with a reduced risk; those that include 1.0 are not significant.

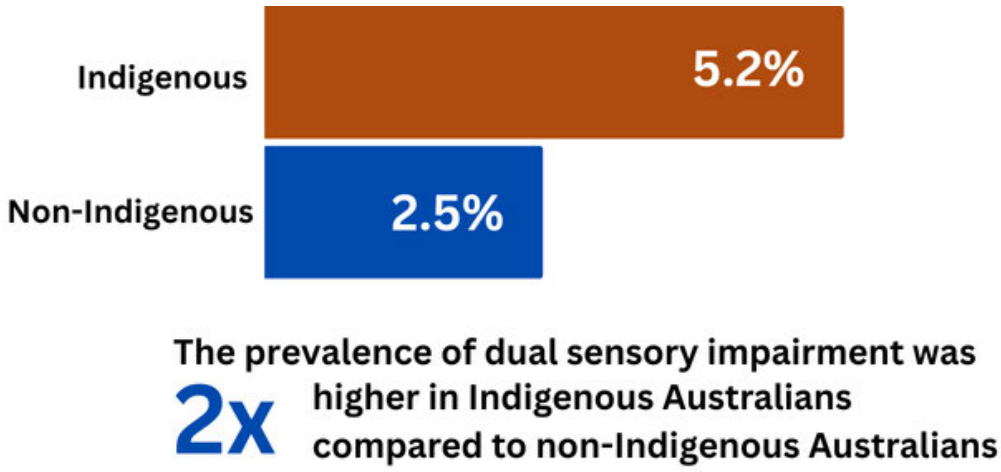


Multivariable adjusted risk factors for moderate or worse hearing loss (>40 dBHL, better ear), in all participants. Factors with odds ratios and 95% confidence intervals that are fully over 1.0 are associated with an increased risk, while those fully below 1.0 are associated with a reduced risk; those that include 1.0 are not significant.



- In multivariable regression analyses, **increasing age, current smoking and presence of diabetes were associated with increased risk of any and moderate to severe hearing impairment**, while **higher education level, having private health insurance and female sex were associated with reduced risk of hearing impairment**. After adjusting for these risk factors, the greater risk of moderate to severe hearing impairment associated with Indigenous status attenuated to an extent, suggesting addressing these factors could contribute to closing the gap. **For the multivariable model of any hearing impairment, Indigenous status remained a significant risk factor.**

- Dual sensory impairment (both vision and hearing impairment) had an overall age-standardised prevalence of 2.5% for any hearing impairment, and 1.3% for moderate or worse hearing impairment. Dual sensory impairment was strongly age-related and significantly more frequent among Indigenous (5.2%) than non-Indigenous participants (2.8%) for any hearing impairment ($p<0.047$) after age standardisation, but the relationship was weaker for moderate or worse hearing impairment, likely due to smaller numbers. However, it was significant for Indigenous participants in their 50s and 60s for both levels of hearing impairment.



***Among Australians aged 50 years and over**

Introduction

Vision and hearing impairment are frequent among older adults and have far-reaching physical, mental and societal impacts on individuals.[7-17] The prevalence of both vision and hearing impairment increases exponentially with age. According to estimates from the Global Burden of Disease study in 2020, there were 596 million people living with vision impairment worldwide, of whom 43 million were blind.[18]

In Australia, there are an estimated 840,000 individuals estimated to be living with vision impairment or blindness, and this number is expected to exceed 1.04 million by 2030 due to the rapid surge in the ageing population and prevalence of diabetes.[19] The economic impact of vision loss in Australia has been reported as $27.6 billion per year.[19] Some 90% of vision loss may potentially be prevented or treated with existing cost-effective interventions such as spectacles for refractive error, cataract surgery and intraocular lens implantation for replacement of lens opacities in persons with cataract, anti-VEGF therapy for diabetic retinopathy and neovascular age-related macular degeneration (AMD), and modern topical and surgical treatments for glacuoma.[20]

Current estimates suggest that more than 3.6 million Australians experience some degree of hearing impairment, with projections indicating that this number will rise to 7.8 million by 2060.[21] Further, within Aboriginal and Torres Strait Islander communities, the burden of hearing impairment and ear disease has been estimated to be higher than that of non-Indigenous Australians.[22] It is well documented that hearing impairment is a chronic condition that has a multifaceted impact on an individual's health and well-being.[23] These include diminished quality of life, increased risk of mental health issues,

mortality and social isolation.[8,12,24-26] The economic repercussions are equally large with hearing impairment costing the Australian economy $33.3 billion annually.[27] Importantly, studies indicate that approximately 37% of hearing impairment may be preventable, highlighting the role of early diagnosis, risk factor awareness, and timely intervention.[28] Hence, accurate age- and sex-specific data for vision and hearing impairment over time are necessary.

As a response to the 74th World Health Assembly's (WHA) call to eradicate avoidable blindness, the Australian Government has worked closely with the WHA on the development of global targets to monitor the implementation of cost-effective interventions such as effective refractive error (eREC) and cataract surgery coverage (eCSC) rates.[29] For example, a global target was set for countries with a higher baseline eREC (≥70%) and eCSC (≥60%), such as Australia, to strive for universal coverage by 2030.[29] Thus, the findings of the AEEHS will contribute to Australia's commitment to eradicate avoidable vision impairment and blindness in fulfilment of the United Nations' General Assembly resolution - *Vision for Everyone – Accelerating Action to Achieve the Sustainable Development Goals;* and *Integrated people-centred eye care, including preventable vision impairment and blindness,* adopted by World Health Organisation Member States.[30]

The National Health Survey (NHS) is conducted periodically by the Australian Bureau of Statistics and helps to ascertain the number of Australians living with eye conditions. According to the 2017-2018 NHS, over 13 million Australians (55%) had one or more chronic eye conditions, and 93% of people aged 65 and over were affected by a chronic eye condition.[31] However, these surveys are based entirely on self-report, which may be

an unreliable measure of eye disease due to the high risk of recall bias.[32] Hence, population-based studies are preferred for measuring the prevalence of sensory (vision and hearing) impairment and eye and ear disease because participants undergo standardised clinical examinations and objective imaging.

Four major population-based prevalence studies on vision impairment and blindness have been conducted previously in Australia. These include the Blue Mountains Eye Study (BMES), Melbourne Visual Impairment Project (MVIP), National Indigenous Eye Health Survey (NIEHS) and the National Eye Health Survey (NEHS).[1,33-35]

The BMES examined 3654 participants aged 49 years and older from two adjoining urban postcode areas in Sydney's west in 1992-4. The prevalence of bilateral vision impairment measured using best-corrected visual acuity (BCVA) in the BMES was 4.7%, with 3.4%, 0.6% and 0.7% of the cohort having mild, moderate and severe bilateral vision impairment, respectively.[33] Uncorrected refractive error was present in 10.4% of study participants.[36] Of those with vision impairment not caused by refractive error, the most frequent causes were cataract (60%), followed by AMD (29%).[33]

The MVIP examined 5147 participants aged 40 years and older from nine urban sites in Melbourne, four rural sites and 14 nursing homes in Victoria in 1992-6. The prevalence of bilateral vision impairment using presenting visual acuity (PVA) in the MVIP was 7.1% in the total study population.[37] In the group of 4744 participants who were not recruited from nursing homes, the prevalence of bilateral vision impairment was 4.3%.[35] The most frequent causes of bilateral vision impairment in the study were uncorrected refractive error, followed by AMD, other retinal diseases, cataract and glaucoma.[35]

The findings of these two major studies were combined to estimate the prevalence and causes of bilateral vision impairment in Australia. In 2004, it was estimated that 480,300 Australians had bilateral vision impairment, including 50,600 Australians with blindness. The most frequent causes of bilateral vision impairment were uncorrected refractive error (62%), cataract (14%) and AMD (10%). AMD was the most frequent cause of bilateral blindness, accounting for almost half of all participants with blindness.

Although the BMES and MVIP were landmark studies that provided valuable insights into the prevalence and risk factors for bilateral vision impairment and blindness in Australia, the data were collected over 25 years ago. The geographic distribution of the study cohorts in these two studies was also limited to relatively small areas within their respective states. Additionally, there was no specific data or specifically targeted recruitment for Indigenous Australians, who were considered at greater risk of having bilateral vision impairment compared with non-Indigenous Australians. Hence, the estimates and projections drawn using this data may not be applicable to the Australian population in the contemporary era.

The NIEHS was conducted in 2008 and focused on the prevalence and causes of vision impairment in Indigenous Australians. The study recruited 1,694 Indigenous children aged 5 to 15 years and 1,189 Indigenous adults aged 40 years and older from 30 random communities across Australia. In the group of Indigenous adults, the age-standardised prevalence rates for bilateral vision impairment and blindness were 8.6% and 1.8%, respectively.[34] Although the NIEHS provided valuable information about the status of Indigenous eye health, it did not assess the prevalence of bilateral vision impairment and blindness among non-Indigenous populations. Furthermore, the implementation of

targeted health interventions for Indigenous people since the study was conducted in 2008 means that the current prevalence of bilateral vision impairment and blindness in the Indigenous population could likely now be different.

The NEHS was conducted in 2016 and examined a total of 3,098 non-Indigenous Australians aged 50 years and older, and 1,738 Indigenous Australians aged 40 years and older, from 30 randomly selected sites across Australia, a total sample of 4,836 older adults.[1,2] The overall prevalence of vision impairment in Australia derived from this study and measured using presenting visual acuity (VA) was 6.6%.[1] The age-standardised prevalence of bilateral vision impairment among Indigenous Australians (13.6%) was almost threefold higher than the prevalence of bilateral vision impairment among non-Indigenous Australians (4.6%).[1] The most frequent cause of bilateral vision impairment was uncorrected refractive error, followed by cataract, AMD and then diabetic retinopathy.[1] Using data from this study, it was estimated that in 2017, 432,800 non-Indigenous Australians aged 50 years or older and 18,300 Indigenous Australians aged 40 years or older were living with bilateral vision impairment.[1] The cataract surgery coverage rate was 87.6% in non-Indigenous Australians and 61.5% in Indigenous Australians.[3] Meanwhile, the refractive error coverage rate was 83.3% in non-Indigenous Australians and 93.7% in non-Indigenous Australians.[4] Thus, the NEHS provided a much-needed update on the contemporary prevalence and causes of vision impairment in Australia since the BMES, MVIP and NIEHS.

In the period since the completion of the first NEHS, there has been further ageing of the Australian population, with a likely increase in prevalence of age-related eye diseases, as well as increasing prevalence of diabetes, with a consequently likely increase in

diabetic retinopathy. However, there has also been an increased emphasis on closing the gap in Indigenous eye care, with initiatives to improve eye examination rates and cataract surgery coverage.

As such, follow-up studies to establish the current prevalence of bilateral vision impairment, blindness and eye diseases among both Indigenous and non-Indigenous Australians are needed. The Department of Health and Vision 2020 Australia advocated for the completion of a second national population-based eye health survey to obtain data on the contemporary eye health of the nation. The collection of high-quality national data at two different time points would allow for the projection of trends in bilateral vision impairment, blindness and major eye disease in Australia. This would also strengthen Australia's eye health and vision care evidence base, facilitating the guidance of future healthcare resource allocation, policy development and economic analysis for effective eyecare service delivery in Australia.

Hearing impairment is another pervasive sensory organ impairment that increases markedly with age.[38] Despite the major health and functional implications of hearing loss, [8,12,25,26] data on the prevalence of hearing loss in Australia remain limited, with only the Blue Mountains Hearing Study (BMHS)[13,26,39,40] having reported these data to date. The BMHS was conducted from 1997-2000, recruited 2956 non-Indigenous adults aged 55 years and over, and reported prevalence rates of bilateral hearing impairment of 39.1%, 13.4% and 2.2% for mild, moderate and severe to profound bilateral hearing impairment, respectively. Thus far, Australia has never conducted a nationwide study dedicated to assessing ear health and hearing status. This lack of data underscores the need to

determine the contemporary prevalence, risk factors, and broader consequences or impacts of hearing impairment in Australia.

These initiatives led to the Australian Eye and Ear Health Survey, with a focus on evaluating both eye and ear health in a representative sample of contemporary Australia, which included sites in all Australian states and Territories.

This survey aimed to fulfil several of the key priorities and actions outlined in the Hearing Health Sector Committee's Roadmap for Hearing Health, particularly the second, third and fourth domains.[41] The actions in these domains consist of identifying and preventing hearing loss, as well as closing the gap for Aboriginal and Torres Strait Islander ear and hearing health.[41] By collecting comprehensive data on the prevalence, risk factors, and impacts of hearing impairment across diverse Australian populations, the survey will enhance the evidence base, identify at-risk populations, inform prevention and awareness strategies and support hearing service delivery improvements.

The survey also aimed to address issues raised during the NEHS, such as the relatively low proportion of gradable retinal images obtained through undilated pupils, which were considered to have potentially affected the ability to detect retinal disease, cataract, and other pathology. To address this, the AEEHS was designed to include routine pupil dilation with mydriatics (when no contraindication was present) and incorporated newer imaging technology such as ultrawide-field retinal photography, fundus auto-fluorescence imaging, together with optical coherence tomography (OCT) of the maculae, optic discs and posterior retina, and OCT angiography. Automated threshold

perimetry (using the 24-2 SITA Faster protocol), measurement of intraocular pressure, auto-refraction, subjective refraction, axial length measurement, and detailed mainstream slit-lamp biomicroscopy were performed or attempted in all participants. In addition, a comprehensive hearing test using pure tone audiometry and a video-otoscopic ear examination was performed following the eye examinations.

This resulted in substantially longer examination times per participant, contributing to the substantially longer recruitment period, but has resulted positively in very high proportions of gradable retinal and optic disc images with greater sensitivity to detect eye pathology, together with modern imaging approaches, plus new detailed hearing data on the Australian population.

Objectives of the AEEHS

1. To determine the age-standardised prevalence and causes of vision impairment and blindness among Indigenous and non-Indigenous Australians aged 50 years and older, by age, sex and geographical area, including remoteness.
2. To measure the detection and treatment coverage rate of major eye diseases and conditions leading to vision impairment, including uncorrected refractive error, cataract, diabetic retinopathy, AMD and glaucoma, among both Indigenous and non-Indigenous Australian adults by:
    a. Assessment of the proportion of Australians with diagnosed and undiagnosed major eye diseases,

b. Assessment of the proportion of Australians with known diabetes who adhere to the recommended retinal examination timeframes set by the National Health and Medical Research Council (NHMRC) – once every two years for non-Indigenous Australians and once per year for Indigenous Australians
c. Estimation of effective refractive error coverage (eREC) and effective cataract surgery coverage (eCSC) rates, as per the WHO Framework on integrated people-centred eye care

3. To determine the age-standardised prevalence and potential causes of hearing impairment among Indigenous and non-Indigenous Australians aged 50 years and older, by age, sex and geographical area, including remoteness.
4. To evaluate the various impacts of vision impairment/eye disease and hearing impairment/ear disease on important health and societal outcomes.

Survey Protocol

The AEEHS was a nationwide cross-sectional study conducted from August 2022 to July 2025. Stratified multi-stage random cluster sampling was used to select 30 geographical target sites in Australia to provide a representative target population of Indigenous and non-Indigenous Australians aged 50 years and older. Recruitment of participants was performed using doorknocking as the primary method, with adjustments as required to adapt to local circumstances within diverse Indigenous communities.

The testing protocol consisted of a comprehensive vision and hearing assessment, including eye and ear imaging, general questionnaire, anthropometry and an optional take-home questionnaire.[42] Participants were provided with verbal feedback and a report

of their results, along with refreshments and a pair of sunglasses and/or reading glasses upon completion of the survey. If abnormalities in vision or hearing were detected, participants were given a referral letter to provide to their local GP, optometrist, ophthalmologist and/or audiologist.

Ethical Approvals

The study protocol was approved by the Human Research Ethics Committee (HREC) of the University of Sydney (ID: 2020/818) and the Australian Institute of Aboriginal and Torres Strait Islander Studies (AIATSIS) HREC (ID: EO303-20211008). Additional state-based ethics approvals and letters of support were obtained from the NSW Aboriginal Health and Medical Research Council (AH&MRC), Aboriginal Health Council of Western Australia (AHCWA) and Queensland Aboriginal and Islander Health Council (QAIHC).
The AEEHS was conducted in accordance with the tenets of the Declaration of Helsinki, and informed consent was obtained from all participants.

Sampling methodology for the AEEHS

Selection of sites

Stratified Multi-Stage Random Cluster Sampling was used to select sites for the AEEHS. This sampling strategy utilised data from the 2021 Australian Bureau of Statistics (ABS) Census and aligned closely with the methods utilised in the NEHS. The ABS Census is based on Australian Statistical Geography Standards (ASGS), which divides all regions of Australia into Statistical Areas (SA) based on population and size of the geographical area. Statistical Area Level 2 (SA2) was used as the unit for random selection, as in the

NEHS. SA2s are defined as medium-sized general-purpose areas that represent a community that interacts together socially and economically. They are built from multiple Statistical Areas Level 1 (SA1s) and typically have a population of 3,000 to 25,000 individuals.

Stratification by geographic location (i.e. state and territory) was first conducted to ensure that the sample of 30 SA2 sites would be representative of the geographic distribution in which most Indigenous and non-Indigenous Australians lived. Sites were allocated to correspond to the population distributions within each of the States and Territories, i.e. more sites in more populated States and Territories. Back-up sites were randomly selected for each state to be utilised in circumstances in which the primary sites were unsuitable due to logistical or administrative reasons.

A second level of stratification was employed based on Indigenous status to ensure adequate sampling of Indigenous participants. This was necessary as fully random sampling would not result in adequate representation of Indigenous participants, who comprise 3.2% of the Australian population (2021). Each state and territory, therefore, had SA2 sites allocated to a high Indigenous proportion group and a low Indigenous proportion group. Sites were allocated to the high Indigenous proportion group if the SA2 proportion of Indigeneity was in the highest 20th percentile of that state. Conversely, sites were allocated to the low Indigenous group if the proportion of Indigenous people was below the 80th percentile of that state. As only one site had been allocated each for Tasmania and the Australian Capital Territory (ACT), no Indigenous population stratum was created for this State and Territory to ensure that each site had a non-zero chance of being selected (i.e. true random sampling).

Additional criteria were employed prior to random sampling to ensure potential sites were feasible and practical from a resource and accessibility standpoint. Sites with a higher proportion of adults aged over 80 years (>5%) were oversampled in the low Indigenous group to counterbalance the lower average age of the high Indigenous group. This and other approaches were also deliberately used to target a generally older Australian population, given the very strong age relationship with eye disease, vision and hearing impairment.

Within the higher Indigenous proportion group, selected sites required a minimum proportion of 25% Indigeneity to maximise the efficiency and likelihood of recruiting enough Indigenous adults within the allocated time frame of the study (with the exception of South Australia, where a 20% cut-off was used and Victoria, where no cut-off was employed given the naturally low proportions of Indigenous persons in that state). Remoteness Area was also considered for the SA2s to maximise representation and generalisability to the Australian population. Random sampling was performed after stratification along the criteria listed, resulting in 30 selected SA2 sites shown in **Table 1**.

Table 1. Allocation of SA2 Sites to State and Territory, by High and Low Indigenous Proportion groups

State	Allocation of SA2 sites	SA2 sites	
		Low Indigenous group	High Indigenous group*
New South Wales	12	• Malabar-La Perouse-Chifley • Padstow • Warilla • Toongabbie • Katoomba – Leura • Seven Hills • Wentworth Falls • Revesby • Greystanes	• Coonamble • Kempsey • Tamworth
Queensland	4	• Townsville • Redcliffe	• Mount Isa • Innisfail
Victoria	3	• East Bendigo – Kennington • Mornington • Clarinda - Oakleigh South	
Western Australia	4	• Rockingham • Albany • Bayonet Head	• Broome
South Australia	2	• Christies Beach	• Port Augusta
Northern Territory	3	• Parap • Jingili	• Katherine Region
Tasmania	1	• Montrose – Rosetta	
Australian Capital Territory	1	• Monash	
Total sites	30	30	

*Figures from ABS website: *2016 Census Aboriginal and/or Torres Strait Islander people QuickStats*

Selection of SA1 sites

Selection of SA1 sites in the high Indigenous group was guided by the opinion of the local elders in each respective SA2. For example, the selected SA1 sites for the Malabar - La Perouse – Chifley SA2 area were 1135033 and 1135015.

Selection of SA1 sites in the low Indigenous group was based on selecting one principal SA1 site using restricted random selection within the SA2, followed by selection of secondary SA1 sites that were contiguous to this principal site. The number of secondary sites selected varied according to the number needed to reach the average number of ~200 participants per SA2 site. The criteria for principal SA1 selection were selected to maximise recruitment and included:

1. SA1 population to be at least 100
2. SA1 proportion of adults aged over 65 years to be higher than the SA2 average
3. SA1 population density divided by the total number of households within that SA1 to be higher than the SA2 average

The final feasibility check for each site was against a set of pre-specified criteria that were not easily found in the census data. These included road access for the equipment van (i.e. need for sealed roads leading to the venue due to the presence of fragile imaging equipment), availability of venues that included at least 75sqm^2 for setup of equipment used for data collection and imaging, feasibility for doorknocking (maximum site area 40sqkm^2) and adequate and safe accommodation for the field team. If a site was deemed not feasible and therefore not used, the next site in the randomly ordered list was evaluated for feasibility and selected if it passed the checks above, until all sites were

finalised. The list was retained and used to select backup sites if it was discovered closer to arrival that setting up data collection in a particular site was not feasible.

Sites selected and sampled in the AEEHS

The final 30 sites that were selected and sampled in the AEEHS are listed in **Table 1**, with site-specific demographic data provided in **Table 2**. These sites covered every State and Territory, a range of Remoteness Areas and geographical areas, and the number of eligible Indigenous and non-Indigenous persons living within the Target site. The geographical distribution of the survey sites across the Australian continent is illustrated in **Figure 1,** with further details/maps of each individual SA2 provided in the **Appendix**.

Table 2. Sites visited in the Australian Eye and Ear Health Survey

Site Number	SA2 Name	State	RA	Area (sq/km)	Target IP	Target NP
1	Malabar-Chifley-La Perouse	NSW	1	11.83	225	8091
2	Toongabbie	NSW	1	7.48	45	7097
3	Seven Hills	NSW	1	11.20	60	6879
4	Kempsey	NSW	2	195	429	5037
5	Tamworth-North	NSW	2	76.04	207	4990
6	Katoomba-Leura	NSW	1	40.87	84	5745
7	Padstow	NSW	1	6.51	46	5902
8	Warilla	NSW	1	9.49	169	7680
9	Coonamble	NSW	4	12142	250	1153
10	Greystanes-Pemulwuy	NSW	1	11.85	55	7944
11	Wentworth Falls	NSW	1	21.04	18	2851
12	Revesby	NSW	1	5.09	27	5280
13	Garbutt-West End	QLD	3	17.05	134	1852
14	Innisfail	QLD	3	53.05	269	3154
15	Margate-Woody Point	QLD	1	4.28	78	4710

16	Mount Isa*	QLD	4/5	62.81	149	3230
17	Clarinda-Oakleigh South	VIC	1	6.32	15	4508
18	Mornington	VIC	1	21.09	34	10610
19	East Bendigo-Kennington	VIC	2	17.15	29	5420
20	Montrose-Rosetta	TAS	2	5.73	34	1948
21	Christies Beach	SA	1	7.22	38	3607
22	Port Augusta	SA	3	254	465	4031
23	Katherine Region*	NT	4/5	7417	404	1601
24	Parap	NT	3	1.10	30	580
25	Jingili	NT	3	1.32	37	451
26	Broome	WA	4	50.04	556	2518
27	Rockingham	WA	1	35.72	43	6264
28	Albany	WA	3	30.50	86	6082
29	Bayonet Head-Lower King	WA	3	24.87	15	1728
30	Monash	ACT	1	3.41	15	2190

RA = Remoteness Area, the remoteness classification derived from the 2016 Australian Statistical Geography Standard (ASGS).

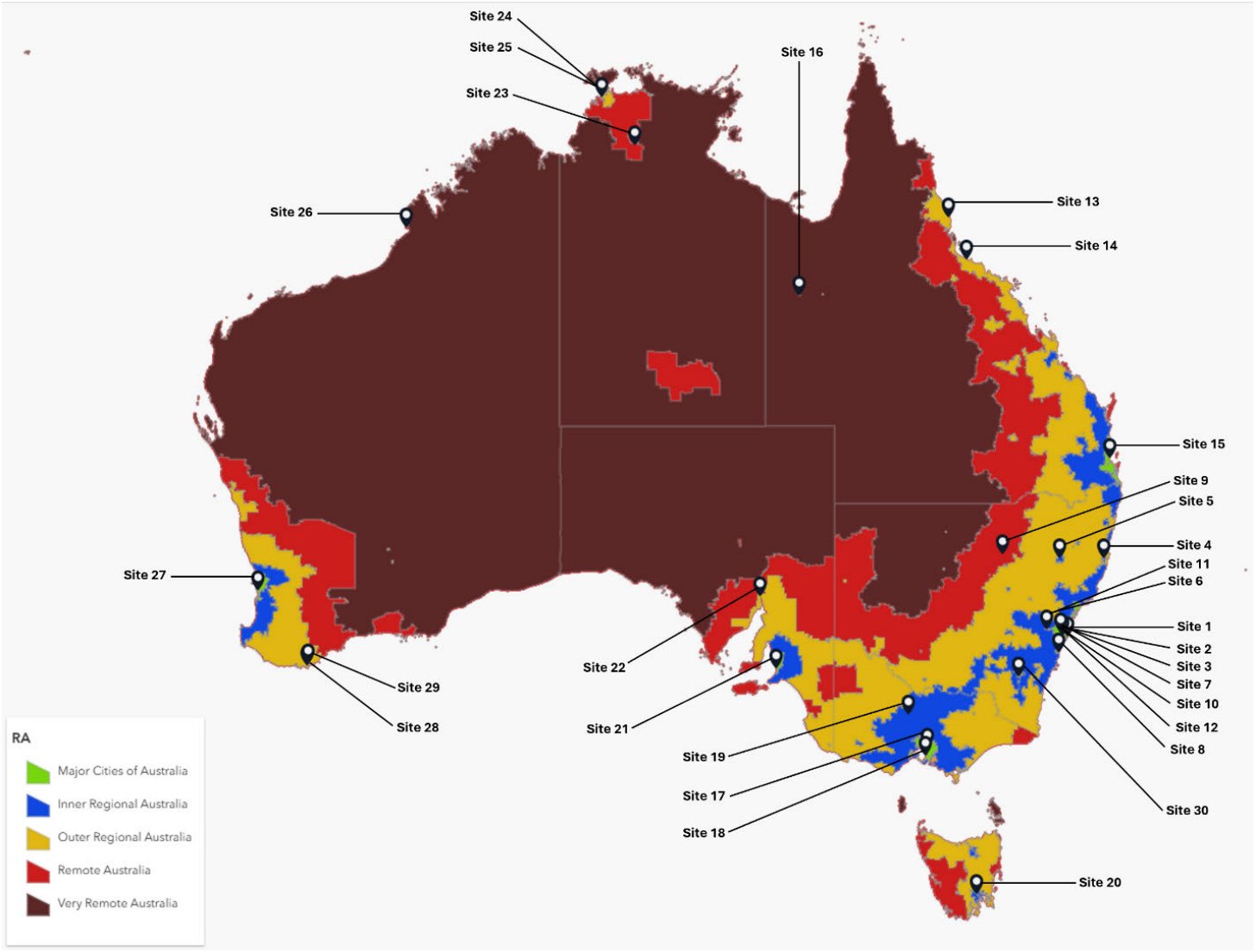
SA2 = Statistical Area Level 2, which are medium-sized general-purpose areas built up from whole Statistical Areas Level 1. They have an average population of around 10,000 persons and represent a community that interacts together socially and economically.

Target IP = Target Indigenous population, corresponding to the number of Indigenous Australians aged 50 years and older residing in the Statistical Area according to the Australian 2016 Census.

Target NP = Target non-Indigenous population, corresponding to the number of non-Indigenous Australians aged 50 years and older residing in the Statistical Area according to the Australian 2016 Census.

*Katherine region: We recruited strongly from Mataranka (one hour drive from Katherine) for both Indigenous and non-Indigenous participants. This town of 350 persons is classified as “Very remote”, whereas Katherine and immediate surrounds are “Remote”. The examination site was at the Katherine AMS; bus transport to and from was arranged for many participants. Mt Isa is classified as both “Remote” and “Very Remote”.

Figure 1. Distribution of AEEHS survey sites across the Australian continent by Remoteness Area (RA)



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Recruitment of participants in the AEEHS

The recruitment team consisted of a recruitment coordinator and two to four trained recruiters. At each survey site, prior to the commencement of doorknocking and testing, recruiters left in each mailbox an information pack containing a letter, an information pamphlet outlining the study and a statement that recruiters will doorknock at their residence.

Following this, recruiters went door-to-door and approached accessible households within the randomly selected SA1 area to recruit participants for that particular survey site. Recruiters used a standardised doorknocking script to briefly provide information to participants about the background, importance and eligibility criteria of the survey. Recruiters screened residents for eligibility and invited those who were eligible to participate in the AEEHS. The eligibility criteria were: (1) Indigenous or non-Indigenous Australian aged 50 years or older*; (2) ability to provide written informed consent; and (3) residence within the selected recruitment boundaries.

Eligible residents who agreed to participate were given a card with the appointment date and time as well as the location of the testing venue. Eligible residents who were undecided about participating at the time of recruitment had their details recorded and were recontacted via phone or home visit to ascertain their final response. If the eligible resident did not wish to participate, they were not re-contacted, and the reasons for declining were noted down where given. If no resident was present in the household at the time of the initial doorknock, an information brochure was left in the mailbox, which included a note that the recruiters would return to the household within three days. Each residence was approached at least twice, and any individuals who declined to

participate were not re-contacted. Residents who were not present following both doorknock attempts were deemed as non-contactable. If doorknocking in primary SA1 was complete, recruiters would progressively visit the adjacent SA1 areas until recruitment was complete.

Although the main form of recruitment was doorknocking, additional modes of recruitment were implemented, particularly for Indigenous Australians, through discussion with community leaders and adhering to local cultural norms. These included postal recruitment, assistance from local Aboriginal Medical Services, media announcements and word of mouth.

Participants who agreed to participate were sent automated text message reminders or contacted via phone number two days before their scheduled appointment time to remind them of the time and location of their testing appointment. Automated text messages were sent using an online booking system called Timely to participants who had access to a mobile phone.

Participants who did not attend their initial scheduled appointment were contacted via phone to ascertain the reason for non-attendance and encourage the appointment to be rescheduled. Participants who did not answer the phone call after three consecutive attempts were visited at home by the recruitment team to encourage the appointment to be rescheduled. Participants who were unable to be contacted via phone or the home visit were then classified as non-contactable.

***Note:** In the initial two sites with high Indigenous proportions in New South Wales (Kempsey, Tamworth), we also targeted Indigenous participants aged 40-49 years, as in

the NEHS, and examined 37 persons within this younger age group (mean age 44.8 ± 10.1 years). As this group had a very low prevalence of eye conditions causing vision impairment and could not be compared with non-Indigenous participants of the same age, it was decided to stop targeting this lower age group at future higher Indigenous sites. For the purpose of final analyses, this small group has been added to the Indigenous participant group aged 50-59 years.

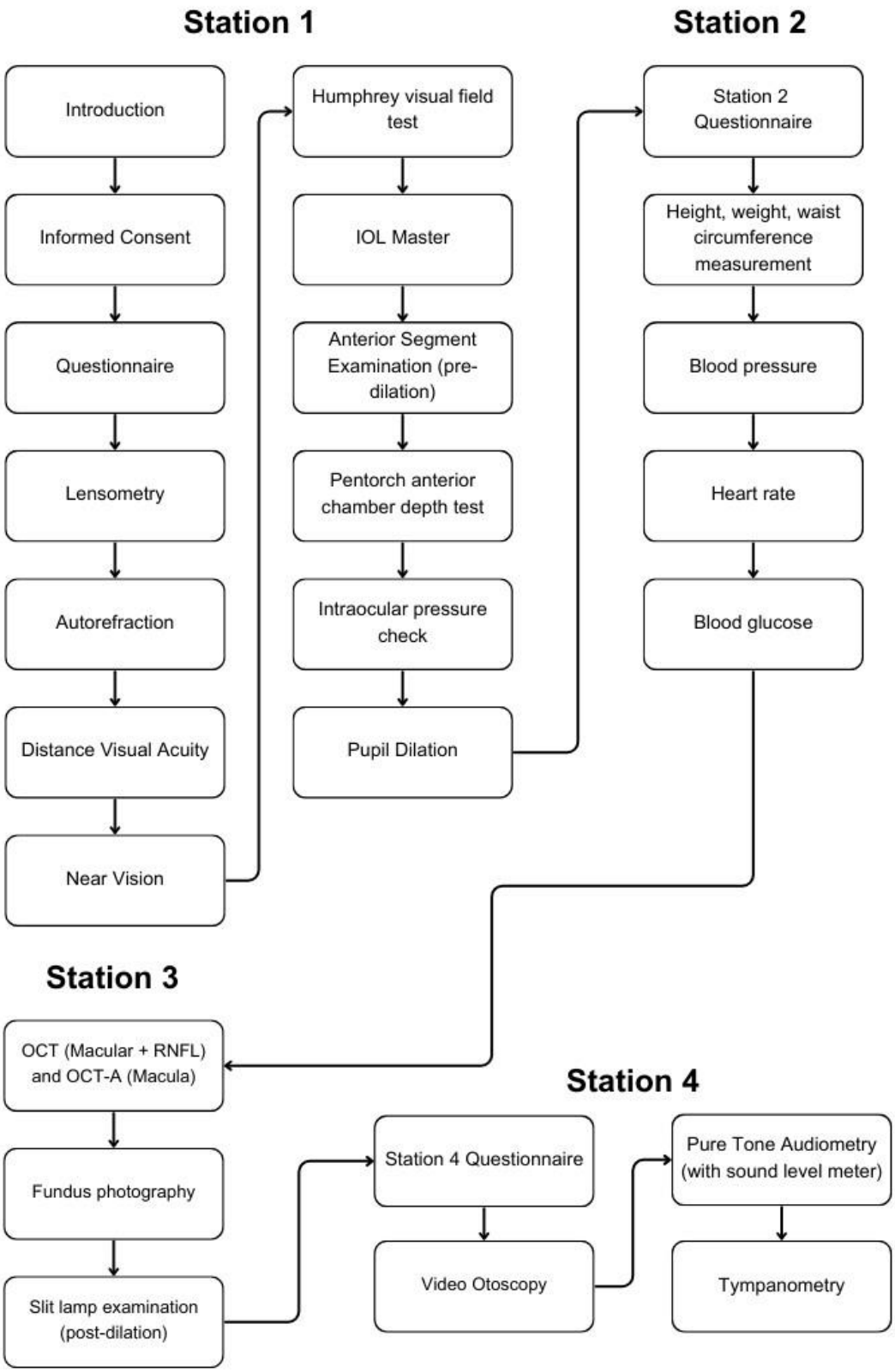
Testing protocol

Participants arriving at the designated testing venue at each survey site were greeted by members of the AEEHS team. Participants were given a standardised consent form and participant information sheet, which provided detailed information about the survey, including its background, aims, significance, testing protocol, benefits/risks of participation, information about eye/ear health support and contact details of the research team and ethics organisations. Participants were given time to review the forms and ask questions of the research team. Individuals who agreed to participate in the survey signed the consent form, which was witnessed twice, by an AEEHS research team member and another adult who was not part of the research team.

Participants who provided written, informed consent underwent a detailed eye and ear health examination, which consisted of four stations. The eye assessment and interviewer-administered general questionnaire were conducted in Stations 1-3, followed by an ear assessment in Station 4 (see Appendix). The examination protocol is summarised in **Figure 2**. The eye examination consisted of visual acuity (VA) testing, autorefraction, ocular biometry, lensometry, tonometry, visual field examination,

anterior segment examination, mydriatic ultrawide-field retinal photography, fundus auto-fluorescence, OCT (posterior pole and optic disc), OCT angiography (6mm and 12 mm diameters) and slit lamp examination. The ear examination consisted of pure tone audiometry, video otoscopy and tympanometry. Verbal feedback about the findings was provided throughout the examination, and written feedback in the form of a report was provided to each participant with appropriate referrals to an optometrist, ophthalmologist, audiologist and/or local general practitioner if abnormalities were detected. Referrals were provided to around one-third of participants to seek further evaluation by an appropriate health professional.

Figure 2. Flow chart of the AEEHS examination protocol



Station 1: Visual Acuity Testing

Station 1 consisted of distance and near visual acuity testing, refraction, lensometry, ocular biometry, autorefraction, pre-dilation anterior segment examination, tonometry, visual fields and pupil dilation. A short questionnaire was also administered, which included questions about sociodemographic information, existing refractive correction and previous visits to a health professional for an eye test. The assessments performed in Station 1 included:

- **Distance visual acuity (DVA) assessment** – Unaided and habitual presenting unilateral DVA were measured at 4 metres using a calibrated, electronic ETDRS logMAR chart (VistaVision) in well-lit room conditions. The smallest line recorded on the chart was the 6/3 line (-0.1 logMAR).

  Participants were instructed to read the letters on the smallest line they were able to see clearly. Unaided DVA was first assessed as a Yes/No question by determining whether participants could correctly identify ≥ 3 letters on the 6/12 line without wearing any refractive correction. Habitual DVA was then assessed with participants using habitual distance correction with spectacles or contact lenses, if worn.

  VA was recorded as the lowest line that the participant correctly identified ≥ 3 letters. If the participant did not correctly identify ≥ 3 letters on the 6/60 line, an electronic Snellen chart at 4 metres was used to test optotypes from 5/60 to 1/60. If no letters could be identified on the Snellen chart, VA was assessed as Counting

Fingers, Hand Movements, Perception or No Perception of Light using a pen torch. DVA was assessed for each eye, and the findings were recorded.

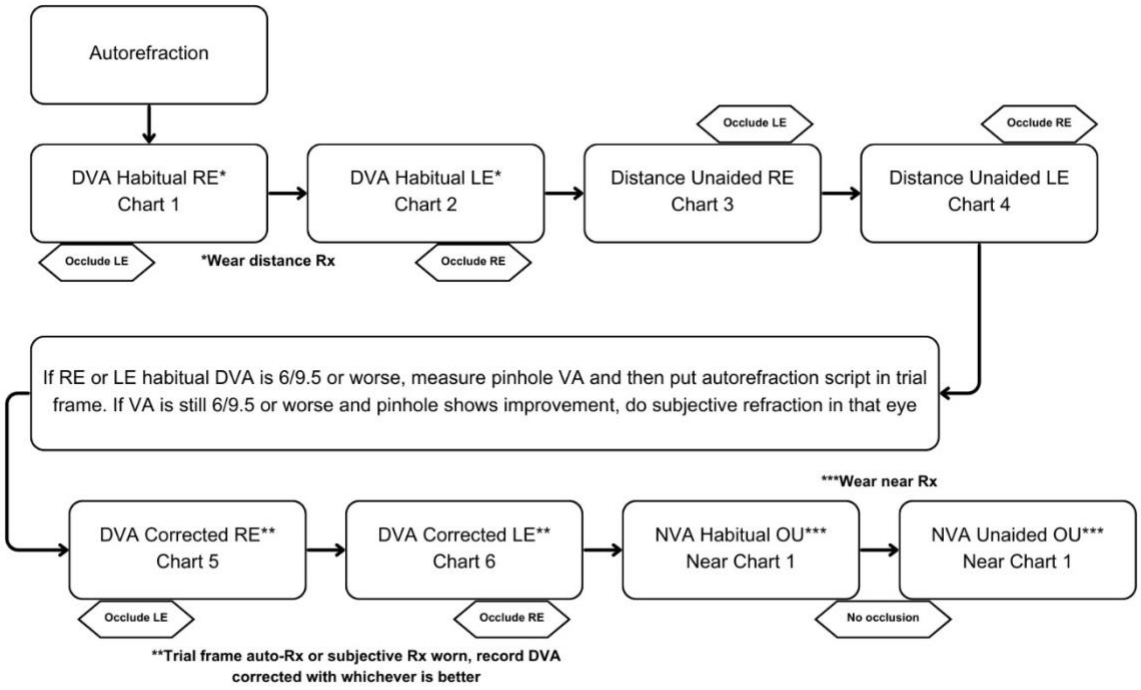
If presenting VA was less than 6/9.5 in one or both eyes, a pinhole test and subjective refraction were performed to help determine if the cause of vision impairment was due to refractive error or other ocular pathology. Pinhole VA was assessed and recorded using the same procedure as the presenting VA, except with the participant viewing the chart through a pinhole (occluder with multiple holes). After pinhole testing, subjective refraction was performed using a set of trial lenses and Jackson cross cylinders. The autorefraction script performed onsite was used to provide a base for the subjective refraction. The examiner subsequently performed subjective refraction and adjusted the script until the best-corrected VA using subjective refraction was obtained and recorded.

- **Near vision acuity (NVA) assessment** – Unaided and habitual NVA were tested binocularly using a Good-Lite near logMAR vision chart at 40cm in well-lit room

conditions and a lamp to provide overhead lighting. Unaided NVA was first assessed as a Yes/No question by determining whether participants could correctly identify ≥ 3 letters on the 6/12 line without wearing any refractive correction. Habitual NVA was assessed by having the participant wear their reading spectacles, if available, and VA was recorded as the lowest line that the participant correctly identified ≥ 3 letters. The smallest line recorded on the chart was the 6/3 line (-0.1 logMAR).

- **Lensometry** – If the participant wore spectacles, the power of the spectacles was measured using a Zeiss Visulens Model 550 device. The sphere, cylinder, axis and reading add (for bifocal/multifocal glasses) were recorded for each lens. This was repeated for each pair of spectacles that the participant wore.
- **Autorefraction** – A Zeiss VisuREF Model 150 autorefractor was used to determine the objective refractive values and keratometric characteristics of each eye. The spherical and cylindrical refractive error values were recorded for each eye. If the participant had presenting VA < 6/9.5 which improved using pinhole, the findings from autorefraction were used to assist with choosing the power of the trial lenses for subjective refraction. The spherical and/or cylindrical lenses were placed in a trial frame, and subjective refraction was performed with a Jackson cross cylinder (if astigmatism was present) until best-corrected visual acuity was obtained. The flow chart in **Figure 3** below provides a summary of how VA was tested.

Figure 3. Flow chart for assessment of visual acuity and refraction



- **Ocular biometry** – Non-contact partial coherence laser interferometry using the Zeiss IOLMaster machine was used to visualise and measure the ocular structures. The axial length, central corneal thickness, anterior chamber depth and lens thickness values of each eye were recorded for each participant. If a participant had a narrow anterior chamber depth, an anterior segment OCT scan was performed using a Zeiss Cirrus 6000 OCT.

- **Pre-dilation anterior segment examination** – The anterior segment of each eye was screened before pupil dilation using a pentorch. The iris colour, presence of pterygium, pupil and lid abnormalities and anterior chamber depth were noted. In the pentorch anterior chamber depth test, the pentorch was positioned adjacent to the participant's temporal canthus such that the pentorch was parallel to the iris plane. The nasal aspect of the iris was observed, and the degree of iris

illumination was used to grade the anterior chamber depth according to 4 grades (Grade 1 ≤1/3 iris illuminated; Grade 2 = 1/3 to 2/3 iris illuminated; Grade 3 ≥2/3 iris illuminated; Grade 4 = iris fully illuminated). If a grade 1 pentorch test was present and/or the anterior chamber depth as measured on the IOLMaster was very narrow (<2.8mm), an anterior chamber OCT was performed using a Zeiss Cirrus 6000 OCT.

Anterior segment OCT was an objective method of assessing the anterior chamber angle, which was useful for the assessment of suspected angle closure glaucoma. In the event of grade 1 pentorch test findings, two scans were taken of each eye: (1) an anterior chamber scan to generate a widefield raster scan of the anterior eye and (2) a wide angle to angle scan to highlight both 0-to-180-degree iridocorneal angles.

- **Tonometry –** Intraocular pressure (IOP) was measured in both eyes of all participants using the iCare tonometer IC-100. The tonometer was held at 48mm from the participant's central cornea. For each eye, six consecutive readings were taken and the average IOP was recorded. If the IOP > 25mmHg or the difference between eyes ≥ 5mmHg, the IOP measurement was repeated with

  Goldmann applanation tonometry (Goldmann AT900 tonometer) at the slit lamp (Haag-Streit BI-900), after administering a drop of amethocaine 1.0% (low-dose local anaesthetic) and sodium fluorescein (for ocular staining).
- **Visual field testing** – A Zeiss Humphrey Field Analyser V3 model 860 was used on both eyes of all participants to screen for visual field loss related to glaucoma and other neurological conditions. The 24-2 SITA Faster visual field assessment

(24 degrees/54 point grid) was performed in each eye due to its short testing time (2 to 3 minutes per eye) and high sensitivity and specificity for detecting visual field loss. The trial lens on the Humphrey Field Analyser V3 machine was used to correct any refractive error for the participant completing the test. If suspected visual field abnormalities were detected or the test was unreliable, the test was repeated where possible to evaluate whether the defect was reproducible, and the best result was recorded.

- **Pupil dilation** – At the conclusion of station 1, tropicamide 1.0% was instilled in each eye to dilate the pupils of consenting participants to improve the accuracy of cataract grading and quality of retinal imaging. If a participant had narrow angles, a drop of tropicamide 0.5% was instilled in that eye instead and the IOP was measured 10 minutes after the eyedrops were given. If the IOP was >35mmHg, we planned that such participants would immediately be referred to a local ophthalmologist; however, this did not occur during the AEEHS, so no such referrals were made.

Station 2: Interviewer Administered Questionnaire

Station 2 consisted of an interviewer-administered questionnaire used to ascertain sociodemographic and clinical information. These included educational/occupational status, income, ethnicity, country of birth, healthcare information, self-reported general health, driving, smoking status, medication history, past medical and surgical history, previous ocular conditions (e.g. cataract, AMD, glaucoma, diabetic retinopathy, dry eye conditions and ocular surgery). The cost of treatments for eye conditions, including spectacles, cataract surgery, AMD and diabetic retinopathy treatments, was also

obtained from the participant. At the conclusion of the questionnaire, several measurements were taken. These included:

- **Anthropometry** – The height, weight and waist circumference of each participant were measured using an adjustable height stand, Wedderburn electronic weight scale and measuring tape, respectively. The height and weight were used to calculate body mass index (BMI).
- **Blood pressure and heart rate** – This was measured using the Omron HEM700 blood pressure monitor. Three readings were taken for each participant, and the average systolic blood pressure (SBP), diastolic blood pressure (DBP)and heart rate were recorded. Hypertension was classified as SBP >140mmHg or DBP >90mmHg.
- **Blood glucose** – This was measured using a finger-prick test for all participants with the Accu-Chek glucose meter. If the participant had fasted for 6 hours prior to the finger-prick test, then the result was recorded as fasting blood glucose. If the participant was not fasting, then the result was recorded as non-fasting blood glucose. Diabetes was classified as having a fasting blood sugar ≥7.0mmol/L or non-fasting blood glucose ≥11.1mmol/L.

Station 3: Eye Examination

Station 3 consisted of anterior segment examination and cataract grading using a slit lamp and retinal assessment using fundus photography and optical coherence tomography. The examination consisted of:

- **Optical coherence tomography (OCT)** – The Zeiss Cirrus 6000 OCT was used to image the optic nerve head, macula and retinal nerve fibre layer (RNFL) of each eye. The AngioPlex module was used to obtain macula and widefield OCT angiography scans to assess the retinal and choroidal vasculature. For each eye, five scans were taken: (1) macular cube 512x128mm, (2) HD line 21, (3) optic disc cube 200x200mm, (4) OCT angiography 6x6mm, (5) OCT angiography 12x12mm. The macular cube scan provided information on macular layer thickness, macular change and a three-dimensional view of the macula. The HD Line 21 provided 21 cross-sectional slices of the retina that were used to detect retinal abnormalities. The optic disc scan generated optic disc parameters including RNFL thickness, cup-to-disc ratio, rim area, disc size, symmetry and volume. The OCT angiography scans provided a detailed assessment of the retinal and choroidal vessel density, thickness, foveal avascular zone dimensions, presence of capillary dropout and neovascularisation.
- **Retinal photography** – The Zeiss Clarus 700 ultra-wide field fundus camera was used to obtain mydriatic retinal photographs to detect retinal, glaucomatous, optic disc and other pathology. Participants were dilated with tropicamide in Station 1, and the camera was used to take a total of 6 images: external, ultra-widefield colour, and auto-fluorescence images of each eye. The ultra-widefield colour photographs involve taking two photographs of each retina, the first centred on the optic disc and the second centred on the macula. The two images were automatically merged together by the Clarus camera into a montage with a 200° field of view when measured from the centre of the eye. Single widefield FAF Green images (133° field of view) were taken of each retina to assist in the

detection of Retinal Pigment Epithelium (RPE) disorders. External images included taking a photograph of the anterior ocular surface to check for abnormalities, including lens opacities.

Each photograph was checked by the examiners and retaken if needed to ensure that the macula, optic disc and vessels were clearly defined to enable accurate grading of pathology. In cases where pupil dilation was refused or contraindicated, the participant was seated in a dark room to allow for physiological pupil dilation, and the same set of images was taken with the nonmydriatic option on the Clarus fundus camera (rather than the mydriatic option). All fundus photographs were saved onto the Zeiss FORUM server and Clarus internal hard drive. Photographs were also duplicated and saved onto an external hard drive for retinal grading at WIMR.

- **Post-dilation slit lamp examination** – A Haag-Streit BM900 slit lamp was used to perform a detailed examination of the anterior segment of each eye. The examiner looked for signs of trichiasis or other eyelid abnormalities, trachoma, pseudoexfoliation, pigment dispersion, corneal opacities, cataract and noted the presence of any other anterior segment abnormalities. The type and severity of cataract were graded using the LOCS III system as shown in the image below. The LOCS III system refers to a series of slit lamp images displaying different grades of nuclear, cortical and posterior subcapsular cataract.

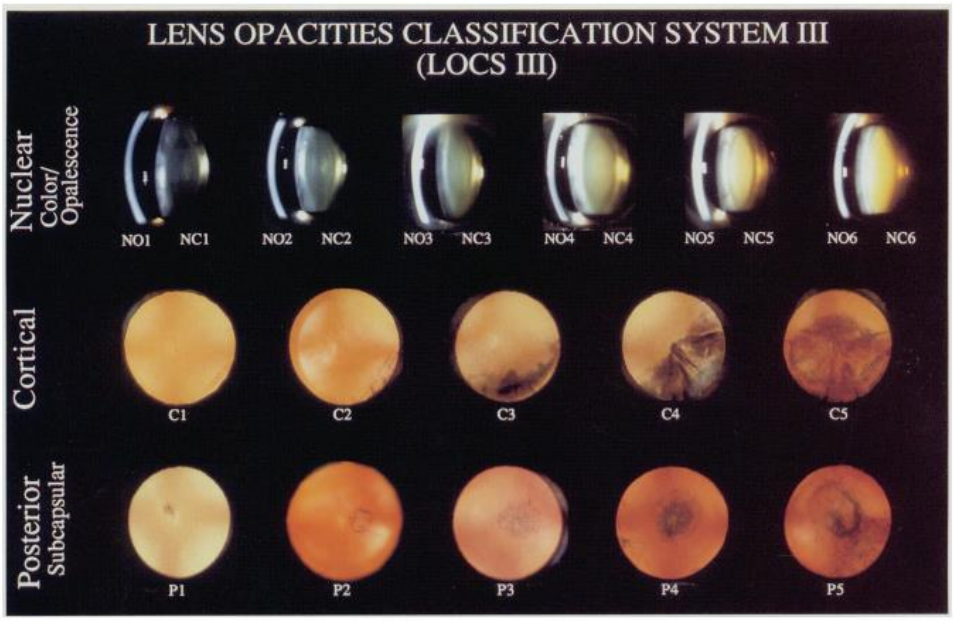


Fig 5.—The LOCS III standards. This set of standards is prepared as a set of slides for grading standardized photographic images of opacity. The five or six individual standard slides for the cataract type or nuclear color being graded are projected at the same size as the slides of unknown opacity. NO1 to NO6 and NC1 to NC6 are the standards for nuclear opalescence and nuclear color, respectively. C1 to C5 are the standards for cortical cataract, and P1 to P5 are the standards for posterior subcapsular cataract.

- If the participant was pseudophakic, the intraocular lens (IOL) was assessed to determine its location (anterior or posterior chamber) and the presence and severity (mild, moderate or severe) of posterior capsular opacification. Finally, a slit lamp examination of the retina was performed using binocular ophthalmoscopy with a 90D lens to ascertain and evaluate the presence of any retinal abnormalities.

Station 4: Hearing and Ear Examination

Station 4 consisted of a hearing examination and an interviewer-administered questionnaire. The questionnaire included questions about the participant's otological history, engagement with hearing services, and use of hearing devices. Individuals with pre-existing hearing loss completed the Hearing Handicap Inventory for the Elderly (HHIE) to assess self-perceived hearing difficulties. Additionally, hearing aid users underwent the International Outcome Inventory for Hearing Aids (IOI-HA) to evaluate the

effectiveness of their auditory rehabilitation. Audiological testing in Station 4 comprised video otoscopy, tympanometry and pure-tone audiometry.

- **Video otoscopy** – The MedRx video otoscope with MedRx software was used to visually inspect and capture a digital, colour photograph of the ear canal and tympanic membrane. One photograph was taken for each ear.
- **Tympanometry** – The Amplivox Otowave 102-1 device was used to conduct tympanometry. For each ear, the gradient, ear-canal volume and tympanometric peak and pressure were recorded. This procedure could cause some discomfort and was optional and dependent on the participant verbally consenting and having enough time to perform the test.
- **Pure tone audiometry** – This was performed using Advant A2D audiometer with passive noise-reducing headphones (DD65v2). A Hughson-Westlake staircase procedure, in conjunction with 40dB of contralateral masking, was implemented to establish thresholds in each ear across the following frequency range: 250Hz, 500Hz, 1000Hz, 2000Hz, 4000Hz, and 8000Hz. During the test, background sound levels were monitored using a Bruel and Kjaer type 2250 sound level meter.

Protocols for determining causes of vision impairment and blindness

Refractive error

Vision impairment was attributed to refractive error when VA improved to ≥ 6/12 on pinhole testing or subjective refraction, and no other substantive eye conditions were present that could be considered the primary cause of vision impairment as determined

by the grader. If such advanced eye conditions (e.g. cataract, AMD, glaucoma) were present, then this condition would be allocated as the main cause for vision impairment or blindness. In the case of multiple conditions, the grader allocated the condition considered the primary cause.

Cataract

Cataract was graded onsite by two examiners during the anterior segment examination using a Haag-Streit 900 slit lamp biomicroscope. The Lens Opacification Classification System (LOCS) III grading system[43] was used to grade nuclear, cortical and posterior subcapsular cataract. This is a widely used classification and highly accurate system for grading slit lamp and retroillumination images of age-related cataract. For nuclear cataract, the grading ranged from 0.1 to 6.0, with 0.1 representing no nuclear cataract and 6.0 indicating the most advanced nuclear cataract stage. For cortical and posterior subcapsular cataracts, the grading for each type ranged from 0.1 to 5.0, with 0.1 representing no cataract and 5.0 highlighting the most advanced form of that type of cataract. Anterior segment images were also taken for all participants using the Clarus 500 retinal camera to adjudicate cases where the stage/ type of cataract were unclear. Data and images from machines were stored on a dedicated Zeiss FORUM Server.

Grading of retinal pathology

At the completion of clinical examinations at each site, de-identified retinal images were transferred to the retinal image grading team at Westmead Institute for Medical Research (WIMR). Images were converted to TIFF files and stored on a double-encrypted share drive accessible only to the grading team. The retinal images and OCT and OCT angiography scans were stored on a double-encrypted computer and accessed using the

ZEISS Forum software. The OCT scans provided additional information to assist with the detection and classification of retinal and optic nerve pathology. The images were graded by two ophthalmologists who were masked to the demographic and clinical information of the study participants. In the case of disagreement, a third senior ophthalmologist adjudicated the case to provide a final diagnosis.

Age-related macular degeneration (AMD)

AMD was graded according to the Beckman Classification System, which classifies AMD into early, intermediate and late AMD. Late AMD is further divided into geographic atrophy or neovascular AMD. Early AMD was defined as the presence of medium drusen (>63μm and ≤125μm diameter) within two optic disc diameters (3500μm) from the fovea in either eye and no AMD pigmentary abnormalities. AMD pigmentary abnormalities were defined as hyperpigmentation or hypopigmentation present within two optic disc diameters (3500μm) from the fovea associated with drusen >63μm in diameter but not associated with known retinal disease entities. Intermediate AMD was defined as large drusen (>125μm diameter) or medium drusen in addition to AMD pigmentary abnormalities. Late AMD was defined as the presence of geographic atrophy or neovascular AMD. OCT and OCT angiography scans of the macula were used as an adjunct to measure drusen size, help detect AMD abnormalities, pigment epithelial detachments, ellipsoid loss in geographic atrophy, as well as choroidal neovascularisation and presence of subretinal or intraretinal fluid in neovascular AMD.

Diabetic retinopathy (DR)

DR was graded using the modified ETDRS classification system.[44] Ultra-Wide Field (UWF) images were loaded onto the screen, and an ETDRS 7-field overlay was superimposed on the UWF image to define the region covered by the seven standard 30° ETDRS fields. Each of these fields was graded, masked to diabetes status, to ascertain the presence and severity of DR lesions. These consist of microaneurysms, haemorrhages including preretinal or vitreous haemorrhage, hard exudates, cotton wool spots, venous beading, intraretinal microvascular abnormalities and neovascularisation. Based on these individual field gradings, an overall retinopathy severity level was determined with 14 levels ranging from level 10 (DR absent) to level 85 (advanced PDR with posterior fundus obscured, or centre of macula detached), excluding level 99 (ungradable image).

OCT and OCT angiography scans of the macula provided additional information for identifying capillary dropout and foveal avascular zone (FAZ) enlargement in DR, neovascularisation in proliferative diabetic retinopathy (PDR), subretinal or intraretinal fluid, as well as macular thickness for classifying and locating diabetic macular oedema (DMO). The definition of clinically significant macular oedema (CSMO) was retinal oedema or hard exudates within 500 microns of the centre of the fovea.[45]

Glaucoma

The retinal images and OCT optic disc cubes were graded for: vertical and horizontal cup-to-disc ratio (CDR), optic disc notching, retinal nerve fibre layer (RNFL) thinning, optic disc ("Drance") haemorrhage, disc pallor and atrophy. The presence of glaucoma was determined as no glaucoma, ocular hypertension, possible primary open angle

glaucoma (POAG), probable POAG, definite POAG, angle-closure glaucoma suspect, and definite angle closure glaucoma, based on the clinical judgement of the two graders. In case of disagreement of classification, adjudication was performed by a masked senior glaucoma specialist. Probable POAG, definite POAG and definite angle closure glaucoma were combined as 'glaucoma' in the analyses.

Other retinal pathology

The OCT and fundus images were also graded to determine if there were any vitreomacular interface abnormalities (epiretinal membrane, vitreomacular traction and macular holes), retinal vein occlusion, retinal emboli, macular telangiectasia, retinal tears, retinal detachments, choroidal naevi, central serous chorioretinopathy/ pachychoroid disease, lattice degeneration and inherited retinal dystrophy. Any other lesions were also noted during the grading process.

Attributing main cause of bilateral vision impairment or blindness

In cases where VA in one or both eyes improved with pinhole or auto-refraction to ≥6/12, refractive error was assigned as the major cause of vision impairment, unless other substantive eye conditions were present that were considered likely to be the primary cause of vision impairment.

For all other cases, the relevant ocular and medical history, visual field results, retinal and optic disc images, OCT and OCT angiography scans were reviewed independently by two ophthalmologists who identified the main disorder causing the greatest impairment of vision. All of these images and tests were available on a high-resolution screen linked

to the Zeiss FORUM Server. A third ophthalmologist adjudicated any cases of disagreement. When multiple disorders were present, the condition considered to have the most clinically significant influence was chosen as the main cause, in line with the NEHS.[1] A "Not Determinable" Cause category did not need to be utilised. This ensured that as many specific causes of vision impairment as possible were identified.

Definitions of Bilateral Vision Impairment and Blindness

In line with previous Australian eye surveys and the NEHS,[1] bilateral vision impairment was defined as a presenting visual acuity of <6/12-6/60 in the better eye. Bilateral blindness was defined as presenting visual acuity of <6/60 in the better eye. In order to ensure comparability with some international eye studies, a separate category was defined to align with the WHO category of moderate vision impairment (VA <6/18-6/60).

Protocols for determining causes of hearing impairment

Video otoscopy

Video otoscopy images were de-identified and stored on a secure online server at WIMR. The images will be graded by a team consisting of an audiologist and Ear, Nose and Throat (ENT) specialist or registrar masked to the other information of the participant. The two hearing professionals examined each otoscopy image independently and categorised them into normal or abnormal tympanic membrane and ear canal presentations. If there was conflict between the graders, adjudication was performed by a third, senior hearing expert masked to the results to determine the appropriate grading.

Each grader recorded their observations on a REDCap video otoscopy grading form. Graders were not able to access each other's observations or any other participant information during the grading process. The questionnaire was split by ear so that answers for the right ear image and the left ear image were conducted independently. Questions focused on both pathology and data integrity. The initial questions involved assessing whether the video otoscopy image was clear or obscured, based on the guidelines for collection and annotation of otoscopy images put forward by Cai et al.[46] This depended on the information on the degree of view available (partial access to the tympanic membrane or entire view of the tympanic membrane) as well as the image focus (clear or blurred image). A 'good' image consisted of a 95% view of the tympanic membrane, an 'intermediate' image consisted of a 90-95% view of the tympanic membrane, while a 'poor' image had an observed area of <90% of the tympanic membrane structure.

The following questions were asked about why the image was unclear. Reasons included whether the camera was not placed deeply enough into the ear canal, whether the lens was unclean, whether the lighting exposure was inappropriate, or whether there was an obstruction obscuring the view of the tympanic membrane. Following this assessment of the image quality, ensuing questions focused on the pathology indication.

Assessors examined the image and recorded any observed pathologies. Each identified pathology's reliability was ranked with each assessor providing a score between 1-10, where 0 indicated low reliability and 10 indicated high reliability. This process was then repeated for the other ear. Once both examiners had input their results, an independent supervisor compared the recorded pathologies and ratings. Where there is conflict, they

will flag the participant number for review by a final masked third assessor, who will act as the adjudicator to make the final decision regarding the grading.

Tympanometry

Tympanometric values will be categorised according to the Jerger classification system,[47] which is used to determine the presence of middle ear pathologies. Tympanometric responses will be classified according to five established Jerger Types. Type A indicates normal middle ear function, while Type As suggests a less compliant middle ear system, often associated with conditions like otosclerosis. Type Ad reflects a highly compliant middle ear system, which may occur in cases of ossicular discontinuity. Type B with a normal ear canal volume (ECV) is indicative of potential middle ear pathology, such as fluid behind the eardrum, whereas Type B with increased ECV may be indicative of a perforated eardrum or patent grommet. Lastly, Type C signifies a retracted or negatively shifted eardrum, consistent with potential Eustachian tube dysfunction. This provides salient additional information on hearing impairment status when taken into consideration against pure-tone audiometry results and the video otoscopy images.

Pure tone audiometry

Hearing impairment was determined as the four-frequency pure-tone average of audiometric hearing thresholds at 500, 1000, 2000 and 4000Hz, with hearing impairment defined according to World Health Organisation (WHO) guidelines as hearing thresholds >25dB hearing level (dB HL).[48-51] Hearing impairment was stratified as mild (26-40dB HL), moderate (41-60 dB HL), severe (61-80 dB HL), and profound (≥81 dB HL).[40,48-51]

Bilateral hearing impairment was defined as hearing threshold >25dB HL in the better ear.

Unilateral hearing impairment was defined as one ear being within the normal hearing range (<=25dB), while the other ear had some degree of hearing loss, ranging from mild to total hearing loss. Single-sided deafness (SSD) referred to a form of UHL where one ear had total hearing loss. Bilateral hearing loss was defined as the presence of hearing impairment in both ears. Each ear may have varying levels of impairment, spanning from mild to total hearing loss, but both were outside the normal hearing range.

For the purposes of data analysis, when both ears were analysed together, the severity of hearing loss in the better ear was used to classify the severity of bilateral hearing loss, as this reflects the functional hearing capacity of the individual in everyday situations and allows for a more consistent, comparable metric across a population.

Data storage and entry

Data collected during the recruitment and clinical examination were recorded and stored using the University of Sydney Research Electronic Data Capture (REDCap) – a secure platform to manage online surveys and databases. Only researchers who had a valid account were able to access the database, with different levels of viewing and editing permissions given to different researchers depending on their role in the survey. There were four laptops and four tablets, which were connected to a Telstra 5G mobile plan to allow for access to REDCap. Station-specific data were entered by each testing staff member responsible for their allocated station. Hardcopy versions of the on-site questionnaires were available on-site in case of technical complications preventing real-time data entry into REDCap. Hardcopy data obtained from each participant, including consent forms, auto-refraction result printouts and hardcopy station questionnaires (if

used), were stored in a locked room at WIMR that was only accessible to key study personnel.

Data entry, checking and cleaning were conducted in 2 stages. The Project Manager reviewed the data collected throughout each examination day to check for missing data or anomalous values. This allowed any issues to be identified and rectified on the same day while the participant was still present on-site. Every month, or more frequently as necessary, the biostatistician reviewed the data collected to check for consistency and any issues detected were immediately raised.

A central, password-protected computer containing ZEISS FORUM 4.4 ophthalmology software was used to store imaging data collected from the ZEISS machines. These included the ZEISS VisuLENS for checking spectacle prescription, ZEISS VisuREF 150 for autorefraction, ZEISS Humphrey Field Analyzer V3 for visual field testing, ZEISS Clarus 500 for external and retinal photography and ZEISS Cirrus OCT 6000 for optic disc and retinal imaging. The central computer was set up at the beginning of each site and connected via a local area network to each of the ZEISS machines. All images or scans taken on each of the ZEISS machines were automatically transferred to the central computer as DICOM files under each respective participant ID, which could then be read via the ZEISS FORUM viewer software. In addition, all scans were manually saved onto an external portable hard drive to prevent loss of data in case of central computer technical failure. A folder was created for each AEEHS participant in the external hard drive labelled with the participant ID, and all scans were manually saved into their respective folders at the end of each day. At the conclusion of data collection, the central computer was set up at the grading centre at WIMR to enable access to images and scans

for grading of ocular pathology. Grading data were then merged with the master dataset for analysis.

Data Analysis

Variables were examined to check for normality using boxplots, Kolmogorov-Smirnov, Shapiro-Wilks and other tests as needed. Continuous variables were presented as mean (standard deviation [SD]) for normal distributions, and categorical variables were presented as number counts (n), relative frequencies (%) and 95% confidence intervals (CI). Comparisons between continuous variables were performed using t-tests and ANOVA for normally distributed variables and using the Mann-Whitney-Wilcoxon test for skewed non-normal data. Proportions of categorical variables between different classes were compared using the chi-squared Pearson's tests, and the Fisher exact test if the sample size was small. Age-adjustment was performed by weighing frequencies in each 10-year age stratum to the Australian population 2021 data.

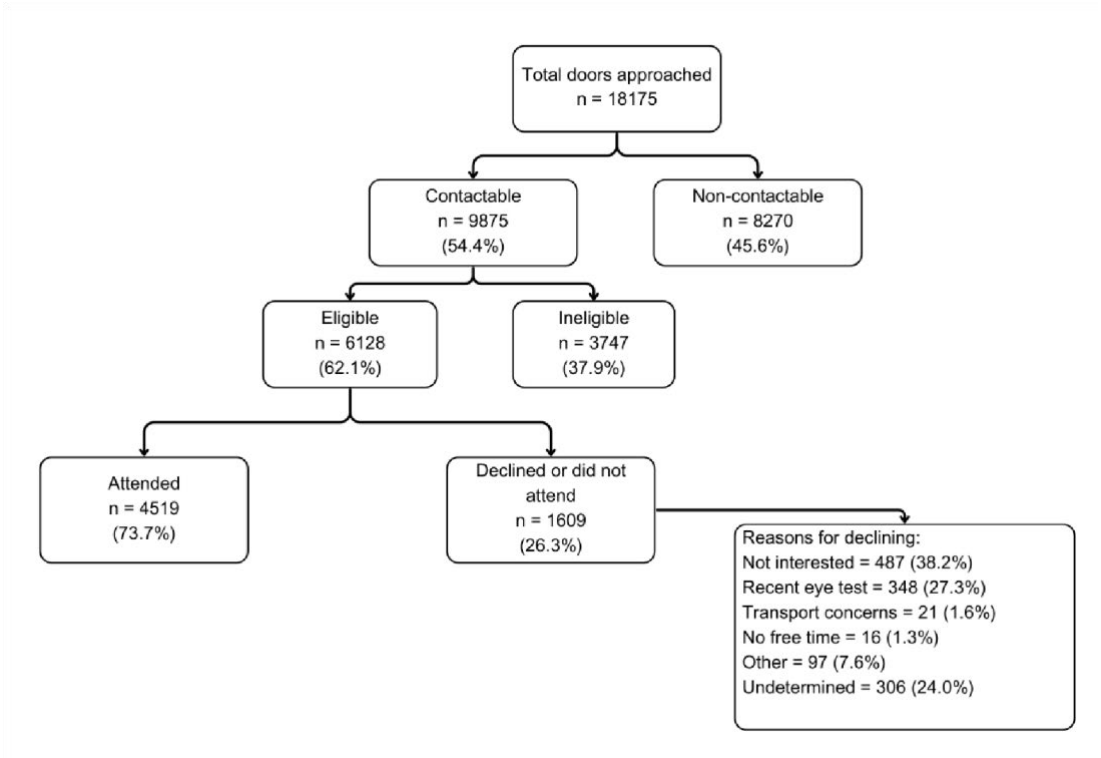
Generalized linear mixed models were employed with outcomes: 1) any bilateral vision impairment; 2) any bilateral hearing impairment with definition of >25dBHL; and 3) moderate or worse bilateral hearing impairment with definition of >40dBHL. The State, remoteness and survey sites were explored as random effects. Akaike Information Criterion and Bayesian Information Criterion were used to determine the best fit mode, as well as Variance Inflation Factor to check for multicollinearity and residual plots and tests for normality and outliers.

All statistical analyses were conducted using SAS version 9.4 (SAS Institute Inc., Cary, North Carolina, USA) and R version 4.4.0. A two-tailed p-value <0.05 was considered to be statistically significant.

Recruitment statistics

During the course of the survey, recruiters doorknocked 18,145 dwellings across the 30 AEEHS sites, of which 9875 (54.4%) had someone present at the time of recruitment. **Figure 4** provides a summary of the recruitment process.

Figure 4. Flowchart of recruitment in AEEHS



A total of 6128 (62.1%) residents who were contactable were eligible to participate in the AEEHS. Of these, 4639 initially agreed to participate, 419 were undecided about participating, and 1070 declined to participate. Upon follow-up, 214 residents who were initially undecided, agreed to participate in the examination.

Of the 4853 eligible residents who agreed to participate, 4519 attended the AEEHS testing venue and completed the clinical examination, resulting in an overall examination response rate of 73.7% (4519/6128). When calculating the overall response rate, any eligible residents who agreed to come but either did not attend or participate in the clinical examination or did not complete a substantial part of the examination (at least Station 1 and Station 2), were regarded as non-responders.

Table 3 shows the overall response rate by Indigeneity status. 913 Indigenous residents were identified as eligible, of whom 617 participated in the clinical examination, resulting in a response rate of 67.6%. A total of 5114 non-Indigenous residents were identified as eligible, of whom 3902 participated in the clinical examination, resulting in a response rate of 76.3%. The difference in response rate between the non-Indigenous and Indigenous population was statistically significant (76.3% vs 67.6%, $p < 0.0001$).

Table 3. Response rates of participants in the AEEHS

	Indigenous	**Non-Indigenous**	**Total**
Present, n (% of attempts)	1806 (18.3)	8069 (81.7)	9875 (54.4)
Eligible, n (% of present)	913 (50.1)	5114 (63.4)	6128 (62.1)
Examined, n (% of eligible)	617 (67.6)	3902 (76.3)	4519 (73.7)

Factors Affecting Recruitment Rates in the AEEHS

Recruitment for the AEEHS was affected by several external factors that occurred during the survey period. These are described in further detail below.

The COVID-19 Pandemic

The Australian government declared a national human biosecurity emergency in response to the COVID-19 pandemic that continued from March 2020 to August 2022. Commencement of doorknocking and recruitment was therefore delayed and started the month the emergency response was lifted. Initial recruitment sites experienced limited recruitment due to lingering community concerns. All study personnel wore personal protective equipment, e.g. face masks and gloves, and underwent regular COVID-19 testing during this period. Participants were encouraged to cancel appointments if they were unwell. No instances of COVID-19 transmission occurred during the survey. The main effect of the pandemic on the survey was a prolonged delay in commencing recruitment, slow recruitment in initial sites, extension of study timelines and postponed study completion.

The Indigenous Voice to Parliament Referendum

This was a national referendum to amend the Australian Constitution to recognise Indigenous Australians in the document and set up an Australian Indigenous body to make representations to Parliament. The referendum was held on 14 October 2023 and was unsuccessful. The period leading up to and after the referendum was marked by a decrease in the recruitment of Indigenous Australians, which continued for a prolonged period after the event. The main effect the Referendum had on the survey was a decline in the recruitment of Indigenous Australians.

Logistic and Accessibility issues

Examinations at some selected high Indigenous proportion sites did not proceed. These included 1) Yuendumu in the Northern Territory - at the time, there were reports of some

town violence, so it was decided to avoid for staff safety; 2) Palm Island – this became logistically difficult because of a lack of appropriate space to conduct the survey and lack of accommodation for staff; 3) Cairns hinterland – local Indigenous health centres advised they had existing arrangements with local optometrists for screening and declined to participate. Additionally, the first site at Little Bay was truncated following the recent passing of two elders who were an integral part of the Indigenous community. As a result of these factors, recruitment of Indigenous participants was slower than expected from the outset. Strategies to address this included deeper engagement with local Indigenous communities, situating examination sites wherever possible within Aboriginal Medical Services (AMS) buildings, and reviewing recruitment criteria. In light of the minimal rate of vision impairment and pathology in the initial sample of 37 Indigenous participants aged 40-49 years who were recruited, a decision was made to harmonise the recruitment criteria to 50+ years for both Indigenous and non-Indigenous participants. This harmonisation of inclusion criteria was also undertaken to better facilitate comparisons between the Indigenous and non-Indigenous participants.

Demographics of Participants in the AEEHS

A total of 4,519 participants were recruited, of whom 617 (13.6%) were Indigenous Australians (53.2% female vs 46.8% male; mean age [SD] 63.8 [10.6] years), and 3,902 (86.4%) were non-Indigenous Australians (54.8% female vs 45.2% male; mean age 70.5 [9.8] years, as shown in **Table 4**).

Table 4. Main demographics of participants in the AEEHS

	Indigenous n (%)	**Non-Indigenous n (%)**	**Total N**	**P-value**
Participants	617(13.6)	3902(86.4)	4519	
Age Groups (years)				
50-59	211(34.2)	582(14.9)	793	
60-69	238(38.6)	1188(30.5)	1426	
70-79	117(19.0)	1389(35.6)	1506	
80+	51(8.3)	743(19.0)	794	<.0001
Mean age (SD)	63.8 (10.6)	70.5 (9.8)	69.6 (10.2)	<.0001
Gender				
Male	289(46.8)	1765(45.2)	2054	
Female	328(53.2)	2137(54.8)	2465	0.4565
Site				
Malabar-Chifley-La Perouse	4(0.6)	56(1.4)	60	
Toongabbie	5(0.8)	101(2.6)	106	
Seven Hills	1(0.2)	158(4.1)	159	
Kempsey	54(8.7)	89(2.3)	143	
Tamworth-North	34(5.5)	107(2.7)	141	
Katoomba-Leura	5(0.8)	270(6.9)	275	
Padstow	1(0.2)	149(3.8)	150	
Warilla	2(0.3)	159(4.1)	161	
Coonamble	22(3.6)	1(0.03)	23	
Greystanes-Pemulwuy	0(0.0)	257(6.6)	257	
Wentworth Falls	0(0.0)	137(3.)	137	
Revesby	2(0.3)	143(3.7)	145	
Garbutt-West End	21(3.4)	33(0.8)	54	
Innisfail	38(6.2)	61(1. 6)	99	
Margate-Woody Point	0(0.0)	110(2.2)	110	
Mount Isa	73(11.8)	72(1.8)	145	
Clarinda-Oakleigh South	1(0.2)	160(4.1)	161	

Mornington	1(0.2)	115(3.0)	116	
East Bendigo-Kennington	5(0.8)	197(5.1)	202	
Montrose-Rosetta	6(1.0)	151(3.9)	157	
Christies Beach	20(3.2)	108(2.8)	128	
Port Augusta	81(13.1)	80(2.1)	161	
Katherine Region	124(20.1)	105(2.7)	229	
Parap	16(2.6)	86(2.2)	102	
Jingili	16(2.6)	82(2.1)	98	
Broome	65 (10.5)	66 (1.7)	131	
Rockingham	0(0.0)	207(5.3)	207	
Albany	12 (1.9)	174(4.4)	186	
Bayonet Head-Lower King	4 (0.6)	138 (3.5)	142	
Monash	4(0.7)	330(8.5)	334	<.0001
Employment status				
Employed	236(38.2)	935(24.0)	1171	
Retired	297(48.1)	2741(70.2)	3038	
Other	84(13.6)	226(5.8)	310	<.0001
Marital status				
Married	222(36.0)	2321(59.5)	2543	
De-facto	80(13.0)	178(4.6)	258	
Separated/Divorced	109(17.7)	588(15.1)	697	
Widowed	68(11.0)	506(13.0)	574	
Never Married	138(22.4)	309(7.9)	447	<.0001
Diabetes				
Yes	196(31.8)	530(13.6)	726	
No	420(68.1)	3361(86.1)	3781	
Not known	1(0.2)	11(0.3)	12	<.0001
Hypertension				
Yes	332(53.8)	1786(45.8)	2118	
No	284(46.0)	2110(54.1)	2394	
Not known	1(2)	6(0.1)	7	0.0010
High cholesterol				
Yes	302(49.0)	1715(44.0)	2017	
No	309(50.1)	2167(55.5)	2476	
Not known	6(1.0)	20(0.5)	26	0.0199
Remoteness				
Major Cities	46(7.5)	2460(63.0)	2506	
Inner Regional	99(16.0)	544(13.9)	643	
Outer Regional	188(30.5)	654(16.8)	842	
Remote/Very Remote*	284(46.0)	244(6.3)	528	<.0001

*Included participants from remote (Katherine and surrounds) and very remote areas (Mataranka) within the Katherine region. Mt Isa also included participants from Remote and very Remote areas.

The number of participants recruited at each of the 30 sites is also provided in **Table 4**.

There were 38.2% of Indigenous and 24.0% of non-Indigenous Australians currently employed in either full or part-time work. The prevalence of diabetes mellitus (either self-reported or diagnosed on pin prick) was 2.3 times higher in Indigenous participants compared to non-Indigenous participants (crude prevalence 31.8% vs. 13.6%, p<0.001). This represents a small reduction in the prevalence of diabetes compared to that found for Indigenous Australians in the NEHS[52] (37.1%), while the diabetes prevalence for non-Indigenous Australians remained similar (13.9%). Higher prevalence rates of hypertension (self-reported or measured at examination) were found among Indigenous (53.8%) compared to non-Indigenous participants (45.8%) (p=0.001). Slightly higher rates of hypercholesterolaemia (self-reported only) were found among Indigenous (49.0%) compared to non-Indigenous (44.0%) participants (p=0.02).

The highest proportion of Indigenous participants was recruited from Remote and very Remote sites (46.0%), while the highest proportion of non-Indigenous participants was recruited from Major Cities (63.0%, p<0.001).

Comparison of the AEEHS sample with the Australian population

Recruitment in the AEEHS was compared with the Australian 2021 population Census (**Table 5**). The AEEHS aimed to over-sample older participants (by deliberately selecting older SA1s) compared to the general population, in order to achieve greater power for those age groups in which the most severe vision and hearing impairment occurs. This

aim was achieved with higher proportions recruited for those aged 60+ years, and overall, particularly in those aged 70+ years. Indigenous persons aged 80 years or older comprised 8.3% and 4.2% of the AEEHS and Australian population, respectively, while the proportions of those aged 80 years or older for non-Indigenous participants were 19.0% and 12.2% respectively.

Table 5. Comparison of AEEHS and the Australian population

Indigenous N (%)		
Age Group (years)	**AEEHS**	**Australia 2021**
50-59	211 (34.2)	87,784 (50.6%)
60-69	238 (38.6)	55,335 (31.9%)
70-79	117 (19.0)	23,256 (13.4%)
80+	51 (8.3)	7, 207 (4.2%)
Total aged 50+	617 (100%)	173,582 (100%)
Non-Indigenous N (%)		
Age Group (years)	**AEEHS**	**Australia 2021**
50-59	582 (14.9)	3,074,764 (35.0%)
60-69	1188 (30.5)	2,700,600 (30.8%)
70-79	1389 (35.6)	1,930,842 (22.0%)
80+	743 (19.0)	1,072,443 (12.2%)
Total aged 50+	3902 (100%)	8,778,649 (100%)

Margin of error (precision) of the recruited sample size

The Indigenous sample size of 617 participants provides 80% power at a 95% confidence level (Type I error rate $\alpha = 0.05$), resulting in a margin of error (precision) of approximately 2–3% for prevalence estimates. For non-Indigenous participants, the sample size of 3,902 achieves the same power and confidence level, with a margin of error of approximately 1%. These margins indicate that the prevalence rates and any statistical analyses performed are subject to minimal error, reducing the potential for bias in this specific context.

Eye Study Findings

The Prevalence and Main Causes of Presenting Bilateral Vision Impairment and Blindness

The prevalence of presenting bilateral vision impairment was 2.3 times higher among Indigenous (11.0%) compared to non-Indigenous participants (4.7%, p<0.001, **Table 6**). The prevalence of presenting bilateral blindness was similar in Indigenous (0.2%) and non-Indigenous participants (0.2%, p=0.497).

After adjustment for age (also known as age standardisation, to the Census 2021 Australian population), the prevalence of bilateral vision impairment remained similar at 10.9% for Indigenous participants, and decreased to 3.8% for non-Indigenous participants, resulting in an almost 3-fold higher age-standardised prevalence in Indigenous participants; the overall age-standardised rate for all Australians was 5.1%. These age-standardised prevalences are lower than the age-standardised prevalences reported in the NEHS (13.6% in Indigenous and 4.6% in non-Indigenous participants, respectively)[1] suggesting there may be a small reduction in the prevalence of bilateral vision impairment in both groups within the Australian population over the intervening 8-9 years between the two surveys. After age-standardisation, the prevalence of blindness in Indigenous Australians increased to 0.4%, while that in non-Indigenous Australians remained similar at 0.2%. For the total combined sample, the rates of bilateral vision impairment were 5.6% (crude) and 5.1% (age-standardised), while rates of blindness were 0.2% (crude and age-standardised).

When these age-standardised prevalences are applied to the Australian population aged 50 years and older (2021 Census - 174,000 Indigenous and 9,331,000 non-Indigenous),

it can be estimated that there are 20,000 Indigenous and 375,000 non-Indigenous Australians who currently live with bilateral vision impairment or blindness.

Using the WHO definition of moderate vision impairment (presenting VA worse than 6/18 but better than 6/60), the crude prevalence of bilateral vision impairment was 1.9% in Indigenous Australians and 0.5% in non-Indigenous Australians. After age-standardisation, the prevalence increased to 2.4% in Indigenous Australians and remained similar at 0.4% in non-Indigenous Australians. Compared to the NEHS,[1] this represents an almost 50% reduction in the WHO moderate vision impairment prevalence in both Indigenous (4.6% to 2.4%) and non-Indigenous (1.0% to 0.4%) Australians. Nonetheless, the rates of WHO moderate vision impairment were still 6x greater among Indigenous compared with non-Indigenous Australians.

Table 6. Prevalence of Presenting Bilateral Vision Impairment and Blindness, Crude and Age-Standardised (or adjusted) to the Census 2021 Australian Population

	Indigenous		Non-Indigenous		Total		
	N	**% (95% CI)**	**N**	**% (95% CI)**	**N**	**% (95% CI)**	**p-value**
Crude prevalence							
None	548	88.8 (86.0–91.1)	3,709	95.1 (94.3–95.7)	4,257	94.2 (93.5–94.9)	<0.001
Vision impaired	**68**	**11.0 (8.7–13.8)**	**185**	**4.7 (4.1–5.5)**	**253**	**5.6 (5.0–6.3)**	**<0.001**
Blind	1	0.2 (0.0–1.0)	8	0.2 (0.1–0.4)	9	0.2 (0.1–0.4)	1
WHO VI definition	12	1.9 (1.1–3.5)	20	0.5 (0.3–0.8)	32	0.7 (0.5–1.0)	<0.001
Age-standardised prevalence							
None	548	93.0 (80.5-107.4)	3,709	97.1 (51.9-208.4)	4,257	96.2 (87.6-106.0)	0.918
Vision impaired	**68**	**10.9 (8.2-14.3)**	**185**	**3.8 (3.2-4.5)**	**253**	**5.1 (4.4-5.8)**	**<0.001**
Blind	1	0.4 (0.0-2.3)	8	0.2 (0.1-0.4)	9	0.2 (0.1-0.4)	0.730
WHO VI definition	12	2.4 (1-5.1)	20	0.4 (0.2-0.7)	32	0.7 (0.5-1.1)	0.054

CI = Confidence Interval; WHO = World Health Organisation; VI = Vision Impairment

Prevalence of Combined Bilateral Vision Impairment / Blindness by Age Group

The prevalence of combined presenting bilateral vision impairment and blindness for Indigenous and non-Indigenous participants differed markedly by age group (**Table 7**). For both Indigenous and non-Indigenous participants, the rates of bilateral vision impairment and blindness increased with age and were highest among those participants aged 80+ years.

Table 7. Prevalence of Combined Bilateral Vision Impairment/Blindness by Age Group

Age Group (years)	Indigenous		Non-Indigenous		Total	
	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)
50-59	17	9.8(6-15.4)	12	2.1(1.1-3.7)	29	3.8(2.6-5.5)
60-69	26	10.9(7.4-15.8)	26	2.2(1.5-3.2)	52	3.6(2.8-4.8)
70-79	16	13.7(8.3-21.6)	68	4.9(3.8-6.2)	84	5.6(4.5-6.9)
80+	10	19.6(10.3-33.5)	87	11.7(9.5-14.3)	97	12.2(10.1-14.7)

CI = Confidence Interval

The small number of participants with presenting bilateral blindness (n=9) were included with bilateral vision impairment (n = 253), in this analysis by age group, with a combined total of n = 262. In each age group, rates of combined bilateral vision impairment/ blindness were substantially higher in Indigenous compared to non-Indigenous participants. For those aged 50-59 years, bilateral vision impairment/ blindness was over 4 times more prevalent among Indigenous participants compared to non-Indigenous participants (9.8% vs 2.1% respectively, with the ratio rising to be ~5 times more prevalent in those aged 60-69 years (10.9% vs 2.2%). In those aged 70-79 years, bilateral vision impairment/ blindness was almost 3 times more prevalent in Indigenous

compared to non-Indigenous participants (13.7% vs 4.9%), and in those aged 80+ years the rates of bilateral vision impairment/ blindness were almost 2 times higher in Indigenous compared to non-Indigenous participants (19.6% vs 11.7%).

Table 8 shows the overall proportions of combined vision impairment/ blindness (n=262) and how this is distributed by each 10-year age group, among Indigenous and non-Indigenous participants. This analysis demonstrates that for Indigenous participants,

Table 8. Proportions of Combined Bilateral Vision Impairment/Blindness by Age Group

Age Group	Indigenous		Non-Indigenous		Total		
	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)	p-value
50-59	17	24.6 (15.4-36.7)	12	6.2 (3.4-10.9)	29	11.1 (7.7–15.7)	<0.001
60-69	26	37.7 (26.5-50.2)	26	13.5 (9.1-19.3)	52	19.8 (15.3–25.3)	<0.001
70-79	16	23.2 (14.2-35.2)	68	35.2 (28.6-42.5)	84	32.1 (26.5–38.1)	0.091
80+	10	14.5 (7.5-25.5)	87	45.1 (38.0-52.4)	97	37.0 (31.2–43.2)	<0.001

CI = Confidence Interval

>60% of vision impairment/ blindness was seen in participants aged under 70 years, whereas for non-Indigenous participants, the proportion recorded for ages under 70 years was low at <20%.

These findings emphasise the need to directly target relatively younger Indigenous populations with preventive and therapeutic measures to reduce the impact of vision impairment and blindness.

Prevalence of Combined Bilateral Vision Impairment and Blindness by Sex

In this study, sex had no significant association with the prevalence of combined presenting bilateral vision impairment or blindness among either Indigenous or non-Indigenous participants (**Table 9**).

Table 9. Prevalence of Combined Bilateral Vision Impairment and Blindness by Sex

	Indigenous				
	Male		Female		
	N	% (95% CI)	N	% (95% CI)	P value
None	256	88.6 (84.4-91.7)	292	89.0 (85.2-92.0)	0.396
Vision Impaired	33	11.4 (8.2-15.6)	35	10.7 (7.8-14.5)	0.444
Blind	0	NA	1	0.31 (0.05-1.7)	NA
	Non-Indigenous				
	Male		Female		
	N	% (95% CI)	N	% (95% CI)	P value
None	1669	94.5 (93.4-95.5)	2040	95.5 (94.5-96.3)	0.084
Vision Impaired	91	5.2 (4.2-6.3)	94	4.4 (3.6-5.4)	0.389
Blind	5	0.28(0.12-0.66)	3	0.14 (0.05-0.41)	0.481

CI = Confidence Interval; NA = Not Applicable

The prevalence of bilateral vision impairment was 11.4% among Indigenous males and 10.7% in Indigenous females (p=0.44), and 5.2% among non-Indigenous males and 4.4% in non-Indigenous females (p=0.39). Similarly, blindness prevalence did not differ significantly between males and females for either Indigenous or non-Indigenous participants (**Table 9**).

Prevalence of Combined Bilateral Vision Impairment/Blindness by Geographic Remoteness

Table 10 shows differences in the distribution of combined bilateral vision impairment/ blindness by remoteness status. Most bilateral vision impairment/blindness in both

Indigenous and non-Indigenous Australians was found in Remote/Very Remote geographical settings (crude prevalence 15.8% and 12.3% respectively, and age-standardised prevalence 15.8% and 11.4% respectively), while the lowest rates were found in Outer Regional areas for Indigenous Australians (crude 4.7%, age-standardised 6.3%), and in Inner Regional areas for non-Indigenous Australians (crude 2.4%, age-standardised 1.8%). In most geographic remoteness areas (Major Cities, Outer Regional, and Remote/Very Remote) the prevalence of bilateral vision impairment in Indigenous and non-Indigenous Australians was similar, except in Inner Regional settings where Indigenous Australians were 5 times more likely to have vision impairment than non-Indigenous Australians (crude prevalence 9.4% vs 2.4%, age-standardised prevalence 11.0% vs 1.8%, $p<0.0001$ for both).

Regarding the prevalence of bilateral blindness, one Indigenous participant in a Remote area and eight non-Indigenous participants in Major Cities met bilateral blindness criteria. Due to small numbers, no further analyses were performed separately for bilateral blindness by geographical remoteness area. Among all participants, the age-standardised prevalence of combined bilateral vision impairment/blindness was similar in Major Cities, Inner Regional and Outer Regional areas (3-4%), and highest in Remote/Very Remote areas (15.3%).

The proportions of combined bilateral vision impairment/ blindness of participants by remoteness category were assessed to indicate where most vision impairment/ blindness occurs (data not shown). This result reflected the domicile of those examined; age-standardised data indicate that ~64% of Indigenous participants with bilateral vision

impairment/ blindness were from remote/very remote or outer regional zones, whereas for non-Indigenous participants, ~60% were from major cities or inner regional zones.

Table 10: Prevalence of Combined Presenting Bilateral Vision Impairment/ Blindness by Remoteness

Remoteness level	Indigenous		Non-Indigenous		Total	
	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)
Crude prevalence of bilateral vision impairment/ blindness						
Major Cities	2	4.3 (0.8-16)	123	5.0 (4.2-6)	125	5.0 (4.2-5.9)
Inner Regional	7	7.1 (3.1-14.5)	10	1.8 (0.9-3.5)	17	2.6 (1.6-4.3)
Outer Regional	15	8.0 (4.7-13.1)	30	4.6 (3.2-6.6)	45	5.3 (4.0-7.1)
*Remote/ Very Remote	45	15.8 (11.9-20.7)	30	12.3 (8.6-17.2)	75	14.2 (11.4-17.5)
Age standardised prevalence of bilateral vision impairment/ blindness						
Major Cities	2	9.4 (1.1-36.0)	123	3.8 (3.1-4.6)	125	3.8 (3.1-4.6)
Inner Regional	7	9.8 (3.3-23.2)	10	2.1 (0.8-5.3)	17	2.8 (1.4-5.2)
Outer Regional	15	7.0 (3.1-14.6)	30	4.1 (2.4-6.8)	45	5.1 (3.5-7.2)
*Remote/ Very Remote	45	15.8 (11.4-21.7)	30	11.4 (7.7-16.7)	75	15.3 (12.0-19.3)

*Participants in Katherine region included remote and very remote residents (Mataranka). Mt Isa also included remote and very remote residential areas.

Main Causes of Presenting Bilateral Vision Impairment and Blindness

The most frequent cause of presenting bilateral vision impairment in both Indigenous and non-Indigenous participants was uncorrected refractive error, which was responsible for bilateral vision impairment in 38.2% and 41.6% of participants, respectively (**Table 11**).

Cataract was the 2nd most frequent cause of bilateral vision impairment among both Indigenous and non-Indigenous participants, with 33.8% and 29.2% of vision impairment attributable to unoperated cataract, respectively. Among Indigenous participants, diabetic retinopathy was the 3rd leading cause of vision impairment, being responsible for 14.7% of bilateral vision impairment, while in non-Indigenous participants, AMD was the 3rd leading cause of vision impairment, responsible for 16.8% of bilateral vision impairment. These proportions were somewhat different for the 4th leading cause of vision impairment, which was AMD for Indigenous participants (4.4%) and glaucoma in non-Indigenous participants (3.8%). Glaucoma and diabetic retinopathy were the 5th leading cause of bilateral vision impairment in Indigenous (4.4%) and non-Indigenous (3.2%) participants, respectively.

The prevalence of AMD and diabetic retinopathy were significantly different between Indigenous and non-Indigenous participants ($p<0.05$ for both), while the prevalence of other ocular diseases was broadly similar. Other causes of vision impairment, e.g. retinal vein occlusion, macular dystrophy, retinitis pigmentosa, neuro-ophthalmic pathology, etc, were responsible for 4.4% of vision impairment in Indigenous, and 5.4% in non-Indigenous participants, respectively. In the overall population, the main causes of bilateral vision impairment were uncorrected refractive error (40.7%), cataract (30.4%), AMD (13.4%), diabetic retinopathy (6.3%), glaucoma (4.0%) and other causes (5.1%).

In contrast to the main causes of presenting bilateral vision impairment, the main cause of presenting bilateral blindness in Indigenous participants was diabetic retinopathy (1 participant), while the main causes in non-Indigenous participants were AMD (3

participants), diabetic retinopathy (1), glaucoma (1) and other (3). These numbers should be interpreted with caution, however, as the total number of participants with presenting bilateral blindness was low at only nine individuals. No cases of bilateral vision loss or blindness from trachoma were found in this survey.

These data suggest that 80-90% of bilateral vision impairment and blindness among both Indigenous and non-Indigenous Australians may be preventable or potentially treatable. This was estimated by combining the major treatable conditions (i.e. where vision loss can be reversed) responsible for most of the bilateral vision impairment and blindness in Australia (uncorrected refractive error, cataract, AMD and diabetic retinopathy) as a percentage of all bilateral vision impairment and blindness.

Comparison of Changes in Main Causes of Vision Impairment between NEHS and AEEHS

The NEHS was conducted from 2015 to 2016, and the follow-up AEEHS from 2023 to 2025, representing an interval of 8-9 years between the two surveys. **Figure 5** shows the changes in the main causes of bilateral vision impairment in Indigenous participants, while **Figure 6** shows the changes in non-Indigenous participants. It should be noted that the grading of eye disease between the two surveys differed somewhat, with NEHS grading utilising portable (Keeler) clinical slit lamp examination and undilated fundus photos,[53] while the AEEHS grading utilised mainstream (Haag-Streit) slit lamp examination, dilated fundus photographs and OCT and OCT angiography scanning.

Among both Indigenous (**Figure 5**) and non-Indigenous (**Figure 6**) Australians, there was a considerable reduction in the proportion of bilateral vision impairment attributable to

Table 10. Main Causes of Bilateral Vision Impairment and Blindness in the AEEHS

	Indigenous		Non-Indigenous		Total		
	N	**% (95% CI)**	**N**	**% (95% CI)**	**N**	**% (95% CI)**	**p-value**
Main cause of bilateral vision impairment (VA worse than 6/12 but better than or equal to 6/60)							
Uncorrected refractive error	26	38.2 (27.0–50.9)	77	41.6 (34.5–49.1)	103	40.7 (34.7–47.1)	0.733
Cataract	23	33.8 (23.1–46.4)	54	29.2 (22.9–36.4)	77	30.4 (24.9–36.6)	0.578
Diabetic retinopathy	10	14.7 (7.7–25.8)	6	3.2 (1.3–7.3)	16	6.3 (3.8–10.3)	0.002
AMD	3	4.4 (1.1–13.2)	31	16.8 (11.8–23.1)	34	13.4 (9.6–18.4)	0.019
Glaucoma	3	4.4 (1.1–13.2)	7	3.8 (1.7–8.0)	10	4.0 (2.0–7.4)	1
Other*	3	4.4 (1.1–13.2)	10	5.4 (2.8–10.0)	13	5.1 (2.9–8.8)	1
Main cause of bilateral blindness (VA worse than 6/60)							
Uncorrected refractive error	0		0		0		NA
Cataract	0		0		0		NA
AMD	0		3	37.5 (8.5–75.5)	3	1.2 (0.3–3.7)	NA
Diabetic retinopathy	1	100.0 (2.5–100.0)	1	12.5 (0.3–52.7)	2	0.8 (0.1–3.1)	NA
Glaucoma	0		1	12.5 (0.3–52.7)	1	0.4 (0.0–2.5)	NA
Other**	0		3	37.5 (8.5–75.5)	3	1.2 (0.3–3.7)	NA

AMD = Age-related Macular Degeneration; CI = Confidence Intervals; VA = Presenting

* Other causes of bilateral vision impairment were retinal vein occlusion (n=4), nystagmus (2), macular telangiectasia type 2 (1), Duane syndrome (amblyopia, 1), foveal hypoplasia (albinism, 1), epiretinal membrane (1), corneal scar (1), macular dystrophy (1), myopic degeneration (1).

** Other causes of bilateral blindness were retinitis pigmentosa (n=1), macular dystrophy (1), and foveal hypoplasia (albinism, 1).

uncorrected refractive error, from 63.4% and 61.7% respectively in NEHS,[1] down to 38.2% and 41.6% in AEEHS, respectively. There was a corresponding increase in the proportion of bilateral vision impairment attributable to cataract, AMD, diabetic retinopathy and glaucoma in both Indigenous and non-Indigenous Australians.

Figure 5. Changes in the Main Causes of Presenting Bilateral Vision Impairment between NEHS and AEEHS surveys, in Indigenous Australians

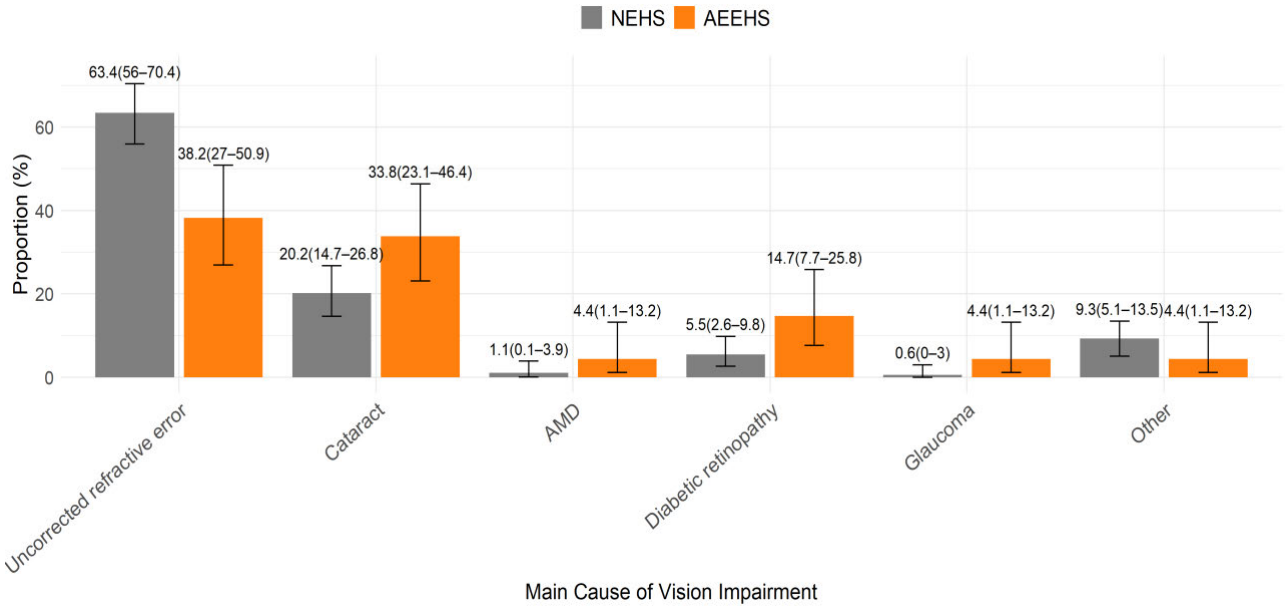


Figure 6. Changes in the Main Causes of Presenting Bilateral Vision Impairment between NEHS and AEEHS surveys, in Non-Indigenous Australians

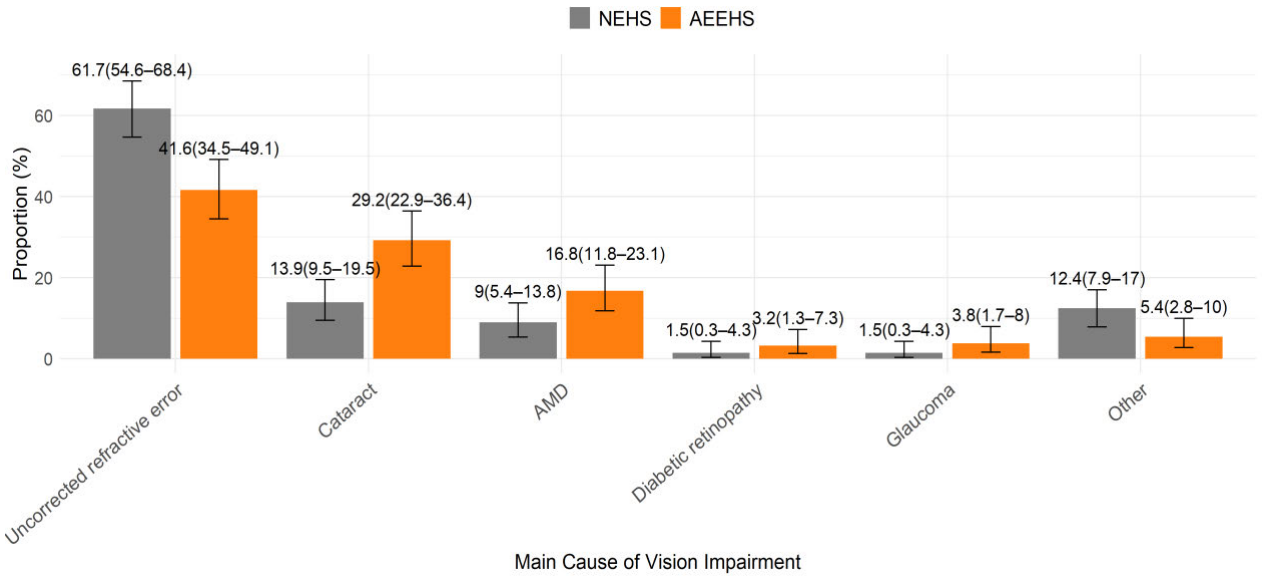


Table 12 shows the mean age of participants by cause of combined bilateral vision impairment/ blindness. Among Indigenous participants, younger participants (around 60 years of age) with vision impairment/ blindness tended to have conditions such as diabetic retinopathy, glaucoma and uncorrected refractive error; older Indigenous participants (around 70+ years of age) tended to have conditions such as cataract and AMD. Indigenous participants with diabetic retinopathy were the youngest, with a mean age of 59.0 years, while participants with AMD were the oldest, with a mean age of 79.3 years.

Among non-Indigenous participants, a different pattern was observed, with an older mean age for all conditions. The youngest participants with combined bilateral vision impairment/blindness were again those with diabetic retinopathy, but this occurred almost a decade later (67.9 years of age). Among Indigenous participants, AMD was the main cause in the oldest participants (84.1 years), followed by glaucoma (80.9 years) and cataract.

Table 13 shows that among Indigenous participants, combined bilateral vision impairment/ blindness was caused by a higher proportion of uncorrected refractive error in women, who had a lower proportion of vision impairment/ blindness due to cataract. Among Indigenous male participants, cataract (45.2%), uncorrected refractive error (25.8%) and diabetic retinopathy (9.7%) were the main causes of bilateral vision impairment/ blindness, while in Indigenous females, uncorrected refractive error (47.4%), cataract (23.7%) and diabetic retinopathy (21.1%) were the main causes.

Among non-Indigenous participants, the main causes of combined bilateral vision impairment/ blindness were similar among males and females, with uncorrected refractive error (40.6%, 39.2%), cataract (21.9%, 34.0%) and AMD (18.8%, 16.5%) being the main causes.

Table 11. Mean Age of Participants with Major Causes of Combined Bilateral Vision Impairment/Blindness

	Indigenous		Non-Indigenous		Total		
	N	**Mean age (SD)**	**N**	**Mean age (SD)**	**N**	**Mean age (SD)**	**p-value**
Uncorrected refractive error	26	63.0 (7.8)	77	74.0 (10.2)	103	71.2 (10.7)	<0.001
Cataract	23	73.3 (8.6)	54	77.0 (9.0)	77	75.9 (9.0)	0.097
Diabetic retinopathy	11	59.0 (6.6)	7	67.9 (9.6)	18	62.4 (8.8)	0.059
AMD	3	79.3 (12.5)	34	84.1 (6.2)	37	83.8 (6.8)	0.575
Glaucoma	3	67.7 (16.6)	8	80.9 (6.8)	11	77.3 (11.2)	0.301
Other	3	70.7 (10.1)	13	74.7 (9.8)	16	73.9 (9.6)	0.576

AMD = age-related macular degeneration; SD = Standard Deviation

Table 12. Proportions of the Major Causes of Combined Presenting Bilateral Vision Impairment/ Blindness among Men and Women

	Indigenous				
	Male		Female		
	N	% (95% CI)	N	% (95% CI)	P value
Uncorrected refractive error	8	25.8(12.5–44.9)	18	47.4(31.3–64.0)	0.112
Cataract	14	45.2(27.8–63.7)	9	23.7(12.0–40.6)	0.104
Diabetic retinopathy	3	9.7(2.5–26.9)	8	21.1(10.1–37.8)	0.340
AMD	1	3.2(0.2–18.5)	2	5.3(0.9–19.1)	1
Glaucoma	2	6.5(1.1–22.8)	1	2.6(0.1–15.4)	0.857
Other	3	9.7(2.5–26.9)			
Total	31	100	38	100	
	Non-Indigenous				
	Male		Female		
	N	% (95% CI)	N	% (95% CI)	P value
Uncorrected refractive error	39	40.6(30.9–51.1)	38	39.2(29.6–49.6)	0.953
Cataract	21	21.9(14.3–31.7)	33	34.0(24.9–44.4)	0.086
AMD	18	18.8(11.8–28.3)	16	16.5(10.0–25.7)	0.824
Diabetic retinopathy	6	6.2(2.6–13.6)	1	1.0(0.1–6.4)	0.120
Glaucoma	4	4.2(1.3–10.9)	4	4.1(1.3–10.8)	1
Other	8	8.3(3.9–16.2)	5	5.2(1.9–12.2)	0.553
Total	96	100	97	100	

CI = Confidence Intervals

Relative Impact of Different Eye Conditions on Visual Acuity

As a measure of the potential relative importance of each cause of bilateral vision impairment, we assessed the highest visual acuity level for each main cause, by the better, worse or average visual acuity (VA) of the two eyes. This analysis is shown in **Table 14** for all persons and in **Tables 15** and **16** for Indigenous and non-Indigenous participants, respectively.

The analysis for all persons examined (**Table 14**) shows that the level of reduced visual acuity below 40 letters (<6/12 in both eyes) was least for uncorrected refractive error, with a mean LogMAR VA for two eyes = 35 letters read. This corresponds to a Snellen equivalent of 6/15, one line below the cut-point of 6/12, and was followed by cataract (32 letters, 6/18 partly). Specific eye diseases like AMD (24 letters; Snellen 6/24 partly), diabetic retinopathy (26 letters), glaucoma (23 letters) and other causes (20 letters), had an increasingly greater impact on reduced LogMAR VA level, or Snellen acuity.

These findings suggest that the visual impact from uncorrected refractive error may be substantially less than for other main causes of vision impairment, so that the potential impact from specific eye disease may be substantially greater than for uncorrected refractive error. More detailed analyses of variables that assess impacts from vision impairment will be needed. The pattern of these impacts was relatively similar for Indigenous and non-Indigenous participants, assessed separately (**Tables 15, 16**). Uncorrected refractive error had the least impact on numerically reduced VA for all, and for Indigenous and non-Indigenous participants, respectively.

Table 13. Average VA (LogMAR letters) of the Better, Worse and Average of 2 eyes, for Main Causes of Bilateral Visual Impairment in All Participants

Condition	Mean VA in better eye	Mean VA in worse eye	Mean VA (average of 2 eyes) + Snellen equivalent	
Uncorrected refractive error	37.13	33.55	35.34	6/15
Cataract	36.01	28.29	32.15	6/18 partly
AMD	31.16	16.59	23.88	6/24 partly
Diabetic retinopathy	30.00	21.44	25.72	6/24
Glaucoma	31.64	14.55	23.09	6/24 partly
Other	27.81	12.75	20.28	6/30

VA = Visual Acuity assessed by number of LogMAR letters read; AMD = Age related macular degeneration

Table 14. Average VA (LogMAR letters) of the Better, Worse and Average of 2 eyes, for Main Causes of Bilateral Visual Impairment in Indigenous Participants

Condition	Mean VA in better eye	Mean VA in worse eye	Mean VA (average of 2 eyes) +	Snellen equivalent
Uncorrected refractive error	34.58	30.88	32.73	6/18 +
Cataract	34.70	23.87	29.28	6/18 partly
AMD	37.67	29.67	33.67	6/18 +
Diabetic retinopathy	29.18	20.45	24.82	6/24
Glaucoma	31.00	0.00	15.50	6/36
Other	34.33	12.33	23.33	6/24

VA = Visual Acuity assessed by number of LogMAR letters read; AMD = Age-related macular degeneration

Table 15. Average VA (LogMAR letters) of the Better, Worse and Average of 2 eyes, for Main Causes of Bilateral Visual Impairment in non-Indigenous Participants

Condition	Mean VA in better eye	Mean VA in worse eye	Mean VA (average of 2 eyes) +	Snellen equivalent
Uncorrected refractive error	37.99	34.45	36.22	6/15 +
Cataract	36.57	30.17	33.37	6/18 +
AMD	31.59	15.44	23.01	6/24 partly
Diabetic retinopathy	31.29	23.00	27.14	6/24 +
Glaucoma	31.88	20.00	25.94	6/24 +
Other	26.31	12.85	19.58	6/30 partly

VA = Visual Acuity assessed by number of LogMAR letters read; AMD = Age-related macular degeneration

Major Eye Disease Causes of Vision Impairment, after excluding Uncorrected Refractive Error

Refractive error stands somewhat apart from other causes of vision impairment and blindness as it is generally readily remediable (or "correctable") through non-invasive means such as spectacles and contact lenses. The visual impact from refractive error is also generally milder than other forms of eye conditions (**Tables 14, 15, 16)**. Refractive error also often co-exists with other eye conditions, and it should be acknowledged that in many cases, multiple causes were found for bilateral vision impairment and blindness,

but we have tried to identify the main cause, using the extensive imaging and functional tests performed on each eye. Among participants found to have eye disease (cataract, AMD, diabetic retinopathy, glaucoma, other causes), as their main cause, some participants were identified as having a minor component caused by uncorrected refractive error. Similarly, cataract was also identified as a contributor to many participants, in which uncorrected refractive error was identified as the main cause.

Excluding participants with uncorrected refractive error as their main cause for bilateral vision impairment leaves the eye disease causes of vision loss that are "non-correctable (by refraction)", but which are still remediable through more interventional means. This provides a concept of the size of the challenge in addressing each of the main causes of vision impairment in Australia. **Table 17** provides this analysis by showing the frequencies of the main causes of bilateral vision impairment after excluding refractive error. Cataract then became the most frequent cause of bilateral vision impairment and accounted for more than half of the cases (51%). This was similar for Indigenous and non-Indigenous groups, and is also potentially the most remediable, through cataract surgery.

Diabetic retinopathy accounted for 11% of bilateral vision impairment, excluding refractive error, and was the second leading cause of bilateral blindness (22%). It was greater for Indigenous than non-Indigenous persons, likely reflecting the higher Indigenous rates for diabetes, shown in **Table 4**, as well as potentially reduced access to eye care in non-urban communities.

Table 16. Main Eye Disease Causes of Bilateral Vision Impairment (<6/12 to 6/60), after excluding Uncorrected Refractive Error

	Indigenous		Non-Indigenous		Total		
	N	**% (95% CI)**	**N**	**% (95% CI)**	**N**	**% (95% CI)**	**p-value**
Main cause of bilateral vision impairment (VA worse than 6/12 but better than or equal to 6/60)							
Cataract	23	54.5 (39.9-68.8)	54	50.0 (40.7-59.3)	77	51.3 (43.4-59.2)	0.73
Diabetic retinopathy	10	23.8 (13.5-38.5)	6	5.6 (2.6-11.6)	16	10.7 (6.7-16.6)	0.003
AMD	3	7.1 (2.5-19.0)	31	28.7 (21.0-37.9)	34	22.7 (16.7-30.0)	0.009
Glaucoma	3	7.1 (2.5-19.0)	7	6.5 (3.2-12.8)	10	6.7 (3.7-11.8)	0.99
Other	3	7.1 (2.5-19.0)	10	9.3 (5.1-16.2)	13	8.7 (5.1-14.3)	0.93
Total n	42		108		150		
Main cause of blindness (VA worse than 6/60)							
Cataract	0	NA	0		0		NA
AMD	0	NA	3	37.5 (13.7-69.4)	3	33.3 (12.1-64.6)	NA
Diabetic retinopathy	1	100.0	1	12.5 (2.2-47.1)	2	22.2 (6.3-54.7)	NA
Glaucoma	0	NA	1	12.5 (2.2-47.1)	1	11.1 (2.0-43.5)	NA
Other	0	NA	3	37.5 (13.7-69.4)	3	33.3 (12.1-64.6)	NA
Total n	1		8		9		

VA= Visual acuity; CI=Confidence intervals; NA=Not applicable

Bilateral vision impairment from glaucoma was less frequent (7%), relatively similar between Indigenous and non-Indigenous participants, and a cause of bilateral blindness (11%). However, this analysis likely underestimates the impact of glaucoma, as reduced visual acuity is a poor measure of the loss of vision function caused by glaucoma, in which substantive peripheral visual field loss can severely impact function and limit activities like driving before central visual acuity is significantly reduced.

Prevalence of Unilateral Vision Impairment and Blindness

Further analyses were performed to determine the prevalence and causes of unilateral vision impairment and blindness. Many studies have shown that unilateral vision impairment, while less disabling than bilateral vision impairment, still has a significant effect on visual function and health-related quality of life.[15,16,54] **Table 18** shows that the crude prevalence of unilateral vision impairment and blindness among Indigenous and non-Indigenous participants was 8.6%, 1.3% and 6.1%, 1.7%, respectively. After age-standardisation, these prevalences reduced to 6.7%, 1.1% and 4.9%, 1.5%, respectively. After age standardisation, the rates for unilateral vision impairment and blindness were similar among both Indigenous and non-Indigenous Australians.

These rates of unilateral vision impairment are lower than those for bilateral vision impairment in Indigenous (6.7% vs 10.9%) but higher for non-Indigenous (4.8% vs 3.8%) Australians. The prevalence of unilateral blindness, however, was higher than for bilateral blindness among both Indigenous (1.1% vs 0.4%) and non-Indigenous (1.5% vs 0.2%) participants.

Compared to the NEHS,[55] the AEEHS data indicate that there appears to have been a substantial reduction in unilateral vision loss for both Indigenous (18.7% to 6.7%) and non-Indigenous (14.5% to 4.9%) Australians, respectively; rates of unilateral blindness among Indigenous Australians may have also declined considerably (2.9% to 1.1%) while remaining similar for non-Indigenous Australians (1.3% to 1.5%).[55]

As we observed with bilateral vision impairment, the prevalence of unilateral vision impairment rose with age, from 8.5% and 2.9% among Indigenous and non-Indigenous participants aged 50-59 years, to 11.8% and 12.0% for those aged 80+ years (**Table 19**).

As with bilateral vision impairment, the prevalence of unilateral vision impairment was higher among Indigenous than non-Indigenous Australians for all age groups (though to a lesser extent than for bilateral vision impairment) except for those aged 80+ years, where the prevalences were similar.

The main causes of unilateral vision impairment (**Table 20**) were similar to those for bilateral vision impairment; however, the relative importance of the causes is different. The leading cause, by far, of unilateral vision impairment among Indigenous Australians and to a lesser extent, non-Indigenous Australians, was cataract (50.9% and 35.1% respectively), followed by uncorrected refractive error (15.1% and 25.5% respectively). As for bilateral vision impairment, diabetic retinopathy (7.5%) and AMD (12.6%) were the 3rd leading causes of unilateral vision impairment for Indigenous and non-Indigenous Australians, respectively.

Table 17. Prevalence of Presenting Unilateral Vision Impairment and Blindness, Crude and Age-Standardised to the Census 2021 Australian Population

	Indigenous		Non-Indigenous		Total		
	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)	p-value
Crude prevalence							
None	556	90.1 (87.4–92.3)	3,598	92.2 (91.3–93.0)	4,154	91.9 (91.1–92.7)	0.090
Vision impaired	53	8.6 (6.6–11.2)	239	6.1 (5.4–6.9)	292	6.5 (5.8–7.2)	0.026
Blind	8	1.3 (0.6–2.6)	65	1.7 (1.3–2.1)	73	1.6 (1.3–2.0)	0.614
Age-standardised prevalence							
None	556	92.6(80.3-106.9)	3,598	95.3(50.2-206.8)	4,154	94(85.5-103.8)	0.947
Vision impaired	53	6.7(4.4-11.2)	239	4.9(4.2-5.6)	292	4.9(3.5-7.8)	0.301
Blind	8	1.1(0.4-2.5)	65	1.5(1.1-2.1)	73	1.5(1.1-2)	0.437

CI = Confidence Interval

Table 18. Prevalence of Combined Unilateral Vision Impairment/Blindness by Age Group

	Indigenous		Non-Indigenous		Total	
Age Group (years)	**N**	**% (95% CI)**	**N**	**% (95% CI)**	**N**	**% (95% CI)**
50-59	18	8.5 (5.3-13.4)	17	2.9 (1.8-4.7)	35	4.4 (3.1-6.1)
60-69	22	9.2 (6-13.8)	79	6.6 (5.3-8.3)	101	7.1 (5.8-8.6)
70-79	15	12.8 (7.6-20.6)	119	8.6 (7.2-10.2)	134	8.9 (7.5-10.5)
80+	6	11.8 (4.9-24.6)	89	12.0 (9.8-14.6)	95	12.0 (9.8-14.5)

Cataract was also the leading cause of unilateral blindness among Indigenous and non-Indigenous Australians (37.5% and 23.1%, **Table 20**). However, other causes were responsible for ~50% of unilateral blindness for both Indigenous and non-Indigenous participants.

The NEHS also reported that cataract and uncorrected refractive error were the main causes of unilateral vision impairment in both Indigenous (75%) and non-Indigenous Australians (70%); however, in the NEHS, uncorrected refractive was much more prevalent than cataract among both Indigenous (64.5% vs 10.7%) and non-Indigenous (56.7% vs 13.7%) Australians.[55]

Table 19. Main Causes of Unilateral Vision Impairment and Blindness

	Indigenous		Non-Indigenous		Total		
	N	**% (95% CI)**	**N**	**% (95% CI)**	**N**	**% (95% CI)**	**p-value**
Main cause of unilateral vision impairment (VA worse than 6/12 but better than or equal to 6/60)							
Cataract	27	50.9(37.0–64.7)	84	35.1(29.2–41.6)	111	38.0(32.5–43.9)	0.047
Uncorrected refractive error	8	15.1(7.2–28.1)	61	25.5(20.2–31.6)	69	23.6(19.0–29.0)	0.150
AMD	1	1.9 (0.1–11.4)	30	12.6(8.8–17.6)	31	10.6(7.4–14.9)	0.042
Diabetic retinopathy	4	7.5 (2.4–19.1)	8	3.3(1.6–6.7)	12	4.1 (2.2–7.3)	0.312
Glaucoma	2	3.8 (0.7–14.1)	14	5.9(3.4–9.8)	16	5.5 (3.3–8.9)	0.787
Others*	11	20.8(11.3–34.5)	42	17.6(13.1–23.1)	53	18.2(14.0–23.2)	0.729
Total n	53	100	239	100	292	100	
Main cause of unilateral blindness (VA worse than 6/60)							
Cataract	3	37.5(10.2–74.1)	15	23.1(13.9–35.5)	18	24.7(15.6–36.4)	0.647
Uncorrected refractive error	0	0.0	2	3.1 (0.5–11.6)	2	2.7 (0.5–10.4)	
AMD	1	12.5(0.7–53.3)	11	16.9(9.1–28.7)	12	16.4 (9.1–27.3)	1.000
Diabetic retinopathy	0	0.0	2	3.1 (0.5–11.6)	2	2.7 (0.5–10.4)	
Glaucoma	0	0.0	3	4.6 (1.2–13.8)	3	4.1 (1.1–12.3)	
Others*	4	50.0(21.5–78.5)	32	49.2(36.7–61.8)	36	49.3(37.5–61.2)	1.000
Total n	8	100	65	100	73	100	

AMD = Age-related Macular Degeneration; CI = Confidence Intervals; VA = Presenting Snellen Visual Acuity; NA = Not Applicable

* Further details on “Other causes” in subsequent tables.

Table 21 shows the other significant causes of combined unilateral vision impairment and blindness. In addition to the five main causes of unilateral vision impairment and blindness described earlier, corneal diseases, optic nerve disease, enucleation, and cortical visual loss were also responsible for considerable numbers (1-3%) of unilateral vision impairment and blindness, with similar prevalences among Indigenous and non-Indigenous Australians. These numbers are low, however, and should be interpreted with caution. Other macular/retinal diseases were responsible for 13-15% of unilateral vision impairment/ blindness, with the major retinal conditions being retinal vein occlusions (~3%), myopic degeneration (~2%), epiretinal membrane (~2%), macular hole (~2-3%) and previous retinal detachment (1-3%).

Table 20. Main Causes of Combined Unilateral Vision Impairment/ Blindness

	Indigenous		Non-Indigenous		Total		
	N	**% (95% CI)**	**N**	**% (95% CI)**	**N**	**% (95% CI)**	**p-value**
Main cause of combined unilateral vision impairment/blindness							
Cataract (+surgery complications)	30	49.2 (36.3–62.2)	99	32.6 (27.4–38.2)	129	35.3 (30.5–40.5)	0.020
Uncorrected refractive error	8	13.1 (6.2–24.8)	63	20.7 (16.4–25.8)	71	19.5 (15.6–24.0)	0.233
AMD	2	3.3 (0.6–12.4)	41	13.5 (10.0–18.0)	43	11.8 (8.7–15.6)	0.041
Glaucoma	2	3.3 (0.6–12.4)	17	5.6 (3.4–9.0)	19	5.2 (3.2–8.1)	0.670
Amblyopia	3	4.9 (1.3–14.6)	12	3.9 (2.2–7.0)	15	4.1 (2.4–6.8)	1.000
Diabetic retinopathy	4	6.6 (2.1–16.7)	10	3.3 (1.7–6.2)	14	3.8 (2.2–6.5)	0.397
Corneal diseases	1	1.6 (0.1–10.0)	6	2.0 (0.8–4.5)	7	1.9 (0.8–4.1)	1.000
Optic nerve diseases	0	0.0	6	2.0 (0.8–4.5)	6	1.6 (0.7–3.7)	NA
Enucleation	1	1.6 (0.1–10.0)	4	1.3 (0.4–3.6)	5	1.4 (0.5–3.4)	1.000
Cortical visual loss	2	3.3 (0.6–12.4)	0	0.0	2	0.5 (0.1–2.2)	NA
Other macular/retinal	8	13.1 (6.2–24.8)	46	15.1 (11.4–19.8)	54	14.8 (11.4–19.0)	0.836
Retinal Vein Occlusion	2	3.3 (0.6–12.4)	9	3.0 (1.5–5.7)	11	3.0 (1.6–5.5)	1.000
Myopic degeneration	1	1.6 (0.1–10.0)	7	2.3 (1.0–4.9)	8	2.2 (1.0–4.4)	1.000
Epiretinal membrane	1	1.6 (0.1–10.0)	6	2.0 (0.8–4.5)	7	1.9 (0.8–4.1)	1.000
Macular Hole	2	3.3 (0.6–12.4)	5	1.6 (0.6–4.0)	7	1.9 (0.8–4.1)	0.736
Vitreomacular traction	0	0.0	2	0.7 (0.1–2.6)	2	0.5 (0.1–2.2)	NA
Retinal Detachment	2	3.3 (0.6–12.4)	2	0.7 (0.1–2.6)	4	1.1 (0.4–3.0)	0.262
Pachychoroid Disease (+ central serous choroidopathy	0	0.0	5	1.6 (0.6–4.0)	5	1.4 (0.5–3.4)	NA
Chorioretinal atrophy	0	0.0	5	1.6 (0.6–4.0)	5	1.4 (0.5–3.4)	NA
Chorioretinal scar -retinitis	0	0.0	3	1.0 (0.3–3.1)	3	0.8 (0.2–2.6)	NA
Macular Telangiectasia type 2	1	1.6 (0.1–10.0)	2	0.7 (0.1–2.6)	3	0.8 (0.2–2.6)	1.000
Total n	61	100	304	100	365	100	NA

AMD = Age-related Macular Degeneration; CI = Confidence Intervals; NA = Not Applicable

Once unilateral vision impairment from uncorrected refractive error is excluded, the main causes of unilateral vision impairment are shown in **Table 22.** Based on these AEEHS data, cataract is now the leading cause of non-correctable unilateral vision impairment, accounting for 50-60% of unilateral vision impairment among Indigenous and non-Indigenous Australians. This is a somewhat higher proportion of vision impairment due to cataract than for bilateral vision impairment (~40% for Indigenous and non-Indigenous Australians). AMD, glaucoma and diabetic retinopathy were the next most common causes of unilateral vision impairment, as with the causes for bilateral vision impairment. Amblyopia was a common cause of unilateral vision impairment, but not for bilateral vision impairment. Cataract was also the leading cause of unilateral blindness among Indigenous and non-Indigenous Australians (**Table 23**). These results are like those reported from the BMES, which also found cataract, followed by AMD, were the most common causes of non-correctable unilateral vision impairment.[56,57]

Further details of major eye causes of combined unilateral vision impairment/ blindness after excluding refractive error are listed in **Table 23**. Again, cataract, followed by AMD, were the main causes, with glaucoma, amblyopia and diabetic retinopathy being the next most common causes. A long list of other less common eye diseases (e.g. corneal disease, optic nerve diseases, retinal vein occlusion, epiretinal membrane), that occurred at lower frequencies (~1 to 4%), were responsible for the remainder of unilateral vision impairment/ blindness. The prevalence of these conditions was generally similar between Indigenous and non-Indigenous Australians.

Table 21. Main Eye Disease Causes of Unilateral Vision Impairment (<6/12 to 6/60) and Blindness (<6/60), after excluding Uncorrected Refractive Error

	Indigenous		Non-Indigenous		Total		
	N	**% (95% CI)**	**N**	**% (95% CI)**	**N**	**% (95% CI)**	**p-value**
Main cause of vision impairment (VA worse than 6/12 but better than 6/60)							
Cataract	27	60.0 (44.4–73.9)	84	47.2 (39.7–54.8)	111	49.8 (43.1–56.5)	0.171
AMD	1	2.2 (0.1–13.2)	30	16.9 (11.8–23.3)	31	13.9 (9.8–19.3)	0.022
Diabetic retinopathy	4	8.9 (2.9–22.1)	8	4.5 (2.1–9.0)	12	5.4 (2.9–9.4)	0.425
Glaucoma	2	4.4 (0.8–16.4)	14	7.9 (4.5–13.1)	16	7.2 (4.3–11.6)	0.638
Other	11	24.4 (13.4–39.9)	42	23.6 (17.7–30.6)	53	23.8 (18.5–30.0)	1.000
Total n	45	100	178	100	223	100	
Main cause of blindness (VA worse than 6/60)							
Cataract	3	37.5 (10.2–74.1)	15	23.8 (14.4–36.5)	18	25.4 (16.1–37.3)	0.684
AMD	1	12.5 (0.7–53.3)	11	17.5 (9.4–29.5)	12	16.9 (9.4–28.1)	1
Diabetic retinopathy	0	0.0	2	3.2 (0.6–12.0)	2	2.8 (0.5–10.7)	
Glaucoma	0	0.0	3	4.8 (1.2–14.2)	3	4.2 (1.1–12.7)	
Other	4	50.0 (21.5–78.5)	32	50.8 (38.0–63.5)	36	50.7 (38.7–62.7)	1
Total n	8	100	63	100	71	100	

AMD = Age-related Macular Degeneration; CI = Confidence Intervals; NA = Not Applicable

Table 22. Main Eye Disease Causes of Combined Unilateral Vision Impairment and Blindness, after excluding Uncorrected Refractive Error

	Indigenous		Non-Indigenous		Total		
	N	**% (95% CI)**	**N**	**% (95% CI)**	**N**	**% (95% CI)**	**p-value**
Main cause of combined unilateral vision impairment/blindness							
Cataract (+complications)	30	56.6 (42.4–69.9)	99	41.1 (34.9–47.6)	129	43.9 (38.2–49.8)	0.056
AMD	2	3.8 (0.7–14.1)	41	17.0 (12.6–22.5)	43	14.6 (10.9–19.3)	0.024
Glaucoma	2	3.8 (0.7–14.1)	17	7.1 (4.3–11.3)	19	6.5 (4.0–10.1)	0.568
Amblyopia	3	5.7 (1.5–16.6)	12	5.0 (2.7–8.8)	15	5.1 (3.0–8.5)	1.000
Diabetic retinopathy	4	7.5 (2.4–19.1)	10	4.1 (2.1–7.7)	14	4.8 (2.7–8.0)	0.487
Corneal diseases	1	1.9 (0.1–11.4)	6	2.5 (1.0–5.6)	7	2.4 (1.0–5.1)	1.000
Optic nerve conditions	0	0.0	6	2.5 (1.0–5.6)	6	2.0 (0.8–4.6)	
Enucleation	0	0.0	4	1.7 (0.5–4.5)	4	1.4 (0.4–3.7)	
Cortical visual loss	2	3.8 (0.7–14.1)	0	0.0 (0.0–2.0)	2	0.7 (0.1–2.7)	0.035
Other macular/retinal disease							
Retinal Vein Occlusion	2	3.8 (0.7–14.1)	9	3.7 (1.8–7.2)	11	3.7 (2.0–6.8)	1.000
Myopic degeneration	1	1.9 (0.1–11.4)	7	2.9 (1.3–6.1)	8	2.7 (1.3–5.5)	1.000
Epiretinal Membrane	1	1.9 (0.1–11.4)	6	2.5 (1.0–5.6)	7	2.4 (1.0–5.1)	1.000
Macular Hole	2	3.8 (0.7–14.1)	5	2.1 (0.8–5.0)	7	2.4 (1.0–5.1)	0.813
Vitreomacular Traction	0	0.0	2	0.8 (0.1–3.3)	2	0.7 (0.1–2.7)	NA
Retinal Detachment	2	3.8 (0.7–14.1)	2	0.8 (0.1–3.3)	4	1.4 (0.4–3.7)	0.308
Pachychoroid Disease	0	0.0	5	2.1 (0.8–5.0)	5	1.7 (0.6–4.2)	NA
Chorioretinal atrophy	0	0.0	5	2.1 (0.8–5.0)	5	1.7 (0.6–4.2)	NA
Chorioretinitis	0	0.0	3	1.2 (0.3–3.9)	3	1.0 (0.3–3.2)	NA
Macular Telangiectasia Type 2	1	1.9 (0.1–11.4)	2	0.8 (0.1–3.3)	3	1.0 (0.3–3.2)	1.000
Total n	53	100	241	100	294	100	NA

AMD = Age-related Macular Degeneration; CI = Confidence Intervals; NA = Not Applicable

Table 23. Mean Age of Participants with the Main Causes of Combined Unilateral Vision Impairment/ Blindness

	Indigenous		Non-Indigenous		Total		
	N	**Mean Age, years (SD)**	**N**	**Mean Age, years (SD)**	**N**	**Mean Age, years (SD)**	**p-value**
Main cause of combined unilateral vision impairment/blindness							
Cataract (+ surgery complications)	30	66.5 (9.4)	99	74.2 (8.2)	129	72.4 (9.1)	<0.001
Uncorrected refractive error	8	58.8 (9.0)	63	71.6 (10.0)	71	70.1 (10.6)	0.004
Other macular/retinal disease	8	69.8 (11.6)	46	73.7 (10.2)	54	73.1 (10.4)	0.391
AMD	2	60.0 (0.0)	41	79.8 (9.1)	43	78.9 (9.9)	<0.001
Glaucoma	2	72.0 (11.3)	17	77.2 (6.3)	19	76.6 (6.7)	0.634
Amblyopia	3	60.3 (5.5)	12	68.1 (9.6)	15	66.5 (9.4)	0.119
Diabetic retinopathy	4	59.0 (10.9)	10	70.6 (6.1)	14	67.3 (9.1)	0.119
Corneal diseases	1	90.0 (NA)	6	77.3 (14.5)	7	79.1 (14.1)	NA
Optic nerve diseases	0	NA	6	75.0 (4.7)	6	75.0 (4.7)	NA
Enucleation	1	74.0 (NA)	4	78.2 (9.6)	5	77.4 (8.6)	NA
Cortical visual loss	2	61.0 (11.3)	0	NA	2	61.0 (11.3)	NA
Total n	61	65.4(10.3)	304	74.3(9.4)	365	72.8(10.1)	<0.001

AMD = Age-related Macular Degeneration; SD=Standard Deviation

The main causes of combined unilateral vision impairment/ blindness occurred at a younger age among Indigenous Australians, as compared to non-Indigenous Australians (**Table 24**). This was particularly the case for cataract, uncorrected refractive error and AMD, which caused unilateral vision impairment/ blindness approximately 10 years (cataract and uncorrected refractive error) and 20 years (AMD) earlier in Indigenous Australians, compared to non-Indigenous Australians.

Any vision loss (bilateral or unilateral vision impairment or blindness) was present in 139 Indigenous Australians (age-standardised prevalence 14.5%) and 497 non-Indigenous Australians (10.3%). Overall, 9.8% of Australians had some form of vision impairment or blindness (**Table 25**).

Near Vision

Near vision is important as this is the key measure of the ability to read normal printed material. We measured habitual binocular near visual acuity, with the participant wearing their current reading glasses, if used, to read sentences from the Good-Lite near vision chart, held at around 40 cm. Near vision impairment was defined as <6/12 or an equivalent of <55 LogMAR letters. Overall, 481 persons (10.6%) of the population examined had near vision impairment. This was significantly worse among Indigenous participants (22.4%) compared with non-Indigenous participants (8.8%), as in **Table 26**.

Table 24. Prevalence of Any Presenting Vision Loss (Bilateral or Unilateral Vision Impairment and Blindness), Age-Standardised to the Census 2021 Australian Population

Vision Loss	Indigenous		Non-Indigenous		Total		
	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)	p-value
None	487	85.5 (73.4-99.8)	3,405	92.4(47.6-204.1)	3,892	90.2(81.7-99.9)	0.865
Vision impairment	121	13.7 (10.7-18.6)	424	8.6 (7.7-9.7)	545	8.6 (7.1-11.5)	0.015
Blindness	9	1.2 (0.5-2.7)	73	1.7 (1.3-2.2)	82	1.6 (1.3-2.1)	0.448
Any vision impairment or blindness	130	14.5 (11.4-19.4)	497	10.3 (9.3-11.4)	627	9.8 (8.3-12.7)	0.207

CI = Confidence Interval

In a number of international studies, unaided near vision is also used as a criterion of disability, as reading spectacles may be relatively more difficult to obtain.[18,58,59] We also assessed this state as shown in **Table 27**. This analysis shows a diminishing proportion of participants who were able to read unaided the 6/12 line, with increasing age, from 53.1% among those aged 50-59 years to 34.5% of those aged 80+, with the overall rate 39.5%. There were only minor, non-significant differences between Indigenous and non-Indigenous participants in this measure.

Table 25. Prevalence of Impaired Near Visual Acuity, by age group

Age Group	Indigenous		Non-Indigenous		Total	
	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)
50-59	48	22.7(17.4-29.1)	35	6.0(4.3-8.3)	83	10.5(8.5-12.9)
60-69	50	21.0(16.1-26.8)	74	6.2(5.0-7.8)	124	8.7(7.3-10.3)
70-79	29	24.8(17.5-33.8)	108	7.8(6.4-9.3)	137	9.1(7.7-10.7)
80+	11	21.6(11.8-35.7)	126	17.0(14.4-19.9)	137	17.3(14.7-20.1)
Total	**138**	**22.4(19.2-25.9)**	**343**	**8.8(7.9-9.7)**	**481**	**10.6(9.8-11.6)**

CI=Confidence Interval

Table 26. Prevalence of Ability to Read 6/12 Unaided, by age group

Age Group	Indigenous		Non-Indigenous		Total	
	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)
50-59	113	53.6(46.6-60.4)	308	52.9(48.8-57)	421	53.1(49.5-56.6)
60-69	87	36.6(30.5-43.1)	486	40.9(38.1-43.8)	573	40.2(37.6-42.8)
70-79	42	35.9(27.4-45.3)	476	34.3(31.8-36.8)	518	34.4(32.0-36.9)
80+	22	43.1(29.6-57.7)	252	33.9(30.5-37.5)	274	34.5(31.2-37.9)
Total	**264**	**42.8(38.9-46.8)**	**1,522**	**39.0(37.5-40.6)**	**1,786**	**39.5(38.1-41)**

CI=Confidence Interval

Cataract surgery coverage in the AEEHS

Effective service coverage indicators are the preferred measure for countries to monitor progress towards universal health coverage.[60] Cataract surgical coverage (CSC) is a service coverage indicator that measures the number of people in a population who have been operated on for cataract as a proportion of all people operated on or still requiring surgery.[61] Effective CSC (eCSC) is a clinical measure of quality which uses post-operative visual acuity to quality-correct cataract surgical coverage.[62] Due to the significant unmet demand for cataract surgery – a widely accepted, cost-effective procedure with a standardised way of measuring coverage – eCSC has emerged as a key metric for tracking improvements in eye care services. Acknowledging this, member states at the 74th World Health Assembly endorsed a global target of increasing eCSC by 30 percentage points by 2030.[29] Additionally, countries with a baseline eCSC of 70% or higher were encouraged to pursue universal eye care coverage.[29] Importantly, eCSC is an important component in the revised Sustainable Development Goal monitoring framework.[30] The definitions of CSC and eCSC in the AEEHS are displayed below.

The cataract surgery coverage (CSC) rate was defined as:

$$\textbf{CSC} = \frac{x+y}{x+y+z} \times 100$$

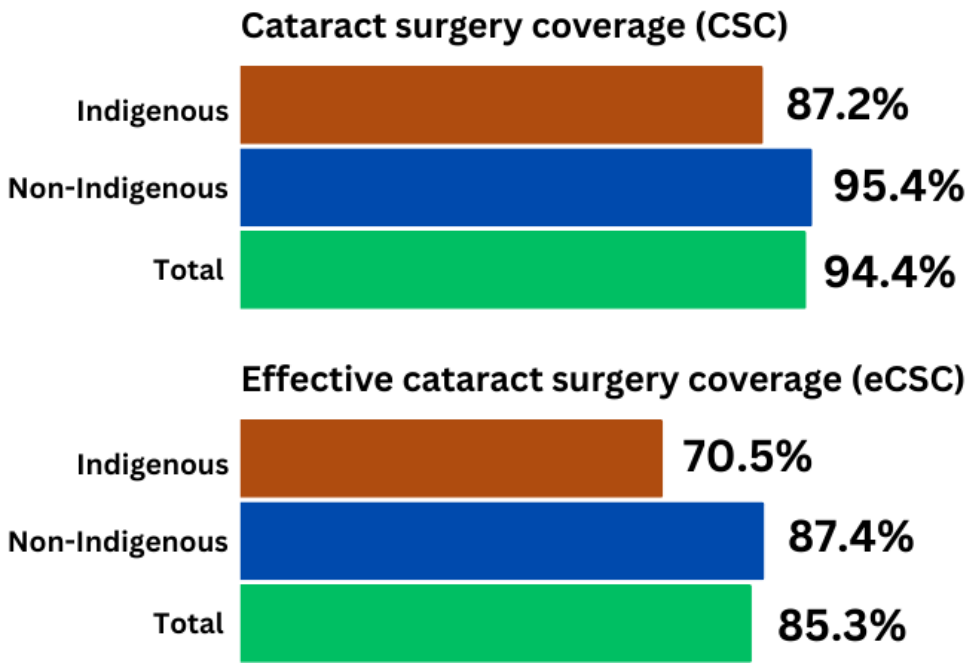
Where *x* is individuals with unilateral operated cataract (regardless of visual acuity in the operated eye) and vision impairment (best-corrected VA worse than 6/12) in the other eye, *y* represents the number of individuals with bilateral operated cataract (regardless of visual acuity in the operated eyes), and *z* represents individuals with vision impairment

(best-corrected VA worse than 6/12) in both eyes with cataract as the main cause of vision impairment in one or both eyes.

The effective cataract surgery coverage (eCSC) rate was defined as:

$$\textbf{eCSC} = \frac{a+b}{x+y+z} \times 100$$

Where *a* represents individuals with unilateral operated cataract attaining a specified threshold of postoperative presenting visual acuity in the operated eye, who have vision impairment (best-corrected VA worse than 6/12) in the other eye and *b* represents individuals with bilateral operated cataract attaining a postoperative presenting visual acuity of 6/12 or better in at least one eye.



The total cataract surgery coverage rate was 94.4%. The cataract surgery coverage rate was greater for non-Indigenous participants (95.4%) compared to Indigenous participants (87.2%). The total effective cataract surgery coverage rate was 85.3%. The effective cataract surgery coverage rate was greater for non-Indigenous (87.4%) compared to Indigenous participants (70.5%).

Refractive error coverage in the AEEHS

Member states of the WHO set their sights on refractive error for the first time at the 74th World Health Assembly in 2021.[30] Nations with baseline effective refractive error coverage (eREC) less than 60% were urged to increase eREC by 40 percentage points by 2030.[30] Nations already at or above 60% eREC should aim for universal access and work to narrow gaps by focusing on underserved groups.[30]

Refractive error coverage (REC) measures whether vision-impairing refractive error has been corrected, regardless of whether a good outcome is achieved.[63] Meanwhile, eREC is a measure of both the availability and quality of refractive correction in a population. It is defined as the proportion of people in need of refractive error correction who have received services (spectacles, contact lenses, or refractive surgery) and have a good quality outcome.[63] This indicator not only captures the extent of coverage (i.e. REC), but also the concept of effective coverage, defined as distance vision with correction of visual acuity equal to or better than 6/12.

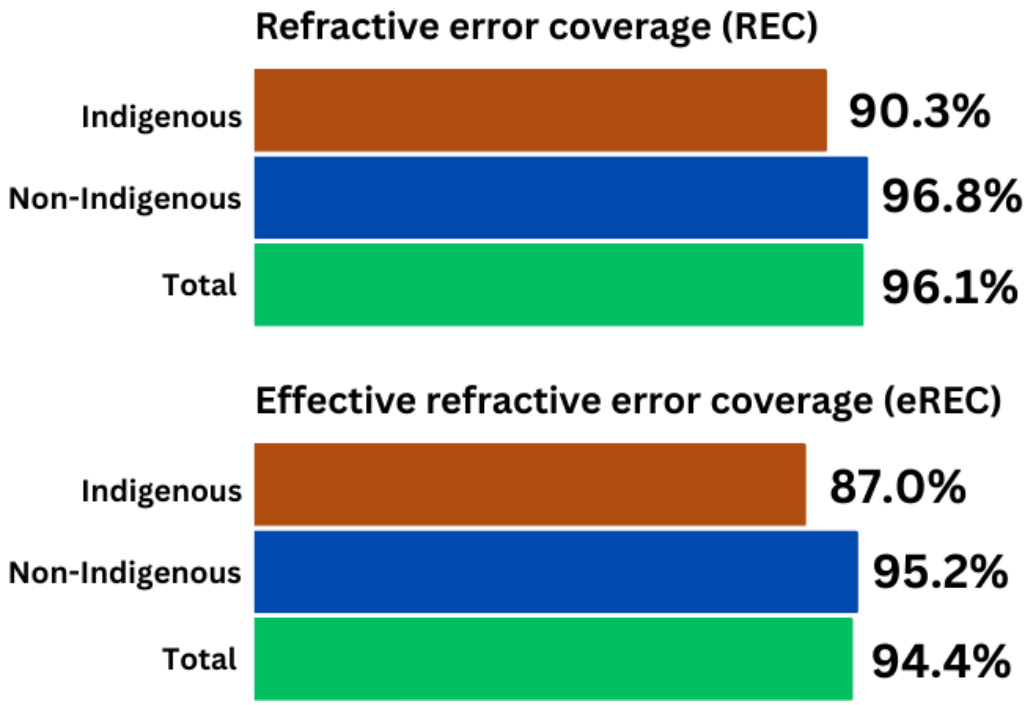
The REC and eREC were defined as:

$$\textbf{REC} = \frac{a+b}{a+b+c} \times 100$$

$$\textbf{eREC} = \frac{a}{a+b+c} \times 100$$

Where “a” refers to individuals who present with spectacles or contact lenses for distance (or have a history of refractive surgery) and whose presenting VA is 6/12 or better in the better eye (met need), “b” refers to individuals who present with spectacles or contact lenses for distance (or have a history of refractive surgery) and

whose presenting VA was worse than 6/12 in the better eye, but who improve to 6/12 or better on pinhole or refraction (undermet need), and “c” refers to individuals with PVA worse than 6/12 in the better eye who do not have correction and who improve to 6/12 or better on pinhole or refraction (unmet need).



The total refractive error coverage rate was 96.1%. The refractive error coverage rate was greater for non-Indigenous participants (96.8%) compared to Indigenous participants (90.3%). The total effective refractive error coverage rate was 94.4%. The effective refractive error coverage rate was greater for non-Indigenous (95.2%) compared to Indigenous participants (87.0%).

Specific Eye Diseases

Cataract

Other than the correction of refractive error, cataract surgery is the most frequent therapeutic eye intervention and is regarded as among the most highly cost-effective procedures in medicine.[64-68] After uncorrected refractive error, cataract was the 2nd most frequent cause of bilateral vision impairment and the leading cause of unilateral impairment; this was found for both Indigenous and non-Indigenous participants.

Cataract surgery (performed on one or both eyes) in the AEEHS cohort was documented (**Table 28**). More than a quarter of participants (26%) in this survey gave a history of past cataract surgery; findings were confirmed at the slit-lamp examination.

Table 27. Prevalence of reported cataract surgery on one or both eyes, by age group

Age Group (Years)	Indigenous		Non-Indigenous		Total	
	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)
50-59	9	4.3 (2.1-8.2)	11	1.9 (1-3.5)	20	2.5 (1.6-3.9)
60-69	35	14.7 (10.6-20)	121	10.2 (8.6-12.1)	156	10.9 (9.4-12.7)
70-79	43	36.8 (28.2-46.2)	447	32.2 (29.7-34.7)	490	32.5 (30.2-35)
80+	33	64.7 (50-77.2)	484	65.1 (61.6-68.5)	517	65.1 (61.7-68.4)
Total	**120**	**19.4 (16.4-22.8)**	**1,063**	**27.2 (25.9-28.7)**	**1,183**	**26.2 (24.9-27.5)**

CI=Confidence Interval

Importantly, Indigenous participants reported greater rates of cataract surgery at younger ages (50-59, 60-69 and 70-79 years) than non-Indigenous participants, though the combined ages cataract surgery prevalence was lower (19.4% vs 27.2%) because of

the generally older age of the non-Indigenous cohort. Overall, 26.2% of study participants reported having cataract surgery performed on one or both eyes.

Age-related macular degeneration

In the AEEHS, after uncorrected refractive error and cataract, AMD was the 3rd most frequent cause of bilateral vision impairment and was the leading cause of bilateral blindness. It was the 3rd most frequent cause of unilateral vision impairment and the 2nd most frequent cause of unilateral blindness. Detailed AEEHS AMD prevalence data are to be completed and published later, but the impact from neovascular AMD can be assessed from data on the frequency of eye injections (anti-VEGF therapy) for neovascular AMD (**Table 29**).

Table 28. Prevalence of reported intravitreal injection therapy for AMD in one or both eyes, by age group

Age Group	Indigenous		Non-Indigenous		Total	
	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)
50-59	0	NA	1	0.2 (0-1.1)	1	0.2 (0-1.1)
60-69	1	0.4 (0-2.7)	8	0.7 (0.3-1.4)	9	0.6 (0.3-1.2)
70-79	0	NA	18	1.3 (0.8-2.1)	18	1.3 (0.8-2.1)
80+	1	2 (0.1-11.8)	38	5.1 (3.7-7)	39	4.9 (3.6-6.7)
Total	**2**	**0.3 (0.1-1.3)**	**65**	**1.7 (1.3-2.1)**	**67**	**1.5 (1.2-1.9)**

CI=Confidence Interval

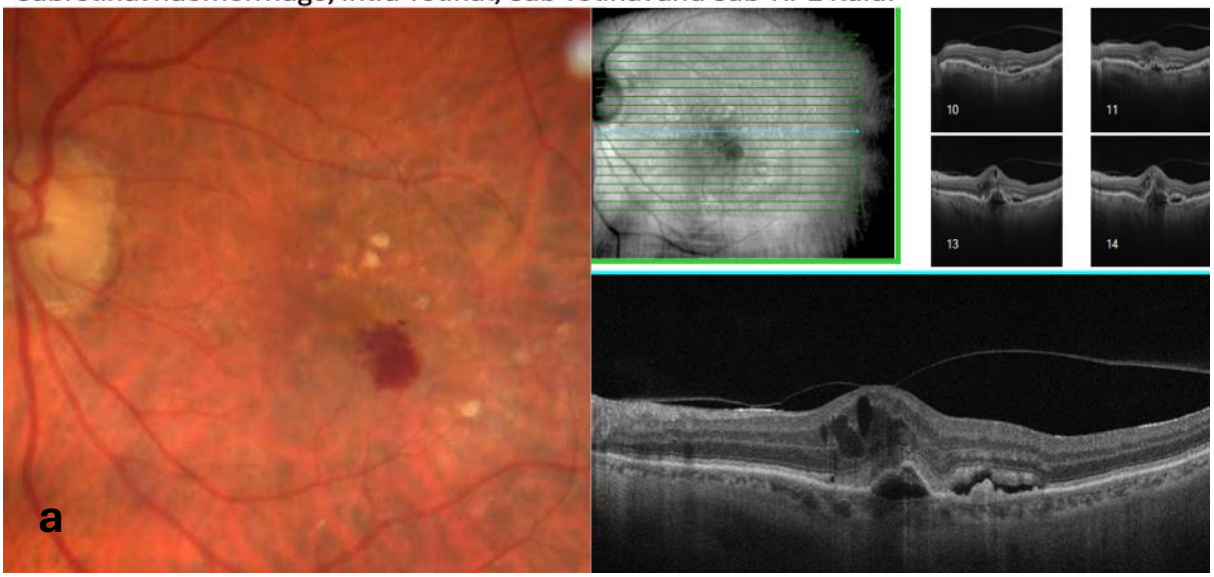
Overall, 1.5% of participants reported having injections for AMD in one or both eyes, including 0.3% of Indigenous and 1.7% of non-Indigenous participants. This discrepancy likely reflects our earlier data showing a lower rate of vision impairment (both bilateral and unilateral) from AMD among Indigenous participants. However, it could also reflect lower access to services, particularly in non-urban settings. The 1.7% rate among non-

Indigenous persons is close to the 1.9% prevalence of late-stage AMD reported from the BMES.[69]

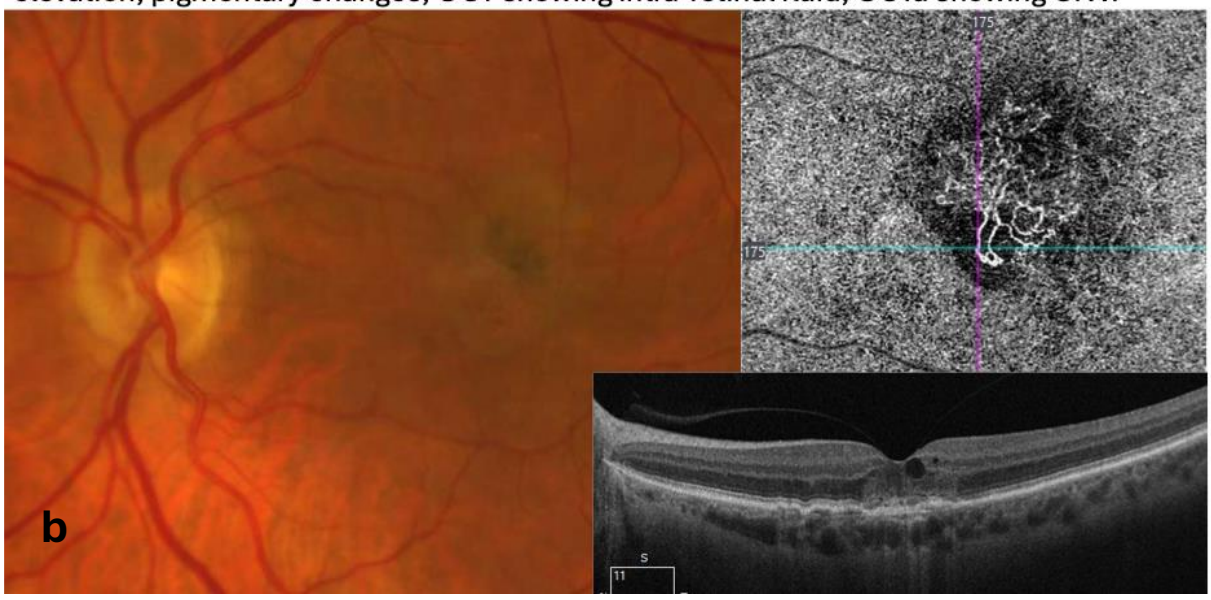
The AEEHS detected neovascular AMD in many cases, such as shown in **Figure 7a and 7b** below, who were referred to a local ophthalmologist for treatment, and also examined many long-standing cases already receiving intravitreal anti-VEGF injections (**Figure 7c**).

Figure 7a, 7b, 7c. Participants with neovascular AMD examined in the AEEHS

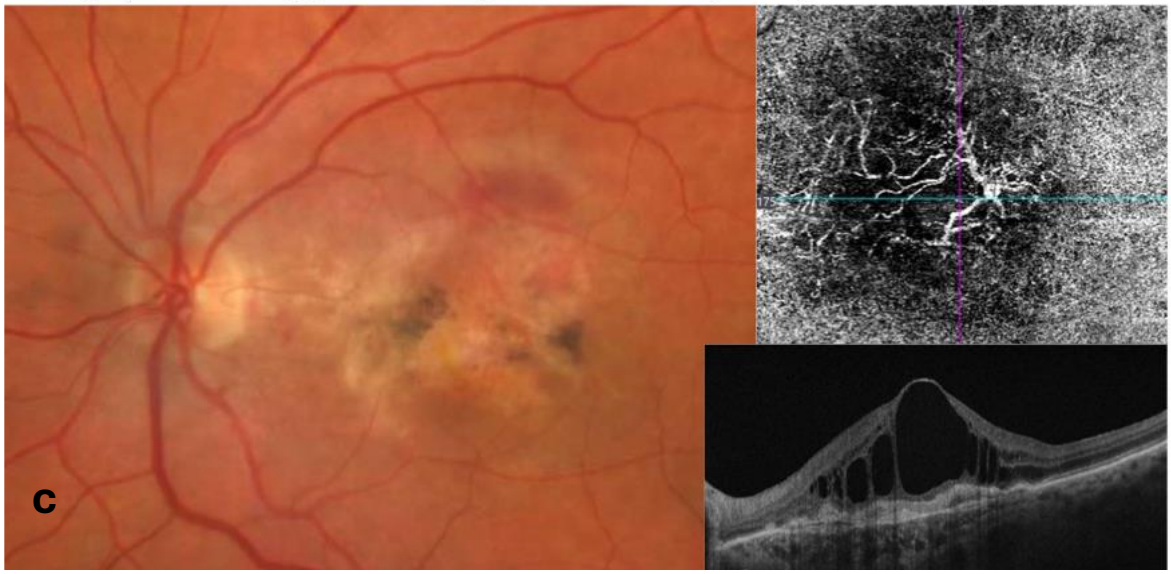
Male participant, WG, aged 84, best-corrected Visual Acuity 36 letters, visual impairment due to **neovascular AMD** not previously detected; colour photograph, OCT, showing subretinal haemorrhage, intra-retinal, sub-retinal and sub-RPE fluid.



Female participant, AG, aged 76, best-corrected Visual Acuity 20 letters, visual impairment due to **neovascular AMD**, not previously detected; colour photo showing elevation, pigmentary changes; OCT showing intra-retinal fluid, OCTa showing CNV.



Female participant, ES, aged 82, best-corrected Visual Acuity 0 letters (blind), long-standing vision impairment due to **neovascular AMD**; colour photo showing pigmentary changes, haemorrhage; OCT showing intra-retinal fluid, SHRM, OCTa showing CNV.



OCT = optical coherence tomography; OCTa = OCT angiography; SHRM = sub-retinal hyper-reflective material (or scar); CNV = choroidal neovascularisation

Diabetic Retinopathy

Participants with diagnosed diabetes were asked whether they had ever had a diabetic eye check (**Table 30**), and when the last test was performed.

Table 29. Frequency of eye check among participants with diagnosed diabetes

Age Group	Indigenous		Non-Indigenous		Total	
	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)
50-59	43	76.8 (63.3-86.6)	41	68.3 (54.9-79.4)	84	72.4 (63.2-80.1)
60-69	72	81.8 (71.9-88.9)	103	69.6 (61.4-76.7)	175	74.2 (68-79.5)
70-79	33	91.7 (76.4-97.8)	151	72.2 (65.6-78.1)	184	75.1 (69.1-80.3)
80+	12	75.0 (47.4-91.7)	83	73.5 (64.2-81.1)	95	73.6 (65-80.8)
Total	160	81.6 (75.3-86.6)	378	71.3 (67.2-75.1)	538	74.1 (70.7-77.2)

CI=Confidence Interval

Having had an eye check was reported by ~82% of Indigenous participants, compared with 71% of non-Indigenous participants, and was slightly worse among younger participants. Whether these examinations were in keeping with the NHMRC Guidelines for the Management of Diabetic Retinopathy relates to when the last exam was performed.[5] The recommendation is that Indigenous persons with diabetes need an eye examination each year, and for non-Indigenous persons, the recommendation is every 2 years.[5]

Table 30. Compliance with the NHMRC recommendations for eye examinations in persons with known diabetes (1 Year Indigenous; 2 Years non-Indigenous)

Age Group	Indigenous		Total	Non-Indigenous		Total
	N	% (95% CI)	N	N	% (95% CI)	N
50-59	28	50(37.3-62.7)	56	37	61.7(48.2-73.6)	60
60-69	43	48.9(38.1-59.7)	88	90	60.8(52.4-68.6)	148
70-79	24	66.7(48.9-80.9)	36	137	65.6(58.6-71.9)	209
80+	10	62.5(35.9-83.7)	16	78	69(59.5-77.2)	113
Total	**105**	**53.6(46.3-60.7)**	**196**	**342**	**64.5(60.3-68.6)**	**530**

CI=Confidence Interval

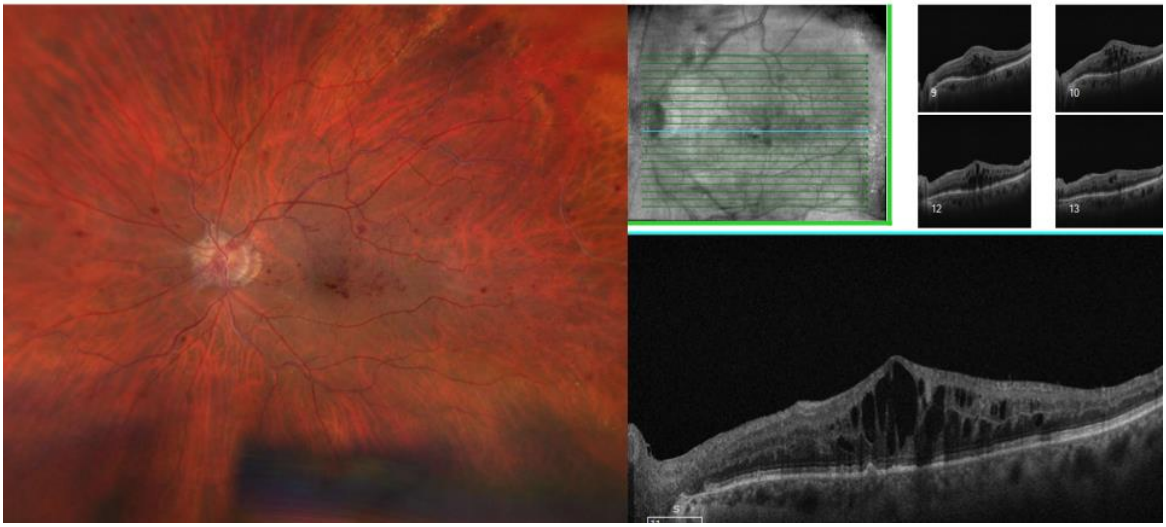
These data (**Table 31**) show that ~54% of Indigenous participants complied with this recommendation, compared with ~65% of non-Indigenous participants. These rates are lower than those found in the NEHS[6] (64% for Indigenous, 78% for non-Indigenous) and may partly reflect the effect of the COVID-19 pandemic, which prevented and delayed in-person health screening. The low rates also suggest a need to improve education for patients as well as general practitioners about the need for regular eye examinations for people known to have diabetes, to detect retinopathy in a timely manner, particularly vision-threatening retinopathy.

Detailed data on the prevalence of diabetic retinopathy in the AEEHS are yet to be finalised. There were 45 participants with diabetes who reported eye treatment other than cataract surgery (laser or injections), 6.2% of those diagnosed with diabetes

(n=726). **Figure 8** shows a male participant who presented with undiagnosed bilateral vision loss due to moderate non-proliferative diabetic retinopathy and diabetic macular oedema.

Figure 8. Participant found to have vision-threatening diabetic retinopathy, referred for consideration of therapy

Male participant with diabetes for 18 years, WS, aged 71, best-corrected Visual Acuity 27 letters, visual impairment due to **diabetic retinopathy/ diabetic macular oedema**; colour photograph showing retinopathy, OCT showing macular oedema



Glaucoma

There were 218 participants (4.8%) who reported having been told they had glaucoma (**Table 32**). This variable showed a steep age-related (almost exponential) increase in prevalence, with the rate slightly higher than reported from the BMES (3.0%). The prevalence was significantly lower among Indigenous participants (1.8%) than non-Indigenous participants (5.2%), suggesting less active or frequent screening of Indigenous persons.

Table 31. Prevalence by age group of having been given a diagnosis of glaucoma

Age Group	Indigenous		Non-Indigenous		Total	
	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)
50-59	3	1.4 (0.4-4.4)	15	2.6 (1.5-4.3)	18	2.3 (1.4-3.6)
60-69	5	2.1 (0.8-5.1)	36	3.0 (2.2-4.2)	41	2.9 (2.1-3.9)
70-79	0	-	75	5.4 (4.3-6.8)	75	5.4 (4.3-6.8)
80+	3	5.9 (1.5-17.2)	78	10.5 (8.4-13)	81	10.2 (8.2-12.6)
Total	**11**	**1.8 (0.9-3.3)**	**204**	**5.2 (4.6-6)**	**215**	**4.8 (4.2-5.4)**

CI=Confidence Interval

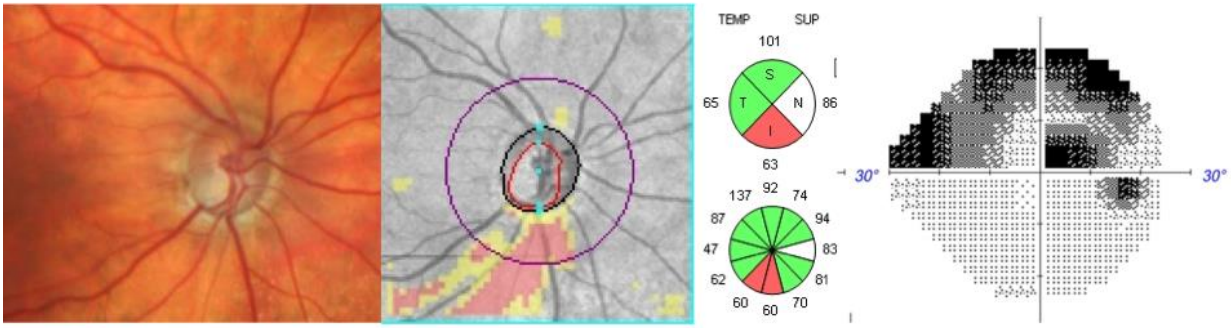
Among these participants, 165 (76.7%) reported using glaucoma eye drops, and a further 30 participants (4.7%) reported use of glaucoma surgery or laser therapy in addition to eye drops. This totals 90.7% of persons who reported receiving therapy among those reporting having been diagnosed with glaucoma. Detailed AEEHS glaucoma prevalence data are yet to be finalised. However, many patients with suspicious glaucoma signs or elevated IOP were referred to ophthalmologists for consideration of therapy. **Figure 9** shows the images from a 76-year-old AEEHS participant with glaucoma, illustrating characteristic glaucoma signs (inferior optic disc rim thinning, inferior sectoral nerve fibre layer loss, and matching upper visual field loss, shown with study imaging.

Other Causes

Retinal vein occlusion (RVO). This category included Central Retinal Vein Occlusion (CRVO), Branch Retinal Vein Occlusion (BRVO), or variant Hemispherical Retinal Vein Occlusion (Hemi-RVO). RVO caused bilateral or unilateral vision impairment and blindness in 15 AEEHS participants (0.33% of the population). Overall, RVO prevalence is yet to be finalised, and it is likely that many other RVO cases causing milder degrees

Figure 9. Female participant with visual impairment from glaucoma showing characteristic signs of inferior cupping, NFL loss and matching upper field defect

Female participant, EM, aged 76, best-corrected Visual acuity 38 letters. Definite glaucoma (currently on treatment) as cause of vision impairment; colour photograph, OCT showing NFL loss and 24-2 SITA visual field



OCT = optical coherence tomography; NFL = nerve fibre layer

of vision loss will be diagnosed. Several RVO cases were detected by the AEEHS survey and referred for consideration of therapy, including the case below (**Figure 10**).

Figure 10. Male participant with signs of a severe ischaemic retinal vein occlusion

Male participant, SM, aged 68, best-corrected Visual Acuity 3 letters (blind), visual impairment due to ischaemic **CRVO/ hemi RVO** 1 year ago with **glaucoma**; colour photograph showing retinopathy, OCT showing macular thinning; OCTa showing severe retinal/ macular ischaemia; referred for further therapy

Risk factors for Vision Impairment

Table 33 shows the age-sex, and multivariable adjusted logistic regression models for risk factors associated with bilateral vision impairment or blindness for the entire sample. Age, Indigenous status, remoteness, current smoking, diabetes, cardiovascular disease history, lower education level, not owning own home, not having private health insurance, and not having had a recent eye check were all associated with bilateral vision impairment or blindness in age-sex adjusted models.

After additional adjustment in the multivariable analysis including all of these risk factors, age per 10 years (Odds Ratio, OR: 2.10; 95% Confidence Intervals, CI: 1.80-2.44), residence in remote/very remote regions (OR: 4.00; 95% CI: 2.02-7.89), and having diabetes (OR: 1.68; 95% CI: 1.24-2.27) were associated with a greater likelihood of bilateral vision impairment or blindness, and could be considered "risk" factors. Living at a remote or very remote site, was the strongest risk factor, followed by older age. As shown in **Table 10**, this substantially impacted both Indigenous and non-Indigenous persons.

Attainment of tertiary education (OR: 0.58; 95% CI: 0.43-0.79), having private health insurance (OR: 0.43; 95% CI: 0.31-0.58), or attending an eye examination in the last 12 months (OR: 0.62; 95% CI: 0.47-0.82) were associated with a reduced likelihood of vision impairment, so could be considered "protective". Socio-economic factors and a recent eye examination likely reflect the likelihood of an earlier diagnosis and consideration for treatment.

Indigenous status was associated with a 2.5-fold greater likelihood having bilateral vision impairment in the age-sex adjusted model. However, this effect was no longer

statistically significant after adjustment for other covariates in the multivariate model. This suggests that a component of the higher risk for bilateral vision impairment among Indigenous participants in the AEEHS could be explained by their remoteness, together with their greater diabetes prevalence, and socio-economic disadvantage.

Table 32. Risk factors associated with bilateral vision impairment/blindness in the AEEHS.

Risk Factor	Total			
	Age-sex adjusted OR	P value	Multivariable OR	P value
Age, per 10 years	1.92 (1.68-2.20)	<0.001	2.10 (1.80-2.44)	<0.001
Female sex	1.01 (0.78-1.30)	0.95	1.05 (0.83-1.38)	0.72
Indigenous	2.53 (1.73-3.71)	<0.001	1.26 (0.83-1.92)	0.28
Remoteness				
Major Cities	1	-	1	-
Inner Regional	0.54 (0.24-1.22)	0.14	0.56 (0.26-1.18)	0.12
Outer Regional	1.18 (0.63-2.20)	0.60	1.09 (0.61-1.95)	0.76
Remote/Very Remote	6.07 (2.99-12.30)	<0.001	4.00 (2.02-7.89)	<0.001
Highest education level				
Below high school	1	-	1	-
High school	0.76 (0.50-1.16)	0.20	0.94 (0.61-1.45)	0.76
Tertiary	0.44 (0.33-0.60)	<0.001	0.58 (0.43-0.79)	<0.001
Owns home	0.51 (0.39-0.67)	<0.001	0.76 (0.56-1.02)	0.07
Private health insurance	0.32 (0.24-0.43)	<0.001	0.43 (0.31-0.58)	<0.001
Smoking status				
Never smoked	1		1	
Current smoker	2.00 (1.31-3.04)	0.001	1.26 (0.81-1.96)	0.31
Ever smoked	0.89 (0.66-1.21)	0.47	0.82 (0.60-1.14)	0.24
Diabetes	1.98 (1.49-2.64)	<0.001	1.68 (1.24-2.27)	<0.001
Cardiovascular disease	1.58 (1.11-2.23)	0.01	1.30 (0.90-1.87)	0.16
Had eye exam in past 12 months	0.57 (0.44-0.75)	<0.001	0.62 (0.47-0.82)	<0.001

OR = odds ratio. Hypertension, body mass index and axial length were not significantly associated with vision impairment and are not included in the table.
*Multivariable model adjusted for Age (age per 10 years), Sex (female sex), Indigenous status, Remoteness, Highest education level, owns home, Private health insurance, Smoking status, Diabetes, Cardiovascular disease and Had eye exam in past 12 months.

Discussion of Eye Health Findings

The AEEHS has found a small reduction in the age-standardised prevalence of bilateral vision impairment in both Indigenous (-2.7%) and non-Indigenous (-0.8%) Australians, when compared to the NEHS which was completed in 2016.[1] This is a reassuring finding that points to the efficacy of national efforts to reduce the burden of eye disease in all Australians. Determining the impact of individual initiatives is beyond the scope of this survey, but some broad conclusions can be drawn.

Although the main causes of bilateral vision impairment remain the same between the NEHS and the AEEHS, there has been a considerable shift in the burden of vision impairment from uncorrected refractive error to other causes of vision impairment, which together now account for approximately 60% of bilateral vision impairment. The AEEHS has found impressive improvements in refractive error coverage rates in both Indigenous (83.3% to 90.3%) and non-Indigenous (93.7% to 96.8%) Australians, which may help to explain this shift. This encouraging result may also reflect the success of programs to deliver affordable spectacles to persons in need, such as the NSW Spectacles Program and other equivalent programs in each State and Territory, as well as other factors improving access to such services. Recent changes to driver licensing requirements in states such as NSW, where renewals now often require an eyesight test by an optometrist or ophthalmologist, may also have contributed to improved correction of refractive error in the driving population. Increased affordability of spectacles and contact lenses may also have contributed, as well as better access to refractive correction through improvements in delivering optometry and ophthalmology services to regional and remote communities. These factors will be studied further in a later report.

Cataract remains the 2nd leading cause of vision impairment in both Indigenous and non-Indigenous Australians, and it is encouraging to see the marked improvement in cataract surgery coverage rates to over 85% in Indigenous, and over 95% in non-Indigenous participants. This likely reflects the impact of improved access to cataract surgery through both private and public channels, as well as cataract surgery waitlist reduction initiatives through public-private collaborations. Diabetic retinopathy, age-related macular degeneration and glaucoma remain the next most common causes of vision impairment. These are chronic eye diseases which require ongoing monitoring and therapy to prevent further vision loss, and it is important that continued access to diabetic retinopathy screening, anti-VEGF intravitreal injection therapy, and topical and interventional glaucoma therapy is maintained or improved to prevent further vision loss, especially in older Australians.

While the sample of Indigenous participants is sufficient to detect the overall prevalence of vision impairment and the major eye diseases, some caution is needed when interpreting the subgroup analyses, such as the distribution of specific eye diseases by sex, and by Geographic Areas. Some caution is also needed when interpreting negative findings of no vision impairment due to rare causes, such as trachoma in the sampled population. No persons with bilateral vision impairment from trachoma were detected in the NEHS either,[1] which gives confidence that the rate in the community is likely very low.

The AEEHS found an age-standardised prevalence of combined bilateral vision impairment or blindness of 11.3% in Indigenous, 4.0% in non-Indigenous, and 5.3% overall for all Australians. A further age-standardised prevalence of combined unilateral vision impairment or blindness of 7.8% in Indigenous, 6.4% in non-Indigenous, and 6.4%

overall for all Australians was recorded. These figures indicate that the total prevalence of any vision loss (bilateral or unilateral vision impairment or blindness) is 14.5% among Indigenous, 10.3% in non-Indigenous, and 9.8% overall for all Australians aged 50 years and over. This points to the considerable impact of vision impairment in the Australian population, with 1 in 7 Indigenous and 1 in 10 non-Indigenous older Australians affected and requiring some sort of vision remedial therapy.

The AEEHS has identified several risk factors for bilateral vision impairment or blindness; increasing age, living in a remote or very remote area and the presence of diabetes (risk enhancing). It also identified socio-economic factors associated with a lower risk: higher education level or having private health insurance. Having an eye exam in the last year was also protective; these factors could increase the likelihood of vision impairment being detected earlier and treated.

Importantly, many of these factors are modifiable, suggesting areas where health promotion initiatives could be better targeted. Vision impairment among both Indigenous and non-Indigenous persons is particularly exacerbated by geographical remoteness and distance from major cities or regional areas where health resources are particularly concentrated. Existing initiatives to mitigate geographical barriers to eyecare include programs to bring eyecare services to Indigenous peoples where they live such the Visiting Optometrists Scheme,[70] Victorian Aboriginal Spectacles Subsidy Scheme,[71] the Rural Health Outreach Fund,[70] Indigenous and Remote Eye Health Service (IRIS)[70] and the Eye and Ear Surgery Support Program,[72] all of which deliver eye care and surgery[73] directly to communities in remote and rural Australia. These have likely contributed to the reduction in prevalence of vision impairment in remote and rural communities.

Protective factors such as access to private health insurance and improved educational opportunities for disadvantaged families could further reduce these health inequities. We found that after adjusting for these factors, the risk of vision impairment associated with Indigenous status attenuated considerably, suggesting that addressing these factors could contribute significantly to closing the gap.

In summary, there has been some reduction in the prevalence of bilateral vision impairment over the last 8 years since the NEHS, pointing to the effectiveness of eye care initiatives and interventions to prevent vision loss.

However, the fact remains that Indigenous Australians remain almost 3x more likely to have bilateral vision impairment or blindness than non-Indigenous Australians. This gap remains unchanged as when last measured by the NEHS.[1] Further research into the underlying causes of the persistent gap in this health outcome, as well as continued efforts to close it, are warranted. As discussed above, increased remoteness, higher diabetes prevalence and socio-economic disadvantage could explain a considerable proportion. These factors can all be addressed.

Hearing Study Findings

Hearing examinations and interviews (**Station 4, Appendix**) were conducted by an audiologist or trained staff after participants had fully completed their eye examinations. The hearing examination and interviews included questions around hearing, including self-report of hearing loss, laterality and duration, the frequency of past hearing examinations, ever use of hearing aids, and other questions on impacts from hearing impairment, including administration of the Hearing Handicap Inventory for the Elderly (HHIE). Pure-tone audiometry, using earphones, was performed, averaging hearing at four frequencies (500 Hz, 1000 Hz, 2000 Hz, 4000 Hz). Tympanometry and video-otoscopy of each ear canal were also conducted; however, the results of these two additional tests are not presented in this report and will be reported later.

Hearing impairment was graded as mild (>25 to 40 dB HL), moderate (>40 to 60 dB HL), severe (>60 to 80 dB HL), or profound (>80 dB HL), in the better ear (WHO criteria).[48-51] Moderate or worse bilateral hearing impairment (>40 dBHL, better ear) was considered a useful measure of frequent hearing disability.

Demographics of AEEHS participants in the Hearing Survey

Of the 30 AEEHS Australian sites, the audiologist/trained staff could not attend three sites. There were also some AEEHS sites at which the audiologist/trained staff could not attend for the entire survey period at that site, for reasons including illness, transport difficulty, machine calibration, and other unexpected issues. Overall, 3573 of the 4519 AEEHS participants underwent both eye and ear examinations (79.1%).

A comparison of the AEEHS Hearing Sample with the Australian population is shown in **Table 34**. This shows that the AEEHS Indigenous Hearing Sample was slightly older than the 2021 Australian population, while the non-Indigenous Hearing Sample was considerably older, with both outcomes resulting from the planned strategy of targeting older SA1s within the randomly selected SA2s.

Table 33. Comparison of AEEHS (Hearing Sample) and the Australian population

Indigenous N (%)		
Age Group (years)	**AEEHS (Hearing Sample)**	**Australia 2021**
50-59	139(30.2)	87,784 (50.6%)
60-69	**182(39.5)**	**55,335 (31.9%)**
70-79	**98(21.3)**	**23,256 (13.4%)**
80+	42(9.1)	7, 207 (4.2%)
Total aged 50+	461(100%)	173,582 (100%)
Non-Indigenous N (%)		
Age Group (years)	**AEEHS (Hearing Sample)**	**Australia 2021**
50-59	436(14.0)	3,074,764 (35.0%)
60-69	924(29.7)	2,700,600 (30.8%)
70-79	**1116(35.9)**	**1,930,842 (22.0%)**
80+	**636(20.4)**	**1,072,443 (12.2%)**
Total aged 50+	3112 (100%)	8,778,649 (100%)

Of the 3573 participants who were included in the hearing analysis, 461 (12.9%) were Indigenous and 3112 (87.1%) were non-Indigenous, as shown in **Table 35**. The mean age was 65.2 ± 9.8 years for Indigenous participants, and 71.1 ± 9.8 years for non-Indigenous participants ($p < 0.0001$). The age distribution varied across groups and included 572 individuals aged 50-59 years, 1096 individuals aged 60-69 years, 1216 individuals aged 70-79 years and 687 individuals aged 80+ years. The gender distribution of Indigenous participants who had hearing examinations was 49.7% male and 50.3% female. This was a somewhat lower female preponderance than the gender distribution of the non-

Indigenous participants who attended the hearing examinations; 43.6% male: 56.4% female, p = 0.014.

The most frequented site for hearing data collection among Indigenous participants was in the Katherine region (Northern Territory), whereas for non-Indigenous participants it was Monash (ACT, p < 0.0001). A higher proportion of Indigenous participants were recruited for hearing examinations from remote/very remote (42.3% vs 5.5%) and inner regional (28.9% vs 13.2%) areas, than for non-Indigenous participants (p < 0.0001).

Table 34. AEEHS participants who had hearing examinations, by Age Group, Study Site and Remoteness

	Indigenous n (%)	**Non-Indigenous n (%)**	**Total N**	**P-value**
Participants who had hearing examinations	461(12.9)	3112(87.1)	3573	
Age				
Mean (SD)	65.2(9.8)	71.0(9.8)	70.2(9.95)	<0.0001
Age Group (years)				
50-59	139(30.2)	436(14.0)	575	
60-69	182(39.5)	924(29.7)	1106	
70-79	98(21.3)	1116(35.9)	1214	
80+	42(9.1)	636(20.4)	678	<0.0001
Gender				
Male	229(49.7)	1357(43.6)	1586	
Female	232(50.3)	1755(56.4)	1987	0.0143
Site				
Malabar-Chifley-La Perouse	4(0.9)	56(1.8)	60	
Toongabbie	3(0.7)	94(3.0)	97	
Seven Hills	1(0.2)	152(4. 9)	153	
Kempsey	29(6.3)	66 (2.1)	95	
Tamworth-North	22(4.8)	99(3.2)	121	
Katoomba-Leura	5(1.1)	269(8.6)	274	
Padstow	1(0.2)	142(4.6)	143	
Warilla	2(0.4)	152(4. 9)	154	

Coonamble	22(4.8)	1(0.03)	23	
Wentworth Falls	0(0.0)	136(4.4)	136	
Revesby	2(0.4)	134(4.3)	136	
Garbutt-West End	18(3.9)	31(1.0)	49	
Innisfail	34(7.4)	53(1.7)	87	
Margate-Woody Point	0 (0.0)	71(2.3)	71	
Mount Isa*	60(13.0)	70(2.2)	130	
Clarinda-Oakleigh South	0(0.0)	78(2.5)	78	
Mornington	1(0.2)	114(3. 7)	115	
East Bendigo-Kennington	5(1.1)	168(5.4)	173	
Christies Beach	12 (2.6)	70(2.2)	82	
Port Augusta	77 (16.7)	78(2.5)	155	
Katherine Region*	113 (24.5)	99(3.2)	212	
Parap	15(3.3)	84(2.7)	99	
Jingili	15(3.3)	79(2.5)	94	
Rockingham	0 (0.0)	198 (6.4)	198	
Albany	12 (2.6)	170 (5.5)	182	
Bayonet Head-Lower King	4 (0.9)	134 (4.3)	138	
Monash	4(0.9)	314(10.1)	318	<0.0001
Remoteness Stratification				
Major Cities	35(7.6)	1980(63.6)	2015	
Inner Regional	56(12.1)	333(10.7)	389	
Outer Regional	175(38.0)	629(20.2)	804	
Remote/Very Remote*	195(42.3)	170(5.5)	365	<0.0001

SD: Standard Deviation

*Includes participants from remote and very remote (Mataranka) areas within the Katherine region. Mt Isa is also classified as both remote and very remote.

Prevalence of Bilateral and Unilateral Hearing Impairment in AEEHS

Among the 3573 participants who had hearing examinations, 1807 persons (50.6%) had bilateral hearing impairment, defined as some measured level of hearing impairment in their better ear (**Table 36**). The crude prevalence of bilateral hearing impairment was

49.0% among Indigenous participants and 50.8% among non-Indigenous participants (p = 0.507). When stratified by the level of hearing impairment as determined by the 4-frequency average of the better ear, 31.5% of Indigenous participants had mild bilateral hearing impairment, 13.9% had moderate bilateral hearing impairment, and 3.7% had severe or profound bilateral hearing impairment. By comparison, among non-Indigenous participants, 31.9% had mild, 16.0% moderate, and 2.9% had severe bilateral hearing impairment. These rates do not differ statistically.

Potentially disabling bilateral hearing impairment (>40 dB HL, better ear) was found in 17.6% of Indigenous participants and 18.9% of non-Indigenous participants (p=0.527), a difference that was not statistically significant.

Among older persons, hearing loss is very steeply age-related. Given that the Indigenous participants were somewhat younger than the non-Indigenous participants in the AEEHS, both groups were directly age-standardised to the Census 2021 Australian population of persons aged 50 years or older. As both samples were somewhat older than equivalent Australian age samples, the age-standardised prevalence rates were expected to fall.

After age adjustment to the Australian population, 42.8% of Indigenous participants had any bilateral hearing impairment, compared with 39.4% of non-Indigenous participants (**Table 36**, p=0.337). The prevalence of potentially disabling bilateral hearing impairment (>40 dB HL, better ear) fell to 14.3% of Indigenous participants and 13.2% of non-Indigenous participants (p=0.583), not statistically different. However, only a marginally greater proportion of Indigenous than non-Indigenous participants had mild (p=0.440),

moderate (p=0.926) and severe or profound (p=0.356) levels of bilateral hearing impairment, after age adjustment to the Australian population.

The overall proportion of Australians (age-standardised prevalence 41.7%) with any bilateral hearing loss found in this survey among non-Indigenous Australians is somewhat greater

Table 35. Prevalence of bilateral hearing impairment in the AEEHS, classified by severity, in the better ear measured using 4-frequency audiometry, before & after age adjustment to the Australian population 2021

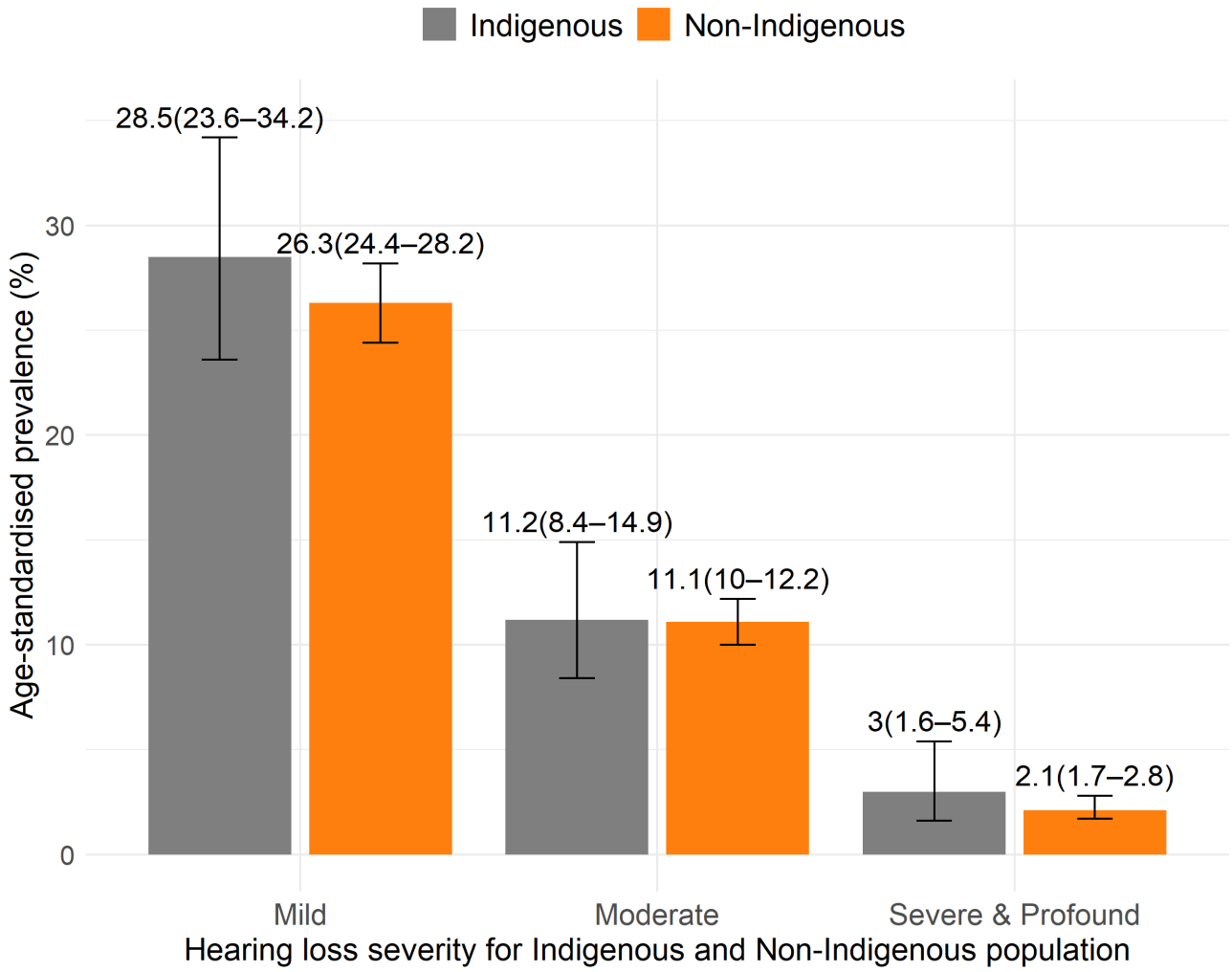
Hearing impairment	Indigenous		Non-Indigenous		Total		
	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)	p-value
Crude prevalence							
Any (>25 dB HL or worse)	226	49.0 (44.4–53.7)	1,581	50.8 (49.0–52.6)	1,807	50.6 (48.9–52.2)	0.507
Moderate or worse (>40 dB HL)	**81**	**17.6 (14.3–21.4)**	**589**	**18.9 (17.6–20.4)**	**670**	**18.8 (17.5–20.1)**	**0.527**
By severity							
Mild (>25 to 40 dB HL)	145	31.5 (27.3–35.9)	992	31.9 (30.2–33.6)	1,137	31.8 (30.3–33.4)	0.898
Moderate (41 to 60 dB HL)	64	13.9 (10.9–17.5)	499	16.0 (14.8–17.4)	563	15.8 (14.6–17.0)	0.265
Severe/Profound (>60 dB HL)	17	3.7 (2.2–6.0)	90	2.9 (2.3–3.6)	107	3.0 (2.5–3.6)	0.430
Age-standardised prevalence							
Any (>25 dB HL)	226	42.8 (36.8-49.5)	1,581	39.4 (37.3-41.8)	1,807	41.7 (39.6-43.9)	0.337
Moderate or worse (>40 dB HL)	**81**	**14.3 (11.0-18.4)**	**589**	**13.2 (12-14.5)**	**670**	**14.2 (13.1-15.5)**	**0.583**
By severity							
Mild (>25 to 40 dB HL)	145	28.5 (23.6-34.2)	992	26.3 (24.4-28.2)	1,137	27.4 (25.7-29.3)	0.440
Moderate (41 to 60 dB HL)	64	11.2 (8.4-14.9)	499	11.1 (10-12.2)	563	11.8 (10.8-13)	0.926
Severe/Profound (>60 dB HL)	17	3.0 (1.6-5.4)	90	2.1 (1.7-2.8)	107	2.4 (1.9-3.0)	0.356

dB HL refers to decibels hearing level; CI = confidence interval

than that reported from the Blue Mountains Hearing Study (BMHS, 1997-2000), which reported a prevalence of 33.0% using testing in a sound booth rather than with headphones and averaging the same four frequencies.[40]

These data are shown below in **Figure 11**. Confidence intervals for the differences between Indigenous and non-Indigenous participants overlap, suggesting the possibility of no true difference.

Figure 11. Age-standardised prevalence of hearing impairment by severity among Indigenous and non-Indigenous participants of the AEEHS



Prevalence of bilateral hearing impairment by age group.

Bilateral hearing impairment was very strongly associated with increasing age, among both Indigenous and non-Indigenous participants (**Table 37**). The prevalence of any bilateral hearing impairment rose from 31.7% to 45.6%, 65.3% and 83.3% among Indigenous participants aged 50-59, 60-69, 70-79 and 80+ years, respectively (p trend <0.0001).

Table 36. Age-specific prevalence of bilateral hearing impairment in the AEEHS

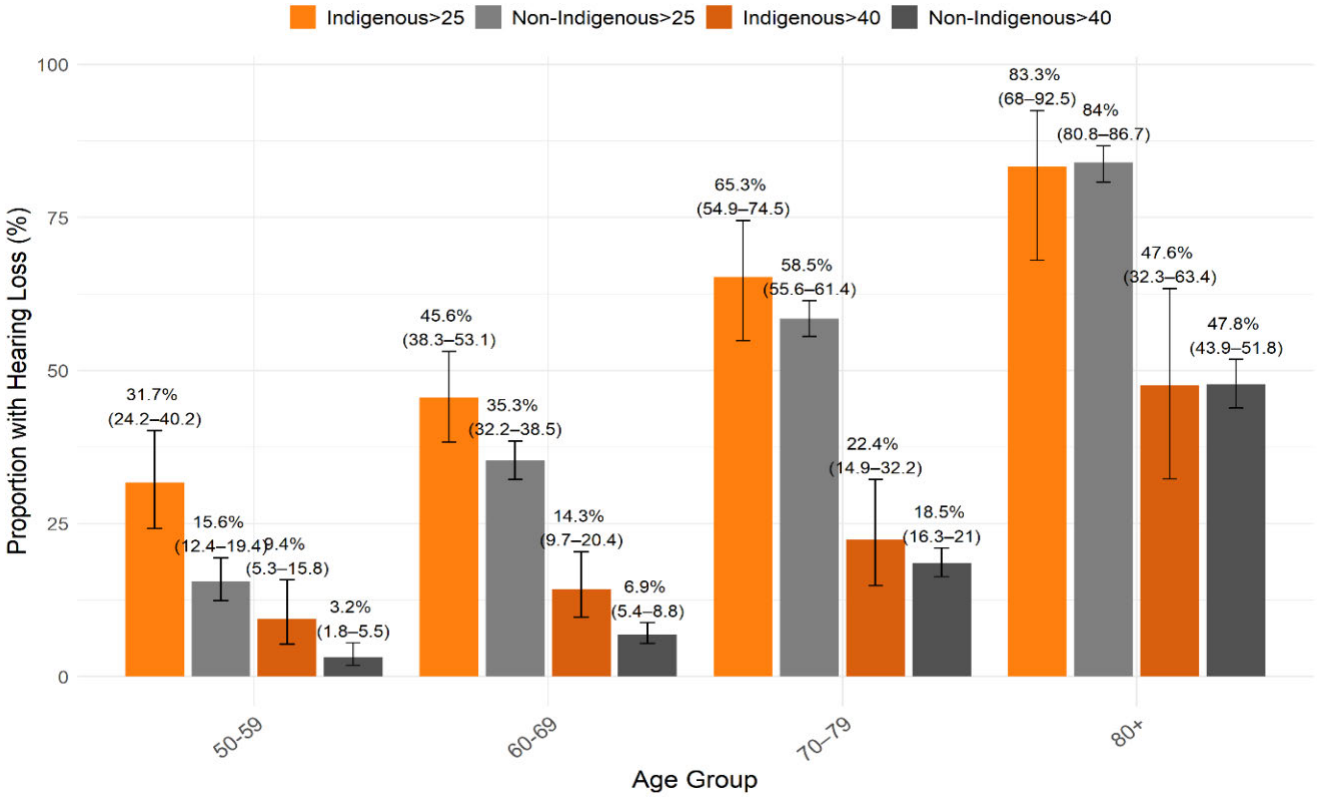
Age Group	Indigenous		Non-Indigenous		Total	
	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)
Any Bilateral Hearing Impairment (>25 dB HL)						
50-59	44	31.7 (24.2-40.2)	68	15.6 (12.4-19.4)	112	19.5 (16.4-23)
60-69	83	45.6 (38.3-53.1)	326	35.3 (32.2-38.5)	409	37 (34.1-39.9)
70-79	64	65.3 (54.9-74.5)	653	58.5 (55.6-61.4)	717	59.1 (56.2-61.8)
80+	35	83.3 (68-92.5)	534	84.0 (80.8-86.7)	569	83.9 (80.9-86.6)
Moderate or Worse Bilateral Hearing Impairment (>40 dB HL)						
50-59	13	9.4 (5.3-15.8)	14	3.2 (1.8-5.5)	27	4.7 (3.2-6.8)
60-69	26	14.3 (9.7-20.4)	64	6.9 (5.4-8.8)	90	8.1 (6.6-9.9)
70-79	22	22.4 (14.9-32.2)	207	18.5 (16.3-21.0)	229	18.9 (16.7-21.2)
80+	20	47.6 (32.3-63.4)	304	47.8 (43.9-51.8)	324	47.8 (44-51.6)

CI=Confidence Interval

The prevalence among non-Indigenous participants similarly rose from 15.6% to 35.3%, 58.5% and 84.0% in the same age groups (p trend <0.0001, **Table 37**). The prevalence of any bilateral hearing impairment was also higher in Indigenous compared to non-Indigenous participants in age groups 50-59, 60-69, and 70-79 years (non-overlapping 95% CIs), but not for 80+ years, where it was similar.

The prevalence of potentially disabling moderate or worse hearing impairment (>40 dB HL, better ear), among younger Indigenous participants was almost 3-fold higher than in similarly aged non-Indigenous participants (9.4% vs 3.2%, among those aged 50-59 years, and around double for Indigenous persons aged 60-69 years than for the non-Indigenous comparison group (14.3% vs 6.9%), with non-overlapping 95% CI suggesting a significant difference (**Table 37** and **Figure 12**). However, these different rates are based on relatively small numbers, and there was no statistically significant difference overall between the age-standardised rates. Nevertheless, these data suggest potentially higher rates of hearing impairment among Indigenous persons aged 50 to 59 and 60-69 years.

Figure 12. Age-specific prevalences for hearing impairment: Any (>25 dB HL, better ear), and Moderate or worse (>40 dB HL, better ear), for Indigenous and non-Indigenous participants of the AEEHS



This finding suggests that there could be factors disproportionately affecting younger Indigenous Australians that lead to early moderate and severe hearing impairment, which persists through older age.[74,75] Potential causal factors include greater incidence of repeated childhood otitis media episodes, higher prevalence of diabetes and smoking, lower education levels and potentially greater likelihood of past work in noisy environments, factors that were found to be associated with higher bilateral hearing impairment prevalence in the BMHS.[40] Subsequent assessments using questionnaire and other data from the AEEHS may help to address whether this difference is real.

Prevalence of bilateral hearing impairment by sex

The prevalence of bilateral hearing impairment was considerably higher in males than in females, in both Indigenous and non-Indigenous participants. In Indigenous participants, 58.5% of males had any bilateral hearing impairment, compared to 39.7% of females ($p<0.0001$), while the corresponding proportions in non-Indigenous participants were 55.8% and 46.9%, $p<0.0001$, respectively (**Table 38** and **Figure 13**).

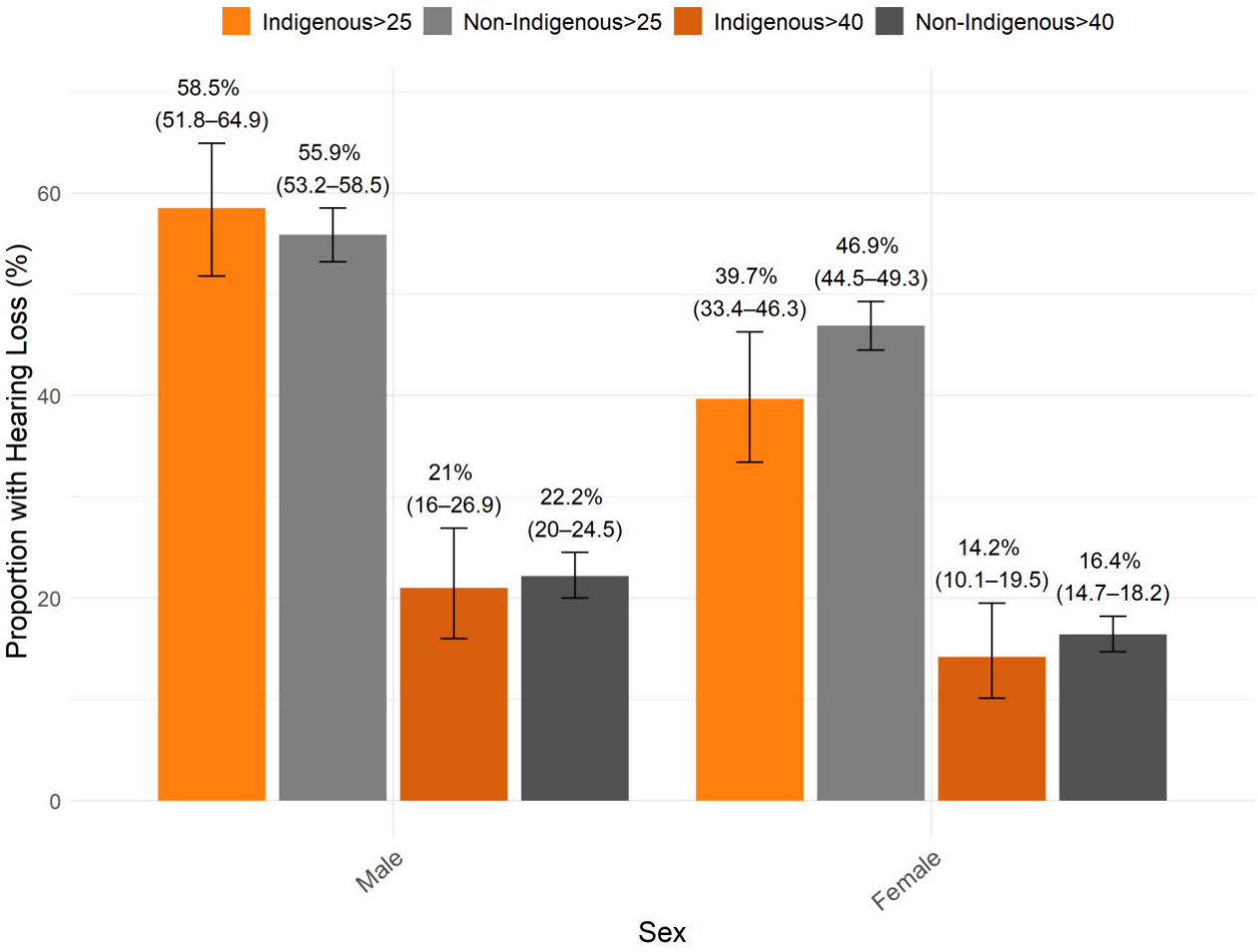
Both Indigenous and non-Indigenous males had a higher prevalence of all severity levels of bilateral hearing loss (i.e mild, moderate and severe or profound) than females, although this difference was statistically significant only for mild (Indigenous and non-Indigenous) and moderate (non-Indigenous) hearing loss. This gender difference has also been previously reported in many other studies, including the BMHS.[40]

Table 37. Prevalence of bilateral hearing impairment in the AEEHS by sex

	Indigenous				
	Male		Female		
	N	**% (95% CI)**	**N**	**% (95% CI)**	**P-value**
Any Bilateral Hearing Impairment (Definition: >25dB HL)					
No	95	41.5 (35.1–48.2)	140	60.3 (53.7–66.6)	
Yes	**134**	**58.5 (51.8–64.9)**	**92**	**39.7 (33.4–46.3)**	**<0.001**
Total	1357	100	1755	100	
By Severity					
Mild	86	37.6 (31.3–44.2)	59	25.4 (20.1–31.6)	0.007
Moderate	38	16.6 (12.1–22.2)	26	11.2 (7.6–16.2)	0.124
Severe & Profound	10	4.4 (2.2–8.1)	7	3.0 (1.3–6.4)	0.602
Moderate or worse (>40 dB HL)	**48**	**21.0 (16.0-26.9)**	**33**	**14.2 (10.1-19.5)**	
	Non-Indigenous				
	Male		**Female**		
	N	**% (95% CI)**	**N**	**% (95% CI)**	**P-value**
Any Bilateral Hearing Impairment (Definition: >25dB HL)					
No	599	44.1 (41.5–46.8)	932	53.1 (50.7–55.5)	
Yes	**758**	**55.9 (53.2–58.5)**	**823**	**46.9 (44.5–49.3)**	**<0.001**
Total	1357	100	1755	100	
Severity					
Mild	457	33.7 (31.2–36.3)	535	30.5 (28.3–32.7)	0.063
Moderate	257	18.9 (16.9–21.1)	242	13.8 (12.2–15.5)	<0.001
Severe & Profound	44	3.2 (2.4–4.4)	46	2.6 (1.9–3.5)	0.359
Moderate or worse (>40 dB HL)	**301**	**22.2 (20.0-24.5)**	**288**	**16.4 (14.7-18.2)**	

CI=Confidence Interval

Figure 13. Sex differences in prevalence for hearing impairment: Any (>25 dB HL, better ear), and Moderate or worse (>40 dB HL, better ear), for Indigenous and non-Indigenous participants of the AEEHS



Hearing Impairment by Remoteness Analysis

Table 39 shows the distribution of bilateral moderate or worse hearing impairment by geographic remoteness level. Overall, there were few significant differences found between Indigenous and non-Indigenous participants, based on geographic remoteness. The low age-standardised prevalence among Outer regional residents could reflect their generally younger age.

Table 38. Prevalence of bilateral moderate hearing impairment (>40 dB HL), by geographic remoteness

Remoteness level	Indigenous		Non-Indigenous		Total	
	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)
Crude prevalence of bilateral moderate or worse Hearing impairment (Definition: >40dB HL)						
Major Cities	7	20.0 (9.1-37.5)	387	19.5 (17.8-21.4)	394	19.6 (17.9-21.4)
Inner Regional	12	21.4 (12.0-34.8)	80	24.0 (19.6-29.1)	92	23.7 (19.6-28.3)
Outer Regional	18	10.3 (6.4-16)	94	14.9 (12.3-18.0)	112	13.9 (11.7-16.6)
Remote/Very Remote*	44	22.6 (17.0-29.2)	28	16.5 (11.4-23.1)	72	19.7 (15.8-24.3)
Age-standardised prevalence of bilateral moderate or worse hearing impairment (Definition: >40dB HL)						
Major Cities	7	18.6 (6.8-45.4)	387	20.0 (18-22.1)	394	14.2 (12.7-15.9)
Inner Regional	12	20.5 (9.1-42)	80	15.4 (11.8-20.6)	92	17.3 (13.5-22.3)
Outer Regional	18	7.1 (3.7-13.3)	94	9.7 (7.6-12.7)	112	10.1 (8.2-12.6)
Remote/Very Remote*	44	19.9 (14.3-27.2)	28	21.3 (14.1-31.2)	72	20.5 (16.0-25.9)

CI=Confidence Interval

*Includes some participants from Remote and Very Remote areas (Mataranka) within the Katherine region. Mt Isa also includes Remote and Very Remote areas.

Prevalence of Unilateral hearing impairment in AEEHS

Among the 1765 persons without any bilateral hearing impairment, 1220 (69.1%) had no unilateral hearing impairment, while 463 (26.2%) had mild, 47 (2.7%) had moderate, 25 (1.4%) had severe, and 10 (0.6%) had profound unilateral hearing impairment (**Table 40**). After age-adjustment to the Australian population, Indigenous participants had a higher prevalence of moderate unilateral hearing impairment (6.1%) compared with non-Indigenous participants (2.4%, p=0.007). A composite level that included moderate, severe and profound unilateral hearing impairment was also greater among Indigenous

than non-Indigenous participants, 7.1% vs 4.3%, but this difference was of borderline statistical significance, p=0.079.

Table 39. Prevalence of unilateral hearing impairment in the AEEHS, classified by severity, before and after age adjustment to the Australian population (2021)

	Indigenous		Non-Indigenous		Total	
	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)
Crude prevalence						
None	171	72.8(66.5-78.3)	1,049	68.5 (66.1-70.8)	1,220	69.1(66.9-71.2)
Mild	47	20 (15.2-25.8)	416	27.2 (25-29.5)	463	26.2(24.2-28.3)
Moderate	12	5.1 (2.8-9)	36	2.4 (1.7-3.3)	48	2.7(2-3.6)
Severe	4	1.7 (0.5-4.6)	19	1.2 (0.8-2)	23	1.3(0.8-2)
Profound	1	0.4(0-2.7)	11	0.7 (0.4-1.3)	12	0.7 (0.4-1.2)
Age-standardised prevalence						
None	171	74.1(63.1-86.5)	1,049	69.2 (64.8-73.8)	1,220	69.1(65.1-73.4)
Mild	47	18.7(13.6-25.3)	416	26.5 (23.8-29.5)	463	26.1(23.6-28.9)
Moderate	12	5.4 (2.8-9.7)	36	2.4 (1.6-3.5)	48	2.8(2-3.9)
Severe	4	2.1 (0.5-5.7)	19	1.2 (0.7-2.0)	23	1.3(0.8-2.0)
Profound	1	1(0-5.6)	11	1.0 (0.5-2.1)	12	1.0(0.5-2.0)

CI=Confidence Interval

Risk factors for Hearing Impairment

Table 41 shows the age-sex and multivariable logistic regression model for risk factors associated with moderate or worse hearing impairment for the entire sample. After adjusting for covariates in the multivariable analysis, age per 10 years (OR: 3.76; 95% CI: 3.31-4.28), current smoking (OR: 1.54; 95% CI: 1.03-2.30), and presence of diabetes (OR: 1.38; 95% CI:

1.07-1.77) were associated with increased likelihood of moderate or worse hearing impairment. Attainment of tertiary education (OR: 0.74; 95% CI: 0.59-0.92), having private health insurance (OR: 0.75; 95% CI: 0.61-0.92), residence in outer regional areas (OR: 0.51; 95% CI: 0.30-0.85) and female sex (OR: 0.73; 95% CI: 0.60-0.89) were protective factors.

Indigenous status was associated with a 1.8-fold increase in moderate or worse hearing impairment in the age-sex adjusted model. However, this effect was borderline statistically significant after adjustment for other covariates. Results for any hearing impairment were similar (**Table 42**). **However, Indigenous status remained significantly associated with any hearing impairment in the multivariable adjusted model (OR: 1.45; 95%CI 1.08-1.95).**

Table 40. Risk factors for moderate or worse (>40 dB HL, better ear) bilateral hearing impairment in the AEEHS

Risk Factor	Total			
	Age-sex adjusted OR	P value	Multivariable OR	P value
Age, per 10 years	3.62 (3.21-4.09)	<0.001	3.76 (3.31-4.28)	<0.001
Female sex	0.72 (0.59-0.87)	<0.001	0.73 (0.60-0.89)	0.002
Indigenous	1.79 (1.28-2.51)	<0.001	1.40 (0.98-2.02)	0.07
Highest education level				
Below high school	1		1	
High school	0.78 (0.56-1.09)	0.15	0.84 (0.60-1.18)	0.32
Tertiary	0.67 (0.54-0.83)	<0.001	0.74 (0.59-0.92)	0.006
Owns home	0.78 (0.62-0.99)	0.04	0.97 (0.76-1.24)	0.79
Diabetes	1.52 (1.19-1.93)	<0.001	1.38 (1.07-1.77)	0.01
Cardiovascular disease	1.22 (0.93-1.60)	0.16	1.11 (0.84-1.47)	0.45
Smoking status				
Never smoked	1		1	
Current smoker	1.89 (1.27-2.80)	0.002	1.54 (1.03-2.30)	0.04
Ever smoked	0.90 (0.72-1.13)	0.36	0.86 (0.68-1.08)	0.19
Remoteness				
Major Cities	1		1	
Inner Regional	1.21 (0.61-2.39)	0.59	1.14 (0.59-2.22)	0.69
Outer Regional	0.55 (0.32-0.92)	0.02	0.51 (0.30-0.85)	0.01
*Remote/Very Remote	1.84 (0.90-3.78)	0.10	1.23 (0.59-2.54)	0.58
Private health insurance	0.66 (0.54-0.80)	<0.001	0.75 (0.61-0.92)	0.007

OR = odds ratio. Hypertension and body mass index were not significantly associated with hearing impairment and not included in the table.

* Multivariable model adjusted for Age (except age per 10 years), Sex (except female sex), Indigenous status, Remoteness, Highest education level, Own home, Private health insurance, Smoking status, Diabetes, Cardiovascular disease in past 12 months.

Table 41. Risk factors for any hearing impairment (>25 dB HL, better ear) in the AEEHS

Risk Factor	Total			
	Age-sex adjusted OR	P value	Multivariable OR	P value
Age, per 10 years	3.35 (3.04-3.69)	<0.001	3.50 (3.15-3.88)	<0.001
Female sex	0.67 (0.57-0.78)	<0.001	0.69 (0.58-0.81)	<0.001
Indigenous	1.82 (1.38-2.40)	<0.001	1.45 (1.08-1.95)	0.01
Highest education level				
Below high school	1		1	
High school	0.84 (0.63-1.10)	0.21	0.91 (0.68-1.20)	0.50
Tertiary	0.71 (0.59-0.85)	<0.001	0.78 (0.65-0.94)	0.009
Owns home	0.80 (0.66-0.98)	0.03	1.03 (0.84-1.27)	0.77
Diabetes	1.56 (1.25-1.94)	<0.001	1.42 (1.14-1.78)	0.002
Cardiovascular disease	1.24 (0.97-1.58)	0.09	1.11 (0.87-1.43)	0.40
Smoking status				
Never smoked	1		1	
Current smoker	1.74 (1.28-2.35)	<0.001	1.43 (1.05-1.96)	0.02
Ever smoked	0.82 (0.68-1.00)	0.04	0.79 (0.65-0.96)	0.02
Remoteness				
Major Cities	1		1	
Inner Regional	1.52 (0.57-4.07)	0.40	1.36 (0.52-3.60)	0.53
Outer Regional	0.62 (0.30-1.28)	0.20	0.56 (0.28-1.15)	0.11
Remote/Very Remote	1.19 (0.43-3.28)	0.73	0.77 (0.28-2.11)	0.61
Private health insurance	0.67 (0.57-0.79)	<0.001	0.75 (0.64-0.90)	0.001

OR = odds ratio. Hypertension and body mass index were not significantly associated with hearing impairment and not included in the table.

* Multivariable model adjusted for Age (except age per 10 years), Sex (except female sex), Indigenous status, Remoteness, Highest education level, Own home, Private health insurance, Smoking status, Diabetes, Cardiovascular disease in past 12 months.

Prevalence of self-reported hearing aid use in Indigenous and non-Indigenous Australians

There were 3560 participants who provided self-reported data about use and benefits of wearing hearing aids, including 602 (16.9%) who indicated that they had used a hearing aid (**Table 43**); 243 (40%) said they had used this for less than 5 years, and 359 (60%) said they had used this for more than 5 years. Most, 541 (90.2%) used a hearing aid in both ears, while 59 (9.8%) used a hearing aid in only one ear. The crude prevalence of hearing aid usage was 14.1% among Indigenous participants and 17.3% among non-Indigenous participants. After age adjustment, the prevalence of hearing aid use fell slightly among Indigenous participants (11.3%), but by a greater proportion among non-Indigenous participants (11.9%); this difference was not statistically significant ($p = 0.701$). Among 3541 participants who answered the question, 8 (0.3%) indicated that they had a cochlear implant.

Table 42. Reported use of hearing aids by participants in the AEEHS

Use of a Hearing Aid	Indigenous		Non-Indigenous		Total		
	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)	P-value
Crude prevalence							
No	395	85.9 (82.3–88.9)	2,565	82.7 (81.3–84.0)	2,960	83.1 (81.8–84.3)	
Yes	65	14.1 (11.1–17.7)	537	17.3 (16.0–18.7)	602	16.9 (15.7–18.2)	0. 103
Age-standardised prevalence							
Yes	**65**	**11.3(8.4-14.9)**	**537**	**11.9 (10.9-13.2)**	**602**	**12.6 (11.6-13.8)**	**0.701**

CI=Confidence Interval

Table 43. Use of a hearing aid (%) by severity of measured bilateral hearing impairment

Use of a Hearing Aid	Indigenous		Non-Indigenous		Total		
	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)	P-value
Mild Bilateral Hearing Impairment (Definition: >25 to 40 dB HL)							
Yes	19	29.2 (18.9–42.0)	143	26.6 (23.0–30.6)	162	26.9 (23.4–30.7)	0.765
Moderate or worse Bilateral Hearing impairment (Definition >40dB HL)							
Yes	43	66.2 (53.3-77.1)	373	69.5 (65.3-73.3)	416	69.1 (65.2-72.7)	0.687

CI=Confidence Interval

Among participants who reported ever having had a hearing aid, only 27% had mild measured bilateral hearing impairment, while 69% of those with moderate or worse hearing impairment had a hearing aid (**Table 44**). The remainder, over 30% of those with measured moderate or worse bilateral hearing impairment (>40 dB HL, better ear), reported having not used a hearing aid in the past. This could be an indication of substantial under-use of hearing aid technology, and demonstrates a gap between community awareness and action, or referral.)

There were no substantive differences in these rates between Indigenous and non-Indigenous participants. However, for moderate or worse bilateral hearing impairment, a level of potentially disabling impairment, the proportion who had used a hearing aid was lower for Indigenous participants (66.2%) than for non-Indigenous participants (69.5%).

Prevalence of Subsidisable Hearing Impairment, according to Hearing Services Program (HSP) criteria

Program eligibility criteria

Among the total sample of 3573 Hearing Survey participants, 2288 (64.0%) met the Australian Hearing Services Program (HSP) criteria for subsidisable hearing impairment in at least one ear (**Table 45**). This criterion refers to the minimum hearing loss threshold (three-frequency average hearing loss (3FAHL) of 23.3 decibels or more, measured at 0.5, 1, and 2 kilohertz), and is required to be met in Australia to receive free hearing services together with subsidised hearing aid(s).[76] There is little survey data available to assess this hearing loss threshold.

This hearing loss criterion was met among 64.4% of Indigenous participants and 64.0% of non-Indigenous participants (p = 0.893). A total of 1995 (55.8%) participants met HSP criteria for a hearing aid in the Right Ear, while a total of 2015 (56.4%) participants met HSP criteria for a hearing aid in the Left Ear. After age adjustment to the Australian population, Indigenous participants had a slightly higher rate (59.1%) of subsidisable hearing loss than non-Indigenous participants (54.4%, p=0.261), but this difference was not statistically significant.

Given the very high rate of potentially subsidisable hearing impairment (64% of all participants aged 50 or older found in this Survey), a case could be made to revisit the minimum hearing loss threshold criterion.

Prevalence of hearing handicap in the AEEHS

There were 1155 participants with bilateral hearing impairment who completed the Hearing Handicap Inventory for the Elderly (HHIE) questionnaire. However, 90 had normal measured hearing and have been excluded, leaving 1,065 participants with measured bilateral hearing impairment (>25 dB HL) who completed the questionnaire. The HHIE questionnaire had 10 questions indicating handicap (See Appendix). Significant hearing handicap was defined if at least eight answers were positive from the total of 10. There were 312 who reported <8 positive answers, while 753 reported at least eight positive handicap answers (**Table 46**). Hearing handicap (score ≥8) was reported by 97 (70.3%) of Indigenous participants and 656 (70.8%) of non-Indigenous participants. Lower levels of hearing handicap were reported by 41 (29.7%) of Indigenous participants and 312 (29.3%) of non-Indigenous participants.

Table 44. Prevalence of subsidisable hearing impairment, stratifying by Hearing Services Program (HSP) criteria among Indigenous and non-Indigenous participants, and standardised to the Australian population

	Indigenous		Non-Indigenous		Total		
	N	**% (95% CI)**	**N**	**% (95% CI)**	**N**	**% (95% CI)**	**P-value**
Crude prevalence							
Subsidisable hearing loss Left Ear							
No	201	43.6(39-48.3)	1,357	43.6(41.9-45.4)	1,558	43.6(42-45.3)	
Yes	260	56.4(51.7-61)	1,755	56.4(54.6-58.1)	2,015	56.4(54.7-58)	1
Subsidisable hearing loss Right Ear							
No	192	41.6(37.1-46.3)	1,386	44.5(42.8-46.3)	1,578	44.2(42.5-45.8)	
Yes	269	58.4(53.7-62.9)	1,726	55.5(53.7-57.2)	1,995	55.8(54.2-57.5)	0.265
Subsidisable hearing loss in at least one ear							
No	164	35.6(31.2-40.2)	1,121	36(34.3-37.7)	1,285	36(34.4-37.6)	
Yes	297	64.4(59.8-68.8)	1,991	64(62.3-65.7)	2,288	64(62.4-65.6)	0.893
Age-standardised prevalence							
Subsidisable hearing loss Left Ear							
Yes	260	50.7(44.2-58.2)	1,755	46.8(44.3-49.5)	2,015	48.9(46.5-51.3)	0.302
Subsidisable hearing loss Right Ear							
Yes	269	53.4(46.6-61.1)	1,726	45.7(43.2-48.3)	1,995	48.4(46.1-50.8)	0.049
Subsidisable hearing loss in at least one ear							
Yes	297	59.1(51.9-67.1)	1,991	54.4(51.7-57.3)	2,288	56.6(54-59.3)	0.261

CI=Confidence Interval

Table 45. Hearing Handicap Inventory for the Elderly (HHIE) Screening Score among participants with hearing impairment by Indigenous status; crude prevalence and after age-standardisation to the Australian population

	Indigenous		Non-Indigenous		Total		
	N	**% (95% CI)**	**N**	**% (95% CI)**	**N**	**% (95% CI)**	**P-value**
Crude Prevalence							
Score <8	41	29.7 (22.4-38.2)	271	29.2(26.3-32.3)	312	29.3(26.6-32.1)	
Score ≥8	97	70.3 (61.8-77.6)	656	70.8(67.7-73.7)	753	70.7(67.9-73.4)	0.989
Total	138	100	927	100	1,065	100	
Age-standardised Prevalence							
Score ≥8	97	66.2 (49.9-87.3)	656	70.7(61.6-81.4)	753	69.6(62.2-78)	0.676

CI=Confidence Interval

Table 46. Hearing Handicap Inventory for the Elderly (HHIE) Scores by age group and Indigeneity

Age Group	**Indigenous**		**Non-Indigenous**		**Total**	
	N	**% (95% CI)**	**N**	**% (95% CI)**	**N**	**% (95% CI)**
50-59	15	60.0(38.9-78.2)	32	69.6(54.1-81.8)	47	66.2(53.9-76.7)
60-69	39	73.6(59.4-84.3)	145	73.6(66.8-79.5)	184	73.6(67.6-78.9)
70-79	27	69.2(52.3-82.5)	238	67.6(62.4-72.4)	265	67.8(62.9-72.3)
80+	16	76.2(52.5-90.9)	241	72.6(67.4-77.3)	257	72.8(67.8-77.3)

CI=Confidence Interval

After age-adjustment to the Australian population, the proportion reporting hearing handicap (score ≥8) remained relatively similar and not significantly different, including 66.2% of Indigenous participants and 70.7% of non-Indigenous participants, p=0.676. The proportion of participants (both Indigenous and non-Indigenous) who reported hearing handicap increased slightly with increasing age (**Table 47**); this was greater for Indigenous participants. Overall, around 2/3 of persons with any measured bilateral hearing impairment had hearing handicap on the HHIE.

Subjective hearing impairment in AEEHS and correlation with measured hearing impairment

The AEEHS hearing questionnaire asked four key questions that related to subjective hearing impairment:

Q1. **Do you feel you have a hearing loss?**

Q2. **Does it affect your right, left or both ears?**

Q3. **How long do you feel you have had a problem with your hearing? <1 year, 1-5 years, 5-10 years, >10 years?**

Q8. **Have you spoken to a professional about your hearing loss?**

For Q1, the data on positive response (1,161 reported **they felt they had a hearing loss**) was shown in **Table 48**. This analysis showed for persons with mild or worse measured hearing impairment (>25 dB HL, better ear), just over 50% of participants felt they had a hearing loss, whereas for those with moderate or worse measured hearing impairment (>40 dB HL, better ear), around 80% felt they had a hearing loss. This suggests that the

>40 dB HL criterion may be more helpful in defining the subjective effects of reduced hearing, and for this criterion, there was moderate agreement between self-reported hearing impairment and objectively measured bilateral hearing impairment. There were no significant differences between Indigenous and non-Indigenous participants for this analysis.

The sensitivity of self-report in detecting objectively measured bilateral hearing impairment was relatively low, and the specificity of self-report in detecting objectively measured hearing impairment was relatively high. This suggests that self-reported hearing loss may not be a reliable indicator, and that screening with objective hearing testing is needed to identify hearing impairment.

For Q2, **whether the hearing loss affected the right, left or both ears**, of the 1158 participants with self-reported hearing loss, 93 (8.0%) stated that it affected their right ear, 117 (10.1%) stated it affected their left ear, and 948 (81.9%) reported it affected both ears. Reported hearing loss in both ears was associated with more severe measured bilateral hearing loss (data not shown).

For Q3, **How long did participants feel they had a problem with their hearing**, a majority of participants reported a problem with their hearing for more than 5 years (**Table 49**). A significantly higher proportion of Indigenous participants (56%) reported having had a problem with their hearing for more than 10 years, compared with non-Indigenous participants (38%), $p<0.001$. This matches the earlier data in **Table 36,** indicating a potentially earlier onset of hearing impairment among Indigenous compared with non-Indigenous participants.

Table 47. Q1. Self-reported hearing impairment compared with measured bilateral hearing impairment, using >25 dB HL and >40 dB HL criteria

Bilateral Hearing Impairment	Indigenous		Non-Indigenous		Total		
	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)	P-value
>25 dB HL, better ear							
No	31	13.2 (9.3-18.4)	192	12.5 (10.9-14.3)	223	12.6 (11.1-14.3)	
Yes	**120**	**53.1 (46.4-59.7)**	**818**	**51.7 (49.2-54.2)**	**938**	**51.9 (49.6-54.2)**	**0.74**
Total	151	100	1,010	100	1,161	100	
>40 dB HL, better ear							
No	92	24.2 (20.1-28.9)	536	21.2 (19.7-22.9)	628	21.6 (20.2-23.2)	
Yes	**59**	**72.8 (61.6-81.9)**	**474**	**80.5 (77-83.6)**	**533**	**79.6 (76.3-82.5)**	**0.085**
Total	151	100	1,010	100	1,161	100	

CI=Confidence Interval

Table 48. Q3. How long do you feel you have had a problem with your hearing? <1 year, 1-5 years, 5-10 years, >10 years?

	Indigenous		Non-Indigenous		Total		
	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)	P-value
1 – 5 years	32	21.2(15.1-28.7)	283	28.0(25.3-30.9)	315	27.1(24.6-29.8)	0.095
<1 year	7	4.6(2-9.7)	48	4.8(3.6-6.3)	55	4.7(3.6-6.2)	1.000
5 – 10 years	28	18.5(12.9-25.9)	292	28.9(26.2-31.8)	320	27.6(25-30.2)	0.010
>10 years	84	55.6(47.3-63.6)	380	37.6(34.6-40.7)	464	40.0(37.1-42.9)	<0.001
Don’t know			6	0.6(0.2-1.4)			
Total	151	100	1,009	100	1,154	100	

CI=Confidence Interval

Table 49. Q8. Have you spoken to a professional about your hearing loss?

	Indigenous		Non-Indigenous		Total		
	N	**% (95% CI)**	**N**	**% (95% CI)**	**N**	**% (95% CI)**	**P-value**
Yes	**92**	**60.9 (52.6-68.7)**	**693**	**68.6 (65.6-71.4)**	**785**	**67.6 (64.8-70.3)**	**0.082**
No	57	37.7 (30.1-46)	310	30.7 (27.9-33.7)	367	31.6 (29-34.4)	0.095
Don't know	2	1.3 (0.2-5.2)	4	0.4 (0.1-1.1)	6	0.5 (0.2-1.2)	0.379
Total	151	100	1,007	100	1,158	100	

CI=Confidence Interval

For Q8, "**Have you spoken to a professional about your hearing loss?**", only around 2/3 of participants (68%) who reported a hearing problem had ever sought help (**Table 50**). This indicates a very substantial gap in self-referral to audiologists or other professionals among persons with hearing impairment. It could reflect stigma, concern about cost, dismissal of the importance of this symptom, or other reasons. Participants clearly understood the question, as there were very few "don't know" responses.

Education programs about the importance and ready availability of screening services could assist in improving this rate. Importantly, the rate was lower among Indigenous participants (61%) than non-Indigenous participants (69%), for whom earlier data (**Table 46**) also indicated hearing symptoms had been present for a longer period.

Dual Sensory Impairment

Dual sensory impairment (both vision and hearing impairments) was explored, as this condition has substantial impacts on quality of life and independent living.[77] Cases included persons with bilateral vision impairment/ blindness, together with either any bilateral hearing impairment (>25 dB HL, better ear) or moderate or worse bilateral hearing impairment (>40 dB HL, better ear), as shown in **Table 51**. For the first (milder) hearing category, the overall prevalence of dual sensory impairment was 3.3%, and for the more severe category, 1.6%. These results are comparable to those reported from the BMHS, which found a prevalence of 6% in those aged 55+ years.[78]

Indigenous participants had a significantly greater prevalence of dual sensory impairment than non-Indigenous participants (6.3% vs 2.9%, $p<0.001$, for the milder hearing category, and 3.3% vs 1.3%, $p=0.004$ for the more severe hearing category.

However, this association was somewhat weaker after age standardising to the 2021 Australian population (**Table 51**). **Table 52** shows this association by age group. It was absent for older Indigenous participants (aged 80 years or older) and was strongest for younger Indigenous participants (aged less than 70 years), compared with non-Indigenous participants.

Table 50. Dual Sensory Impairment prevalence in the AEEHS, among Indigenous and non-Indigenous participants, by level of hearing impairment, before and after age standardisation to the Australian population

	Indigenous		Non-Indigenous		Total		
	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)	P-value
Crude prevalence							
Bilateral Vision Impairment + Any Bilateral Hearing Impairment (Definition: >25 dB HL)							
Yes	29	6.3 (4.3-9.0)	90	2.9 (2.3-3.6)	119	3.3 (2.8-4.0)	<0.001
Bilateral Vision Impairment + Moderate or Worse Bilateral Hearing Impairment (Definition: >40 dB HL)							
Yes	15	3.3 (1.9-5.4)	42	1.3 (1.0-1.8)	57	1.6 (1.2-2.1)	0.004
Age-standardised prevalence							
Bilateral Vision Impairment + Any Bilateral Hearing Impairment (Definition: >25 dB HL)							
Yes	29	5.2(3.3-7.9)	90	2.8(2.2-3.4)	119	2.5(2-3.1)	0.047
Bilateral Vision Impairment + Moderate or Worse Bilateral Hearing Impairment (Definition: >40 dB HL)							
Yes	15	2.8(1.5-5.2)	42	1.3(0.9-1.8)	57	1.3(0.9-1.7)	0.115

CI=Confidence Interval

Table 51. Dual Sensory Impairment, by age group and Indigeneity

Age Group	Indigenous		Non-Indigenous		Total	
	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)
Bilateral Vision Impairment + Any Bilateral Hearing Impairment (Definition: >25 dB HL)						
50-59	4	2.9(0.9-7.7)	0		4	0.7(0.3-1.8)
60-69	12	6.6(3.6-11.5)	4	0.4(0.1-1.2)	16	1.4(0.9-2.4)
70-79	9	9.2(4.5-17.2)	28	2.5(1.7-3.7)	37	3.0(2.2-4.2)
80+	4	9.5(3.1-23.5)	58	9.1(7.1-11.7)	62	9.1(7.1-11.6)
Bilateral Vision Impairment + Moderate or Worse Bilateral Hearing Impairment (Definition: >40 dB HL)						
50-59	3	2.2(0.6-6.7)	0		3	0.5(0.2-1.5)
60-69	6	3.3(1.3-7.4)	3	0.3(0.1-1)	9	0.8(0.4-1.6)
70-79	3	3.1(0.8-9.3)	11	1.0(0.5-1.8)	14	1.2(0.7-2)
80+	3	7.1(1.9-20.6)	28	4.4(3-6.4)	31	4.6(3.2-6.5)

Discussion of Ear Health Findings

This comprehensive analysis of hearing health in Australian adults reveals a picture of relatively frequent and somewhat under-treated hearing impairment, with possible earlier onset and disproportionate burden among Indigenous Australians. It is potentially worsened by the underutilisation of available hearing technologies. The findings carry significant implications for hearing health policy, service delivery, and health equity in Australia. Both our Indigenous and non-Indigenous hearing samples were somewhat older than the comparative Australian population in the same age groups.

The age-standardised prevalence of mild, moderate and severe to profound hearing loss among non-Indigenous participants aged 50+ years was 27.4%, 11.8% and 2.4%. This is comparable to what we previously observed in the Blue Mountains Hearing Study[28] (99% Caucasian population aged 55+ years), where prevalence rates were 39.1%, 13.4% and 2.2% respectively, and also similar to findings from mainly Caucasian populations in the United States.[79-81]

Most participants in the AEEHS with hearing impairment had mild to moderate hearing loss, but a substantial number of participants had severe or profound impairment. This highlights that hearing loss in the community spans a wide severity spectrum, reinforcing the inadequacy of a one-size-fits-all approach to hearing care. The need for personalised treatment pathways, educational materials, and support systems, tailored to severity and functional impact, is important.

Both the crude and age-standardised prevalences of bilateral hearing impairment were relatively similar between the Indigenous and non-Indigenous groups. After age

standardisation, Indigenous participants were only slightly more likely to have moderate or worse hearing loss (14.3%) than non-Indigenous participants (13.2%). They were also only slightly more likely to have severe or profound impairment (3.0%) compared with non-Indigenous participants (2.4%). However, there was a consistent trend for moderate or worse hearing impairment to be present at relatively younger ages among Indigenous than non-Indigenous participants (9.4% vs 3.2% for ages 50-59, and 14.3% vs 6.9% for ages 60-69). Any hearing impairment was also more frequent among Indigenous participants in their 50s (31.7%) than in non-Indigenous participants (15.6%).

However, these different rates, particularly those for moderate or worse impairment, were based on relatively small numbers. As mentioned, there were also no statistically significant differences overall in the age-standardised rates. If real, the possible earlier onset among Indigenous participants could be driven by socioeconomic, environmental, or systemic health inequities.

The usual male preponderance of hearing impairment, reported previously in Australia[28] and internationally,[82] was greater among Indigenous than non-Indigenous participants, at least for any impairment. There were no significant differences in the rate of hearing aid use between the groups, nor in their use among persons with measured bilateral hearing impairment.

One-third of persons with measured moderate or worse hearing impairment had never used a hearing aid. This is a potential indication of the unmet need for hearing support. Hearing handicap appeared somewhat greater among Indigenous participants. Self-reported hearing problems were also recorded for longer periods among Indigenous participants, and they were somewhat less likely to have sought professional help.

The findings underscore the need for early, culturally safe, and community-based hearing screening and intervention programs for Indigenous Australians, particularly targeting middle-aged adults to reduce the documented long-term impacts of hearing loss, such as social isolation, poor quality of life and cognitive decline.

Prevalence of hearing impairment increased sharply with age across both men and women, reaching over 80% in those aged 80+, with males consistently exhibiting higher prevalence than females. These trends are expected to continue with the ageing population but emphasise the importance of routine hearing monitoring in older adults, particularly men. The age-standardised rates of around 14% for moderate or worse hearing impairment reflect the likely proportion with potentially disabling hearing loss, for whom only two-thirds have accessed a hearing aid or sought professional help.

Despite 64% of participants being eligible for hearing aid provision (as per HSP criteria), only 13% reported hearing aid use, and 0.2% had received a cochlear implant. There is obvious under-utilisation of hearing technologies by older Australians. However, the HSP criteria may need re-evaluation and better targeting to affected individuals.

The AEEHS data highlight the potential for systemic barriers (e.g. cost, access, stigma, and follow-up care) that need to be addressed through targeted policy reform, including subsidised device programs, and for the Indigenous community, mobile outreach services and culturally appropriate counselling and education for younger members.

Although hearing aid usage was statistically similar between groups, the need may be significantly greater among Indigenous participants, particularly those at younger ages. It will be important to both reach and serve Indigenous communities, not only with

hearing interventions but also potentially with follow-up support and education. Our findings suggest that hearing services should invest in Indigenous-led service models, co-designed with communities, that are culturally safe, geographically accessible, and integrated with broader health and social services.

Around 2/3 of participants with any measured bilateral hearing impairment reported a perceived hearing handicap; this reported handicap increased with age and was greater for Indigenous participants. Self-report did not appear to be a particularly reliable indicator of hearing function. Dual sensory impairment (vision and hearing loss) was significantly more common among Indigenous adults.

Indigenous participants were found to have higher rates of vision impairment, and this translated to significantly higher prevalence of dual sensory impairment (both vision and hearing), which persisted after age standardisation. The higher prevalence of dual sensory impairment among Indigenous than non-Indigenous persons was particularly seen among those aged under 70 years, where it was at least 3-fold higher. This condition has considerable impacts on quality of life[8] and the ability of people to live independently,[83] being associated with a higher risk of falls,[84] cognitive decline,[85,86] earlier retirement[87] and also mortality.[12]

Several risk factors for any or moderate to severe hearing impairment were identified in the multivariate analyses conducted, of which some were also shared with vision impairment. These included the very marked effect of increasing age, male gender, diabetes, and smoking (significant for hearing, but not for vision impairment).

Indigenous status was borderline significantly associated with moderate or worse hearing impairment after adjustment for other covariates in the multivariate model but was significantly associated with any hearing impairment (OR 1.45, 95%CI 1.08-1.95) in this model.

Some protective factors included greater education levels and having private health insurance (these may represent a proxy for lower work-related noise exposure). Importantly, many of these factors are modifiable, suggesting areas where health promotion initiatives could be better targeted to improve both eye and ear health. These findings again emphasise the close links between vision and hearing impairment, and support efforts to address both jointly. Unlike for vision impairment, living in remote or very remote settings was not independently associated with hearing impairment after adjusting for other risk factors. Our findings could also reflect the effect of other risk factors, such as occupational noise exposure, past history of middle ear infections (known to be more frequent among Indigenous children) and drug ototoxicity, for which data were not fully available at the time of report preparation. Data on these risk factors were collected in the take home questionnaire and future reports from our survey will aim to investigate the impact of these exposures on hearing impairment in more detail.

Hearing loss is not merely a sensory issue but may be a driver of social, functional, and emotional challenges, especially in already underserved populations. Intervention programs should extend beyond amplification to address the broader social and emotional impacts of hearing loss, including through rehabilitation, counselling, and community support mechanisms.

In summary, our AEEHS data paints a picture of hearing loss as a major, yet under-recognised public health issue in Australia. Some 14% of Australians aged 50+ years (around 1 in 7) have moderate or worse bilateral hearing impairment, a level likely to reflect frequent hearing disability.

The possibility of earlier-onset and under-treated hearing impairment among Indigenous populations calls for a shift in hearing care delivery, from reactive to proactive, and from standardised to person- and community-centred models. Additionally, Indigenous Australians were less likely to consult a professional, despite being concerned about their hearing for longer periods.

Dual sensory impairment is also a significant issue, particularly among younger Indigenous Australians, and interventions to detect and treat both sensory losses could improve quality of life substantially.[8,14] Addressing these disparities requires cross-sector collaboration, sustained investment, and a commitment to equity and inclusion in hearing health policy and practice.

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The AEEHS Team

The AEEHS project team comprised a broad consortium with representation from major stakeholders in Australian eye and ear health. The project was governed by a Steering Committee consisting of members from the Westmead Institute for Medical Research (Executing Research Body), University of Sydney, University of New South Wales, Macquarie University, Brien Holden Foundation, The George Institute for Global Health, Australian Institute of Aboriginal and Torres Strait Islander Studies (AIATSIS) and National Aboriginal Community Controlled Health Organisation (NACCHO). The Project Advisory Group provided expert advice on appropriate community consultation, participation, research/clinical processes and capacity building at all stages of the project. Research planning, data collection, analysis and report writing were managed by the Project Manager, Dr Richard Kha and his research team with support from the Steering Committee.

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Westmead Institute for Medical Research

Steering Committee

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Australian Government Department of Health, Disability and Ageing

Aboriginal and Torres Strait Islander Representatives

Diabetes Australia

Glaucoma Australia

Macular Disease Foundation Australia

Optometry Australia

Royal Australian and New Zealand College of Ophthalmologists (RANZCO)

Vision 2020 Australia

Major Contributing Partner

Australian Government – Department of Health, Disability and Aged Care

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Aboriginal Family Clinic Noarlunga

Tamworth Aboriginal Medical Service

Durri Aboriginal Corporation Medical Service

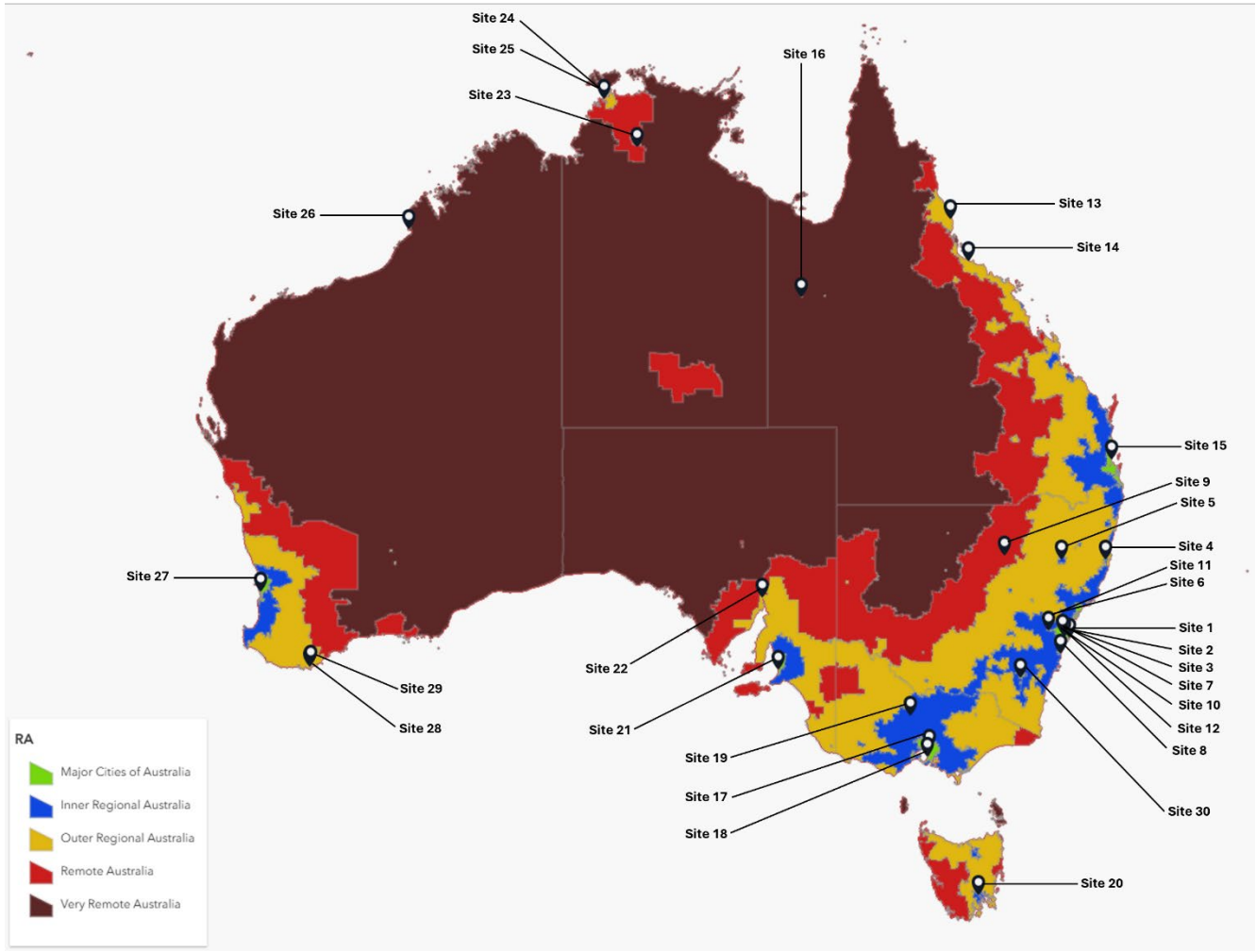
Greater Western Aboriginal Health Service

Broome Regional Aboriginal Medical Service

Great Southern Aboriginal Health Service

Appendices

Figure. Map of sites visited in the Australian Eye and Ear Health Survey



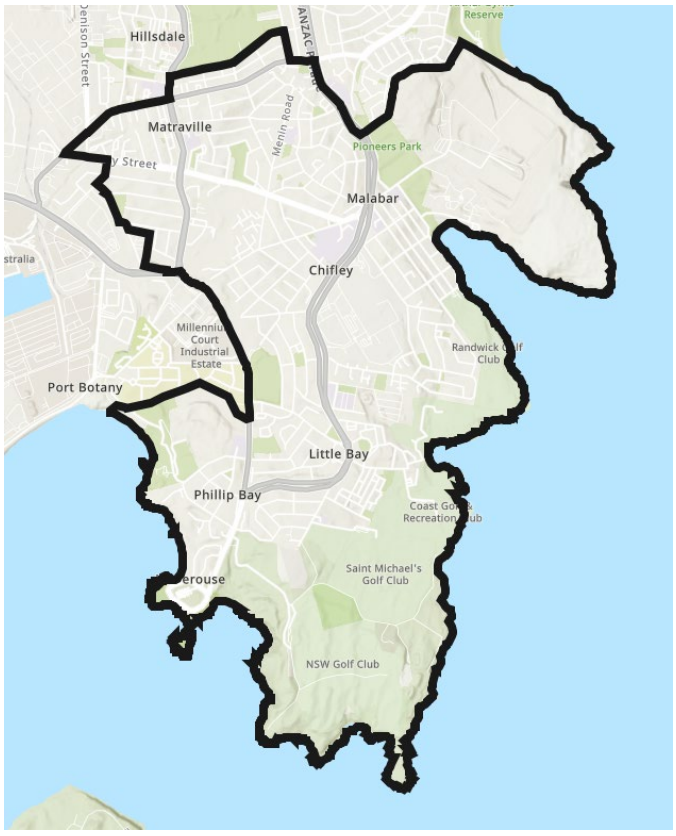
RA = Remoteness Area, the remoteness classification derived from the 2016 Australian Statistical Geography Standard (ASGS).

Table. Sites visited in the Australian Eye and Ear Health Survey

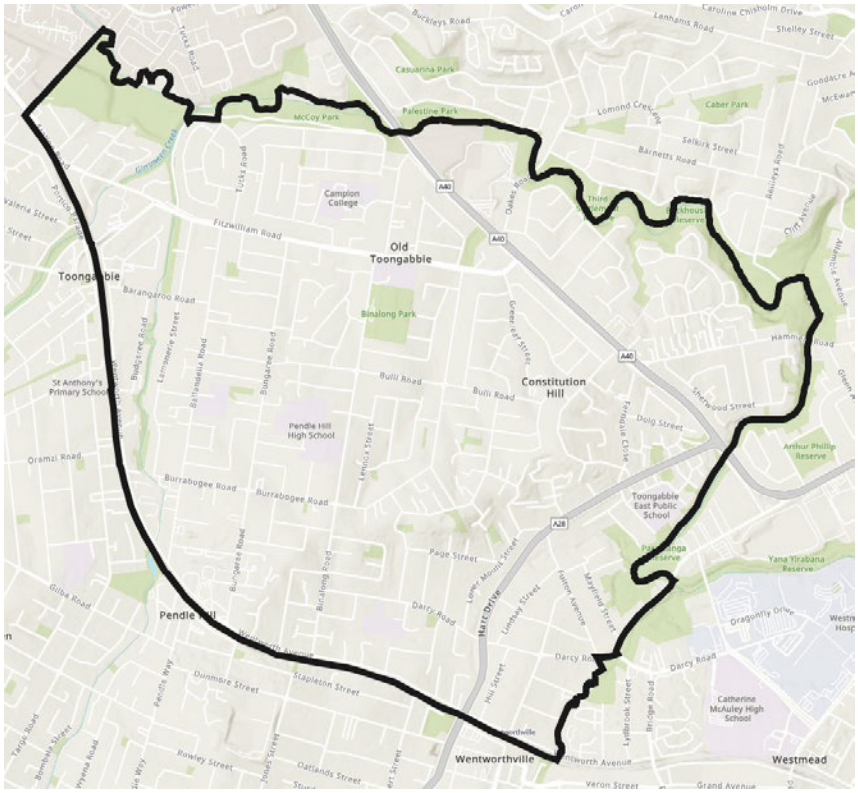
Site Number	SA2 Name	State	RA	Area (sq/km)	Target IP	Target NP
1	Malabar-Chifley-La Perouse	NSW	1	11.83	225	8091
2	Toongabbie	NSW	1	7.48	45	7097
3	Seven Hills	NSW	1	11.20	60	6879
4	Kempsey	NSW	2	195	429	5037
5	Tamworth-North	NSW	2	76.04	207	4990
6	Katoomba-Leura	NSW	1	40.87	84	5745
7	Padstow	NSW	1	6.51	46	5902
8	Warilla	NSW	1	9.49	169	7680
9	Coonamble	NSW	4	12142	250	1153
10	Greystanes-Pemulwuy	NSW	1	11.85	55	7944
11	Wentworth Falls	NSW	1	21.04	18	2851
12	Revesby	NSW	1	5.09	27	5280
13	Garbutt-West End	QLD	3	17.05	134	1852
14	Innisfail	QLD	3	53.05	269	3154
15	Margate-Woody Point	QLD	1	4.28	78	4710
16	Mount Isa	QLD	4/5	62.81	149	3230
17	Clarinda-Oakleigh South	VIC	1	6.32	15	4508
18	Mornington	VIC	1	21.09	34	10610
19	East Bendigo-Kennington	VIC	2	17.15	29	5420
20	Montrose-Rosetta	TAS	2	5.73	34	1948
21	Christies Beach	SA	1	7.22	38	3607
22	Port Augusta	SA	3	254	465	4031
23	Katherine	NT	4/5	7417	404	1601
24	Parap	NT	3	1.10	30	580
25	Jingili	NT	3	1.32	37	451
26	Broome	WA	4	50.04	556	2518
27	Rockingham	WA	1	35.72	43	6264
28	Albany	WA	3	30.50	86	6082
29	Bayonet Head-Lower King	WA	3	24.87	15	1728
30	Monash	ACT	1	3.41	15	2190

RA = Remoteness Area, the remoteness classification derived from the 2016 Australian Statistical Geography Standard (ASGS).
SA2 = Statistical Area Level 2, which are medium-sized general purpose areas built up from whole Statistical Areas Level 1. They have an average population of around 10,000 persons and represent a community that interacts together socially and economically.
Target IP = Target Indigenous population, corresponding to the number of Indigenous Australians aged 50 years and older residing in the Statistical Area according to the Australian 2016 Census.
Target NP = Target non-Indigenous population, corresponding to the number of non-Indigenous Australians aged 50 years and older residing in the Statistical Area according to the Australian 2016 Census.

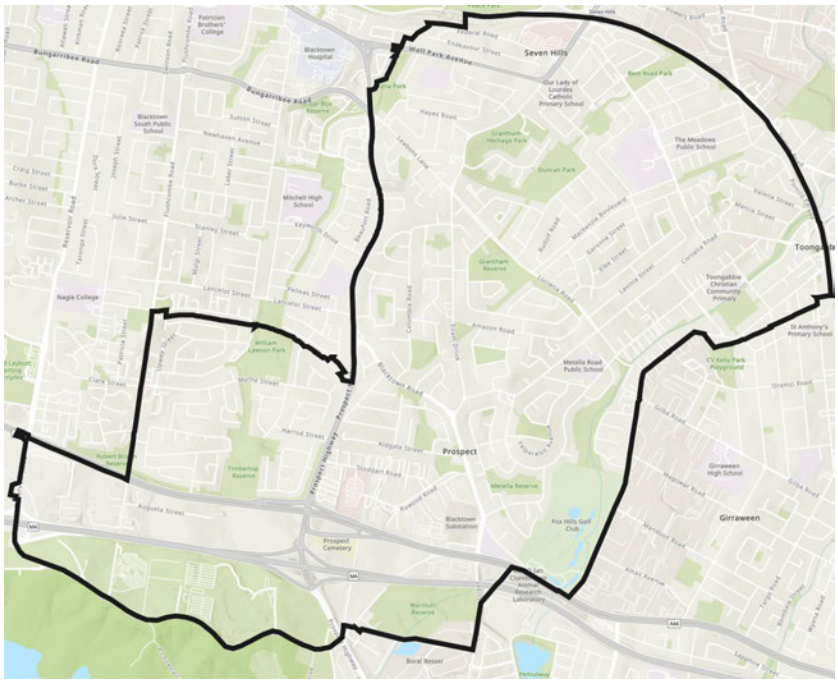
Malabar-Chifley-La Perouse



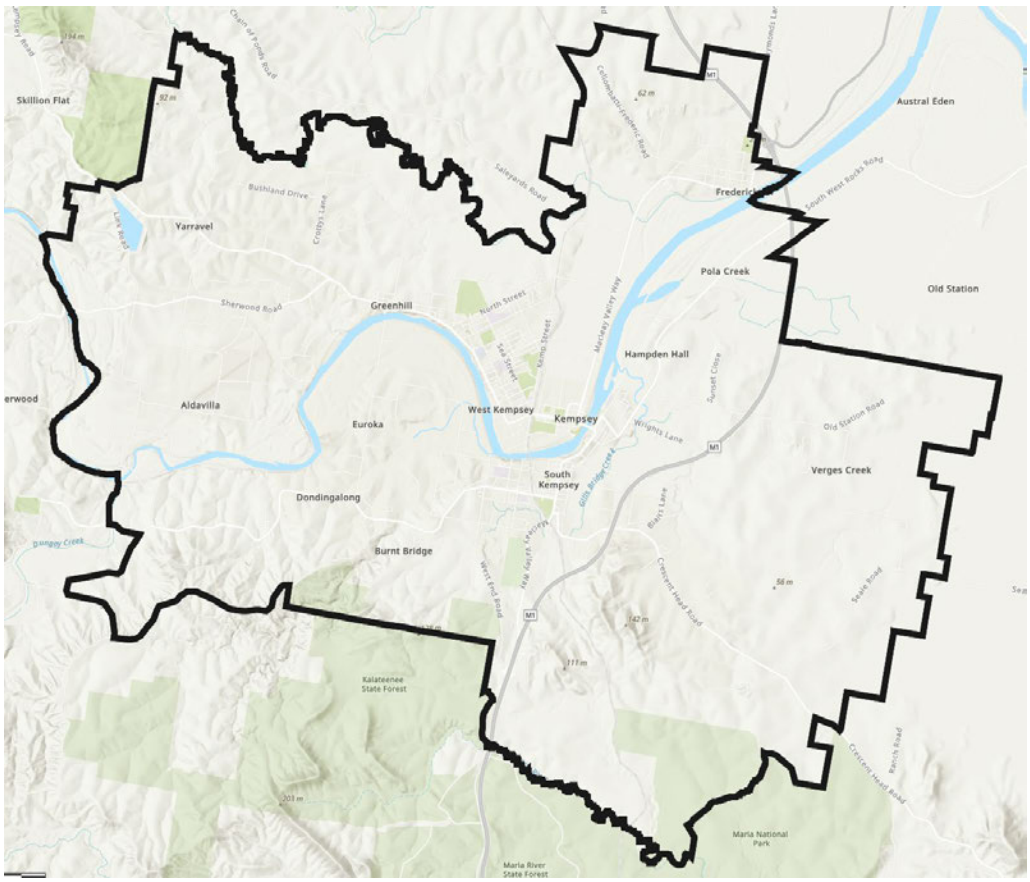
Toongabbie



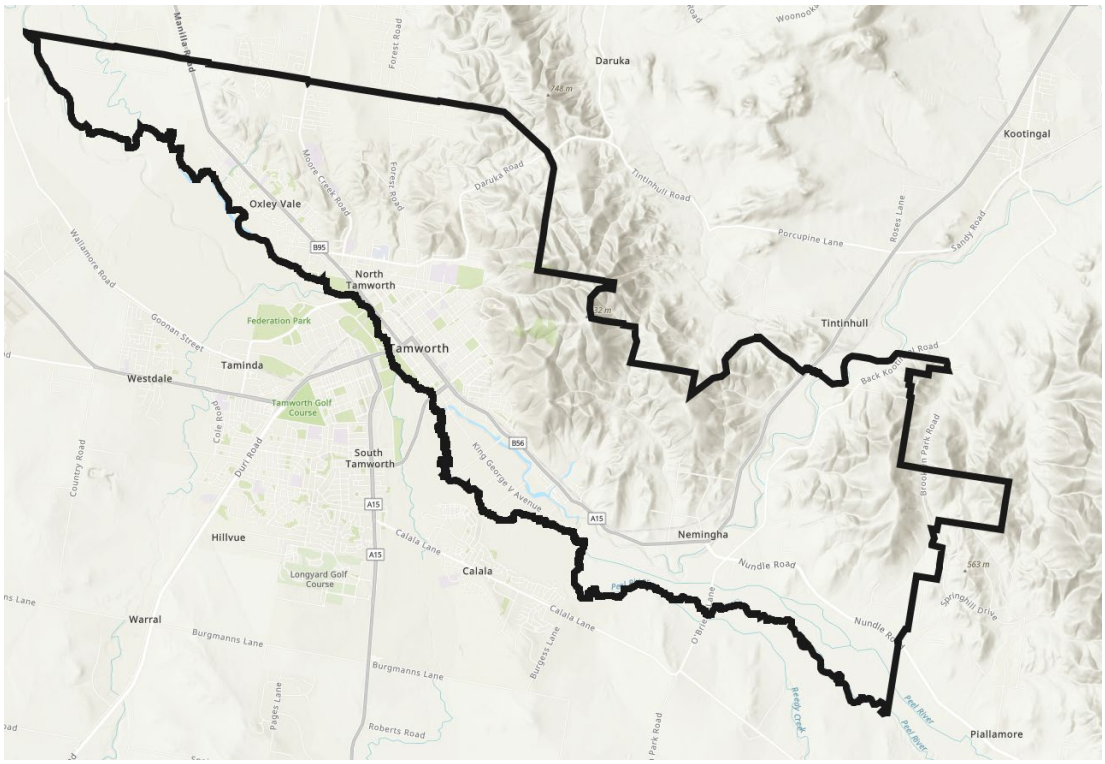
Seven Hills



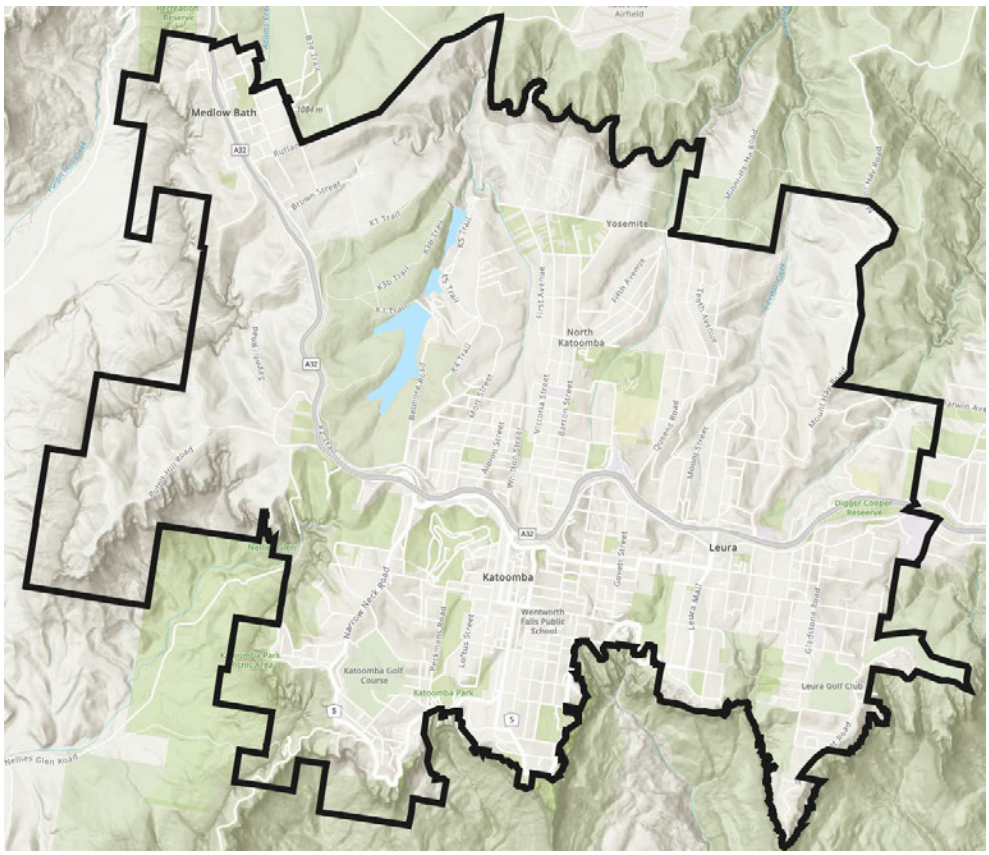
Kempsey



Tamworth-North

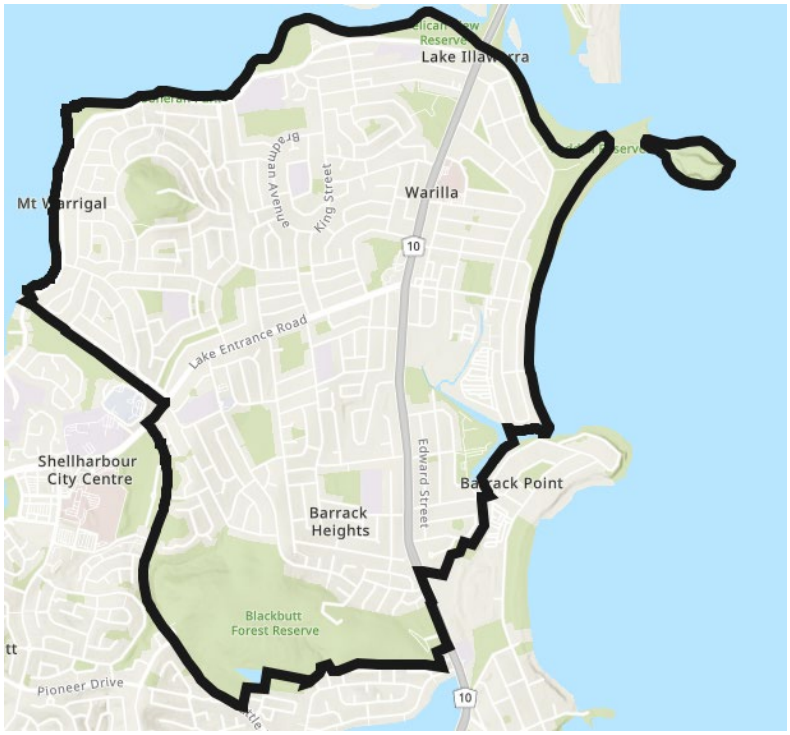


Katoomba-Leura

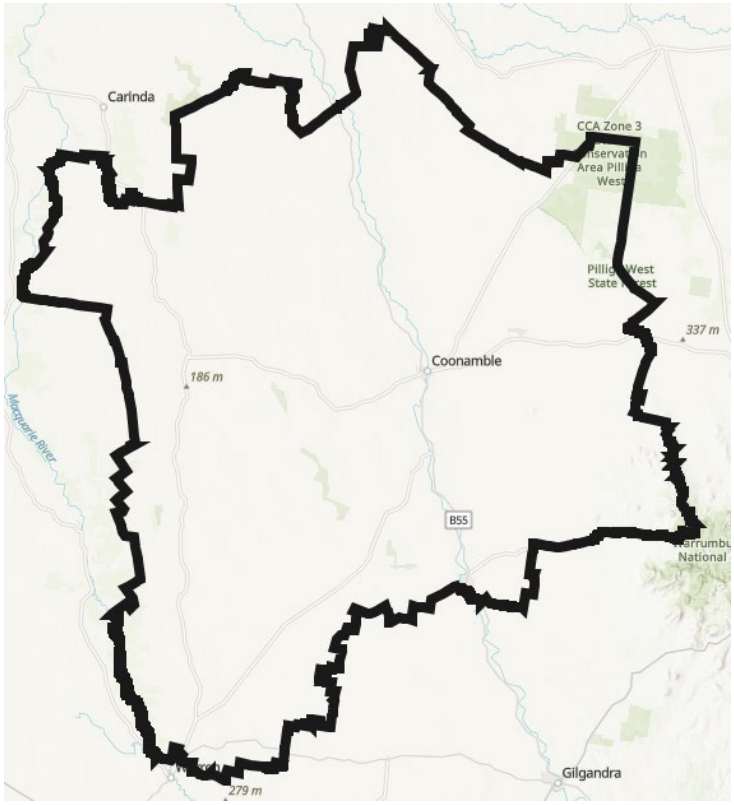


Padstow

Warilla

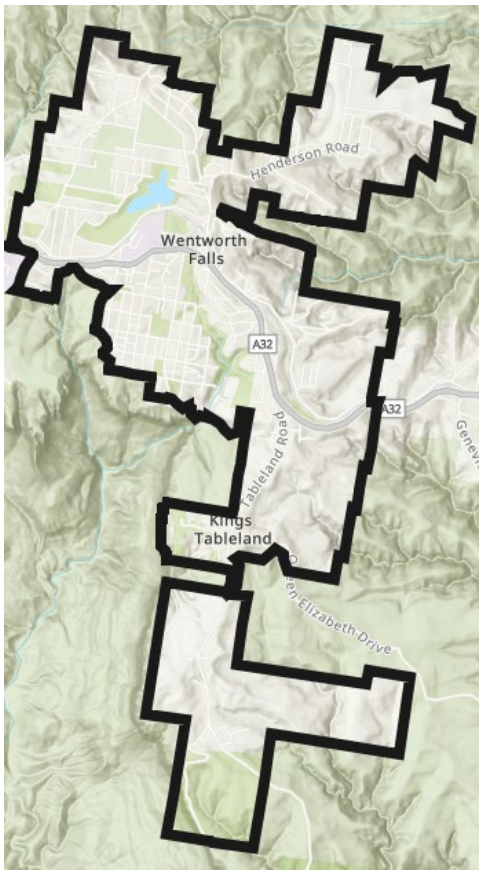


Coonamble



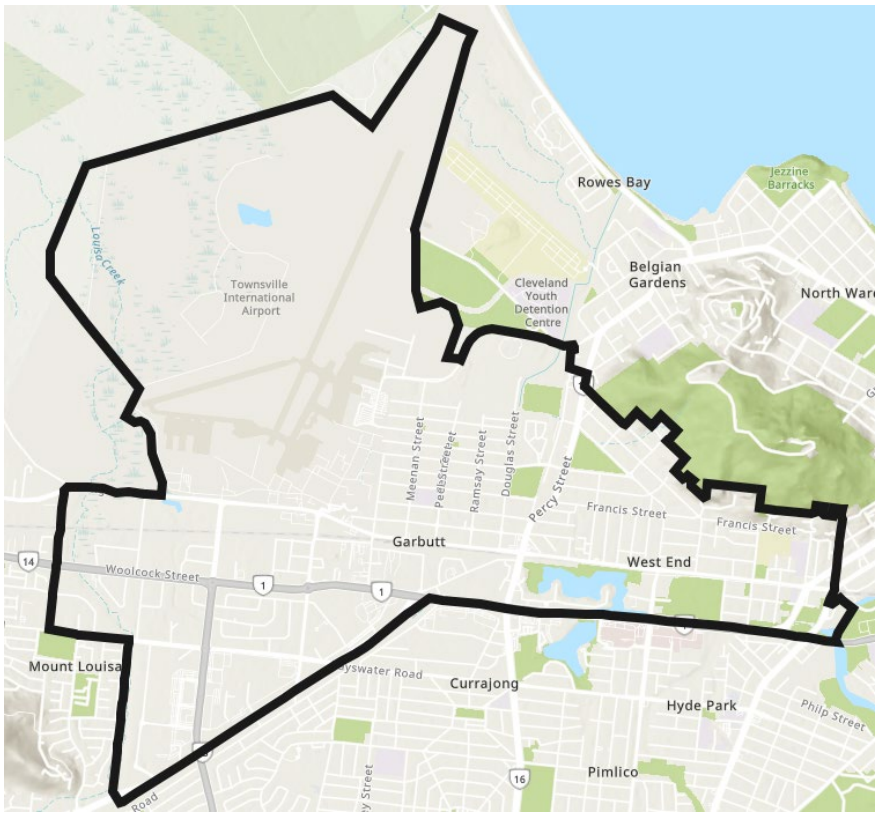
Greystanes-Pemulwuy

Wentworth Falls

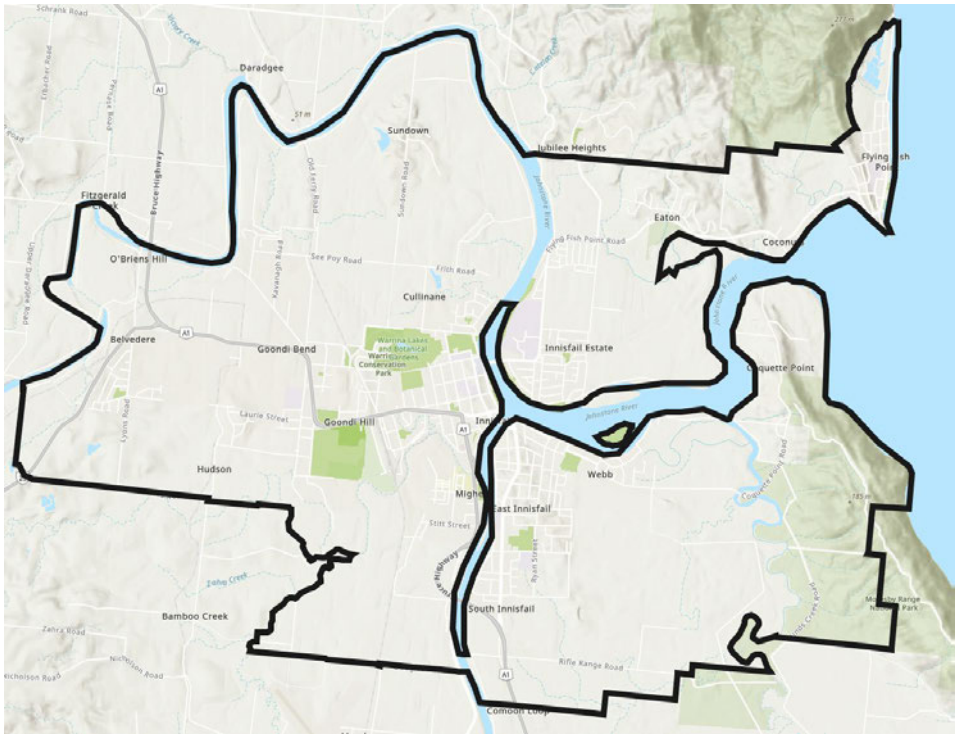


Revesby

Garbutt-West End

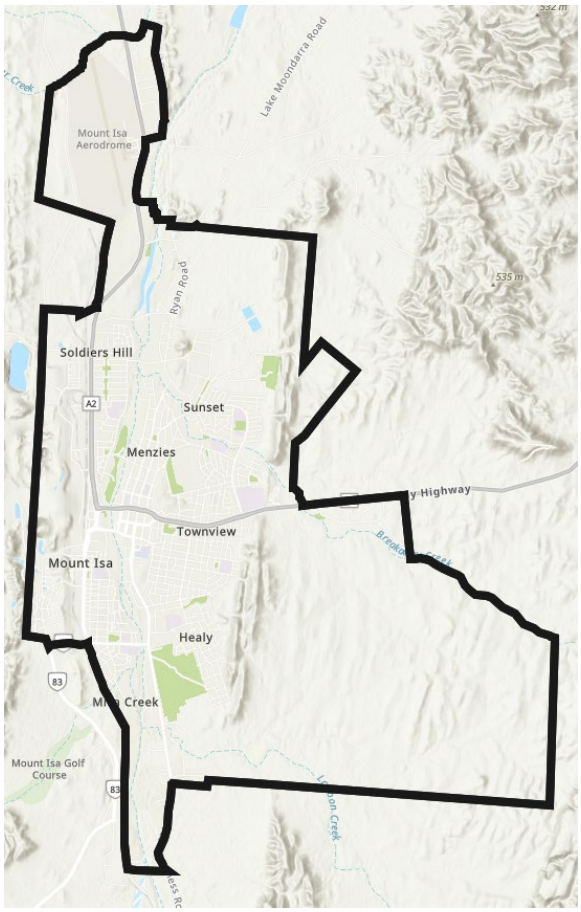


Innisfail



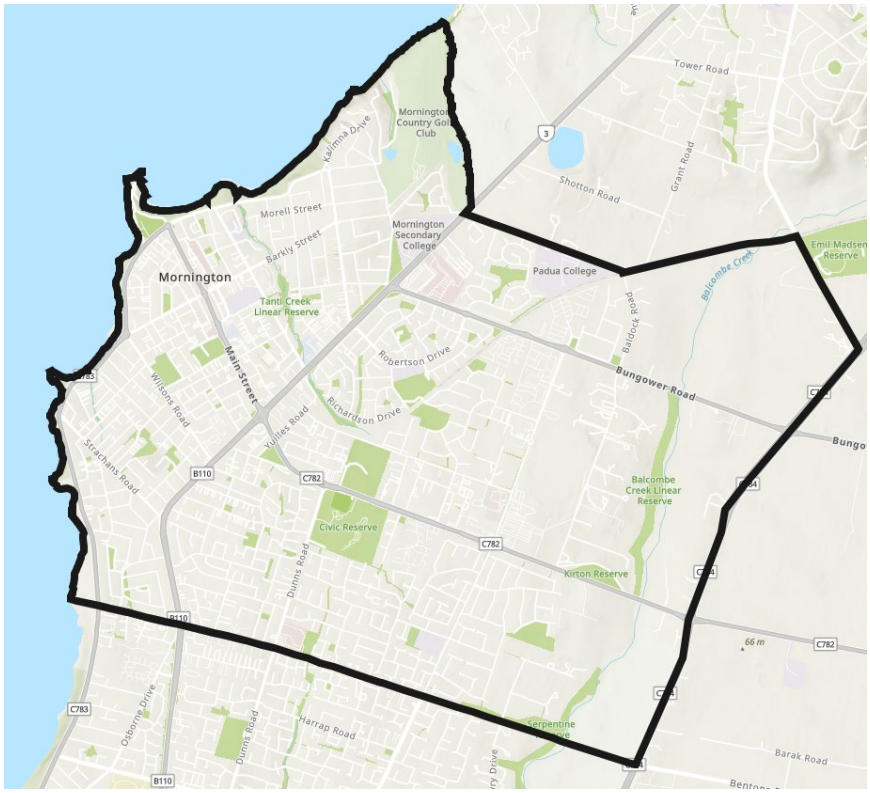
Margate-Woody Point

Mount Isa

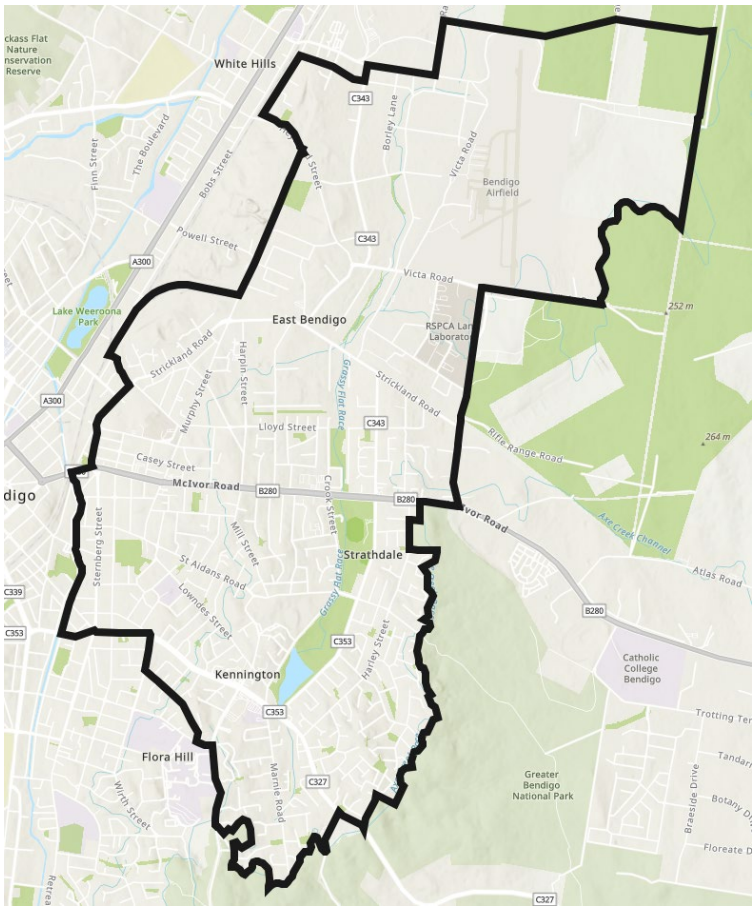


Clarinda-Oakleigh South

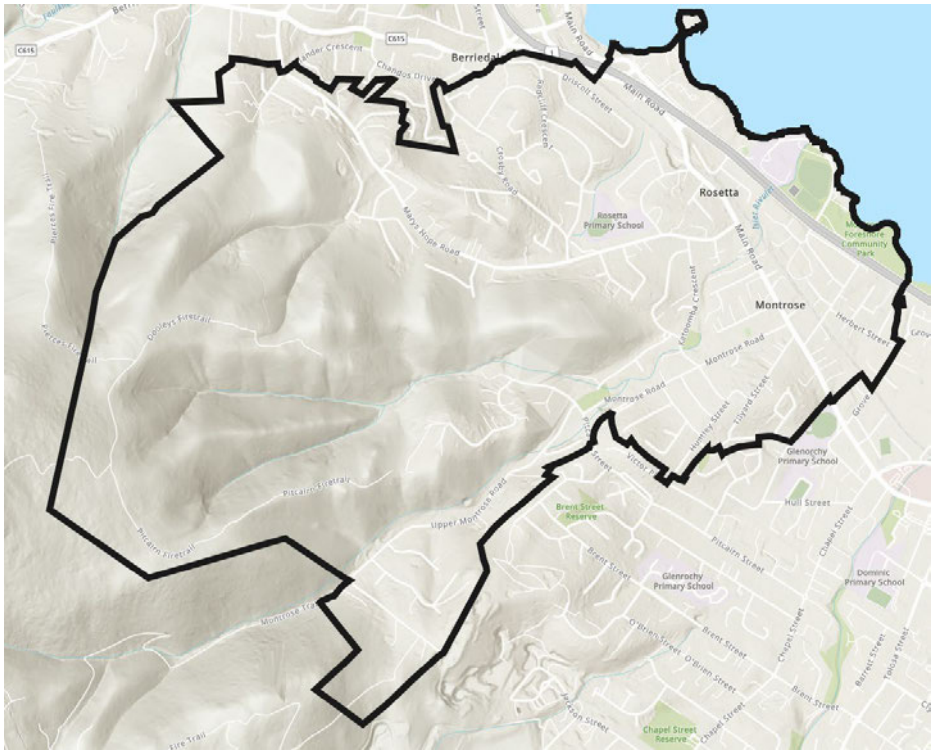
Mornington



East Bendigo-Kennington



Montrose-Rosetta



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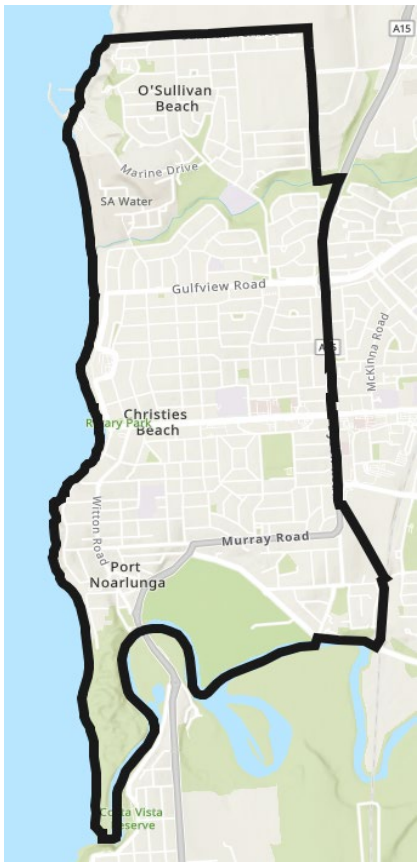
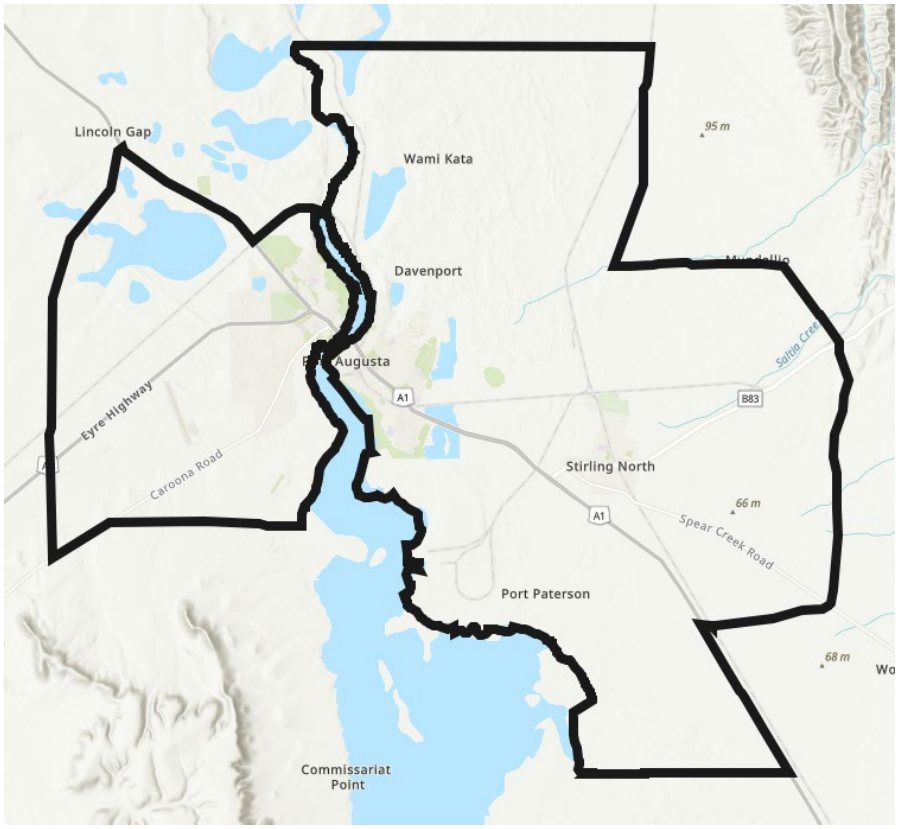
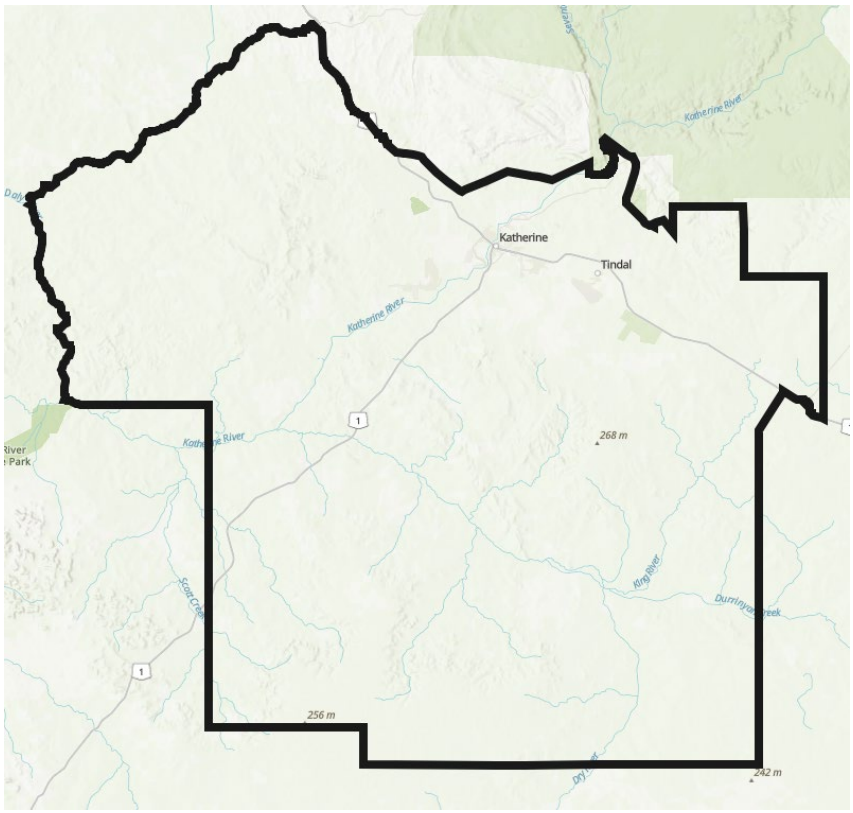


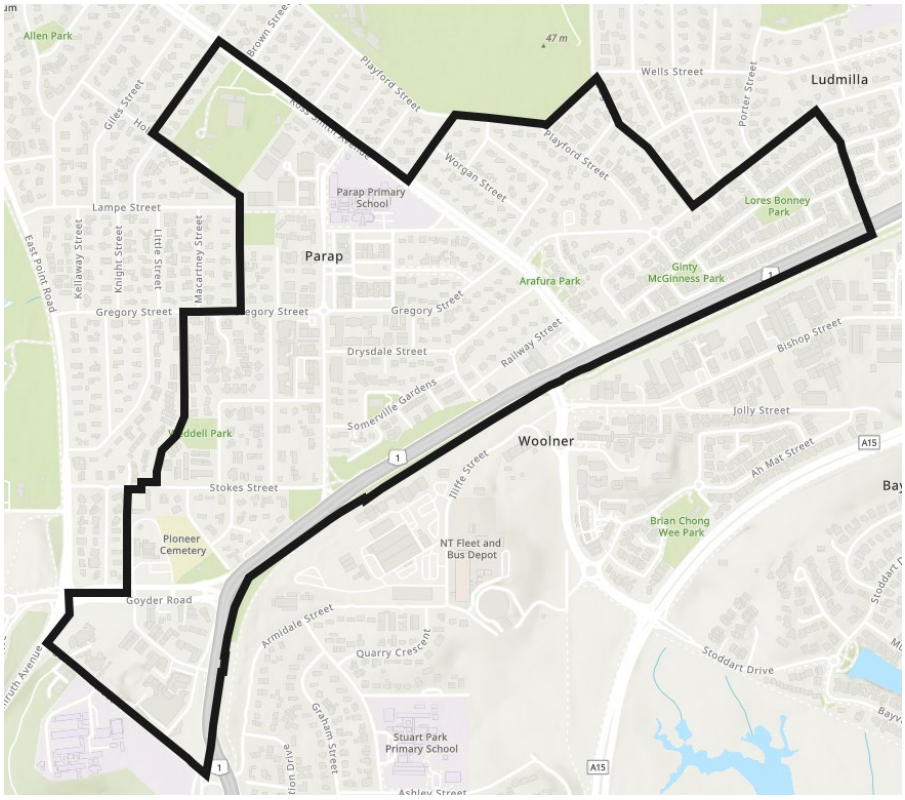
Port Augusta



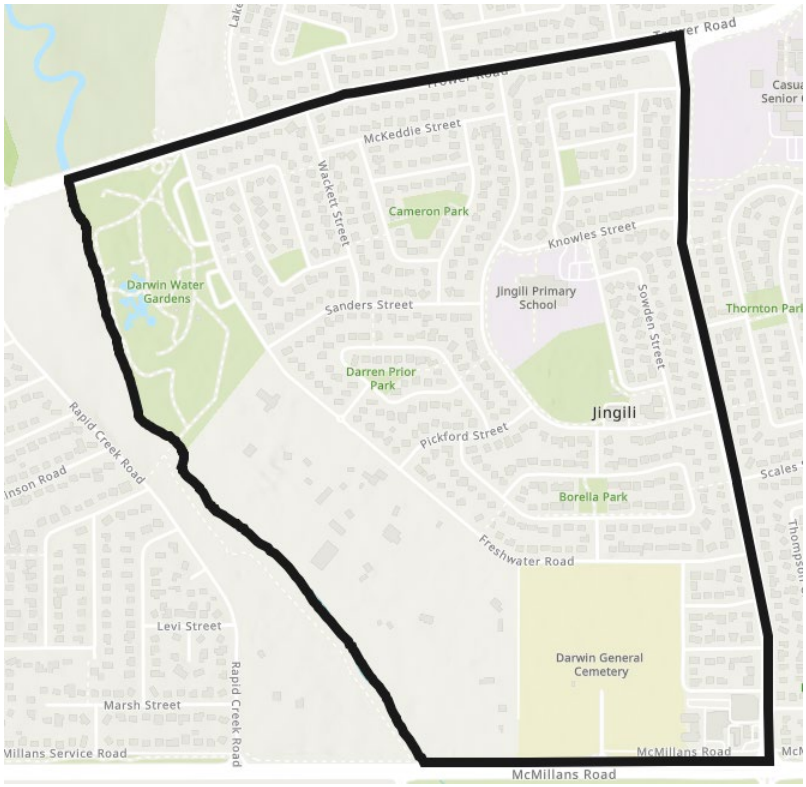
Katherine



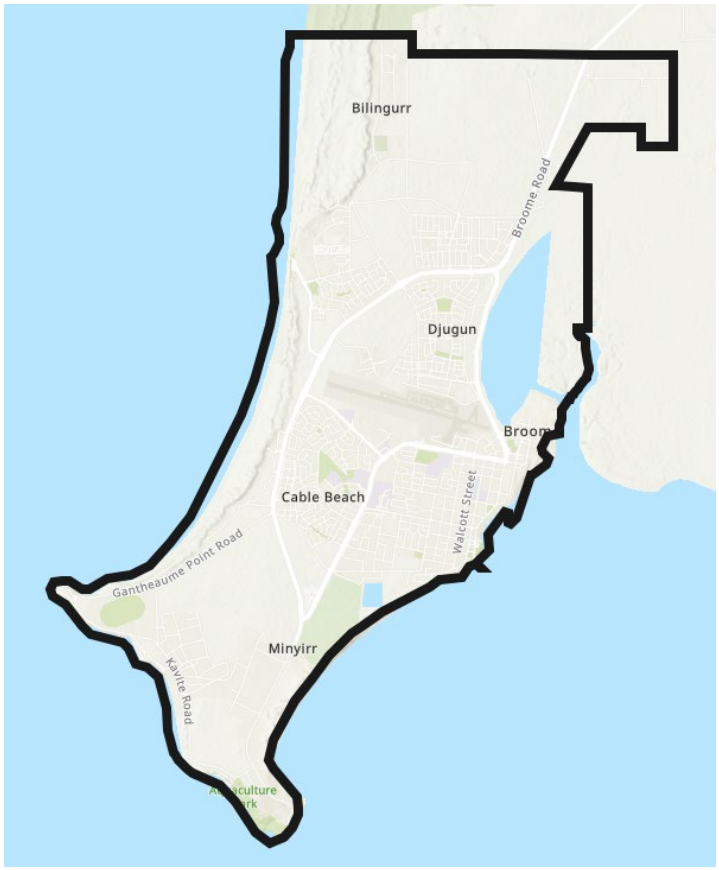
Parap



Jingili



Broome



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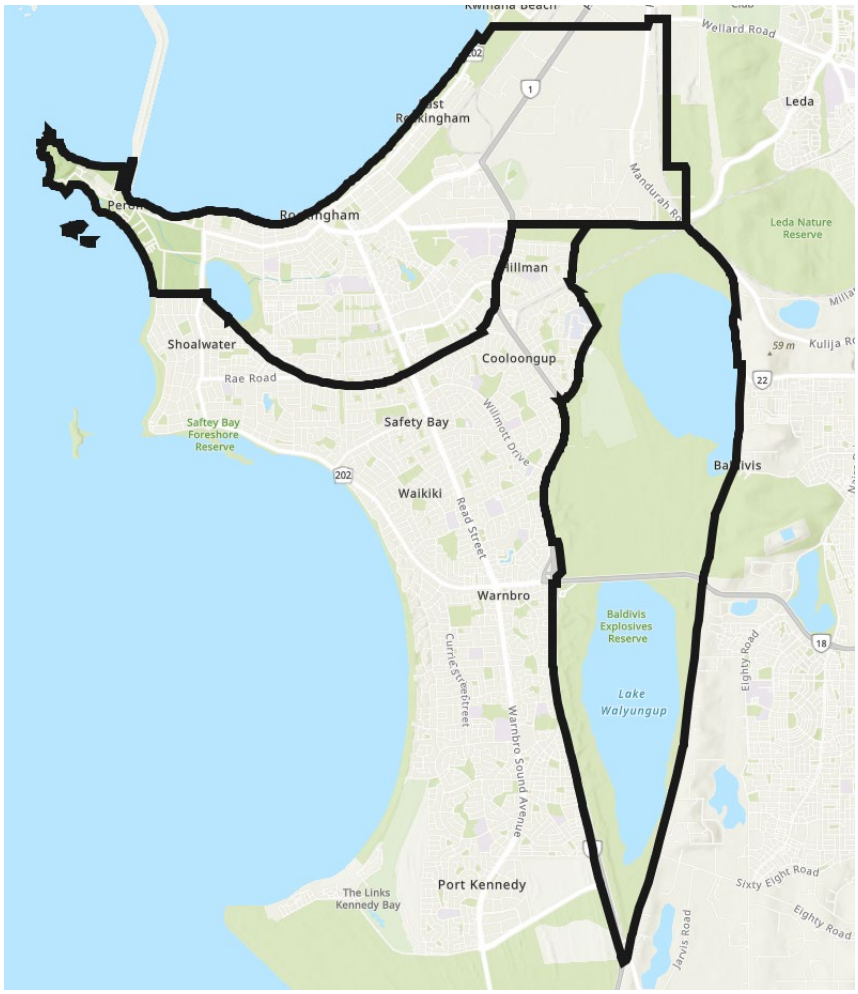
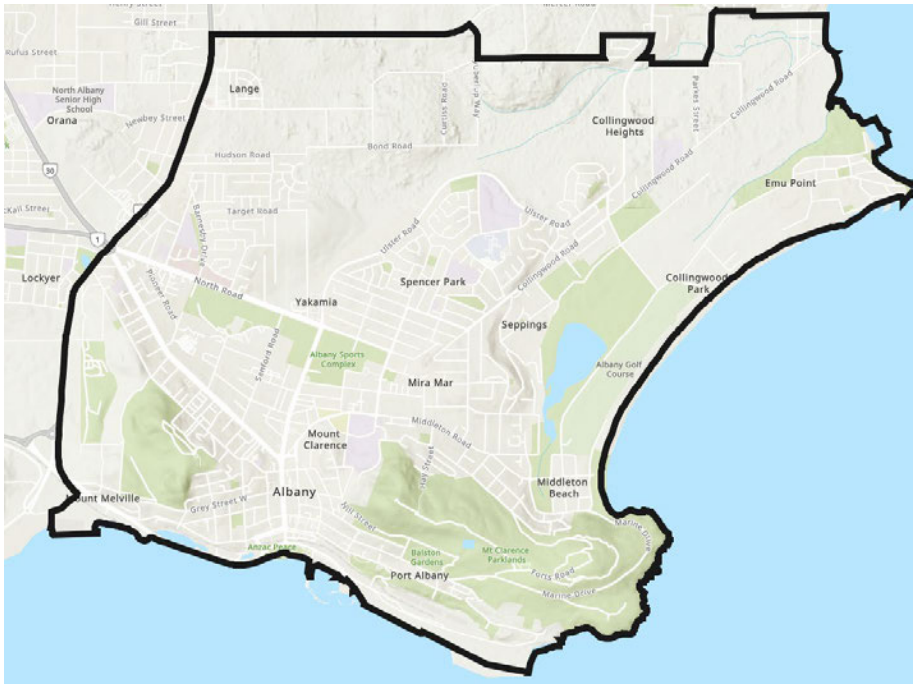
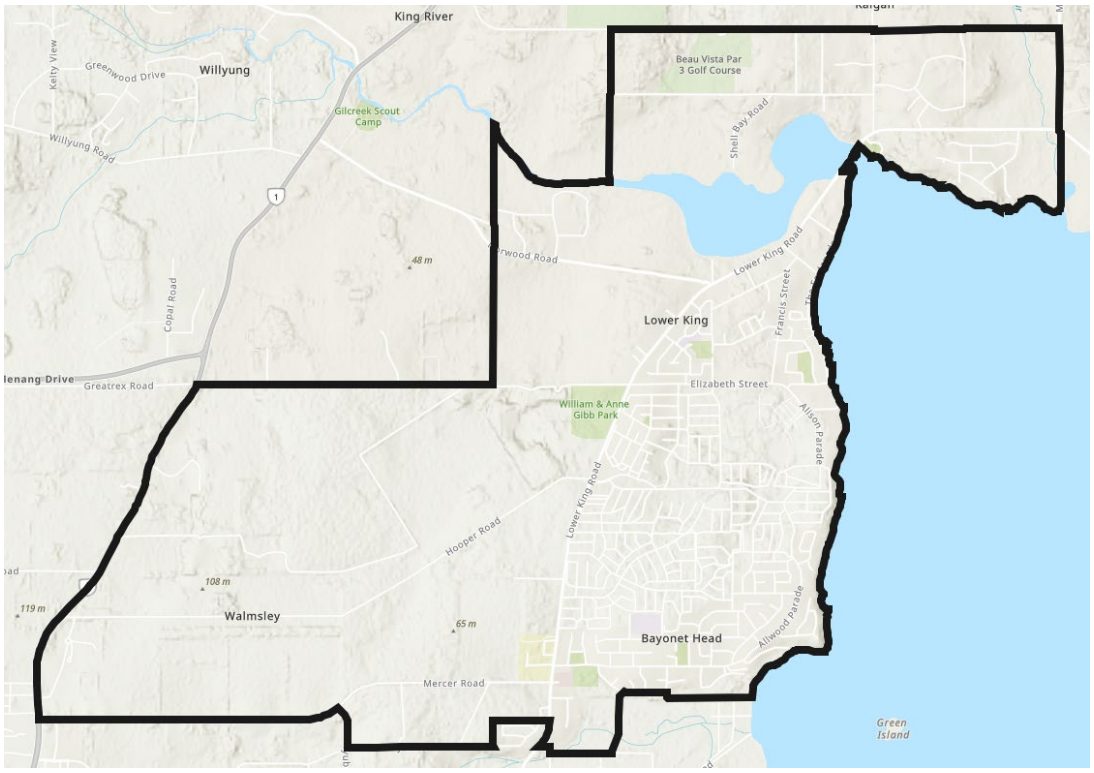


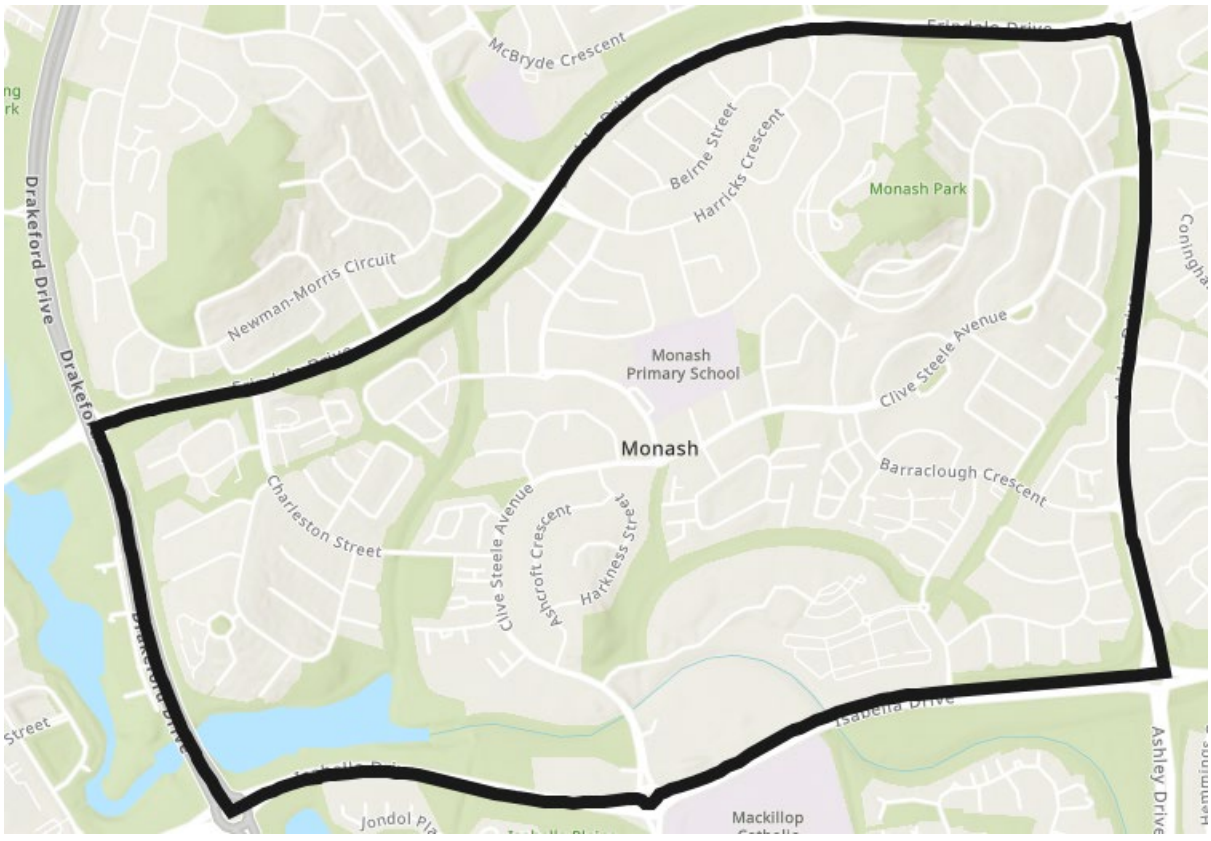
Albany



Bayonet Head-Lower King



Monash



CONSENT FORM - ADULT PROVIDING OWN CONSENT

Version: 3.0 – Dated 27th October 2021

Title	The Australian Eye and Ear Health Survey
Short Title	Australian Eye and Ear Survey
Protocol Number	TBC
Project Sponsor	Australia Government, Department of Health
Principal Investigator	Professor Paul Mitchell
Associate Investigator(s)	Associate Professor Gerald Liew, Professor Bamini Gopinath, Professor Lisa Keay, Associate Professor Gian Luca Di Tanna, Ms Colina Waddell, Dr Tim Fricke
Primary Organisation	The Westmead Institute for Medical Research
Site No.	_ _ _

Declaration by Participant

I have read the Participant Information Sheet, or someone has read it to me in a language that I understand.
I understand the purposes, procedures and risks of the research described in the project.
I understand that my participation in this study will allow the researchers to collect and process information about my health, including health information for future medical research.
I have had an opportunity to ask questions and I am satisfied with the answers I have received.
I freely agree to participate in this research project as described and understand that I am free to withdraw at any time during the study without affecting my future health care.
I understand that I will not receive any payment for participating in this study.
I understand that the results of this study may be published in a public or other forum.
I understand that no culturally restricted information will be collected during my participation.
I understand that I will be given a signed copy of this document to keep.

I consent to:

1. ☐ 1 Participating in the eye/vision survey

☐ 2 Participating in the eye/vision survey AND hearing survey

2. Receiving feedback about the results of this study:

☐ 1 Yes ☐ 2 No

If you answered **Yes**, please provide the following information:

Name	
Contact Number	
Email Address	
Postal Address	

Could you please provide the name and address of one person we could contact to get a forwarding address for you if you move?

Name	
Relationship to you	
Contact Number	
Email Address	
Postal Address	

3. Linking health information

I consent to the linking of my personal and health information with health records for hospital and emergency departments, death and cancer registries. The researchers affiliated with the study will use my linked health information for the purposes of the study in a manner that does not disclose my identity.

☐ 1 Yes ☐ 2 No

4. Being contacted about a follow up study:

☐ 1 Yes ☐ 2 No

Participant's Name (printed) ……

Signature…… Date ……

Witness (where required – see Note for Guidance on Good Clinical Practice CPMP/ICH/135/95 at 4.8.9)

Name of Witness* to Participant's Signature (printed) ……

Signature ……Date ……

* Witness is not to be the investigator, a member of the study team or their delegate. In the event that an interpreter is used, the interpreter may not act as a witness to the consent process. Witness must be 18 years or older.

Declaration by researcher*: I have given a verbal explanation of the research project, its procedures and risks and I believe that the participant has understood that explanation.

Researcher's Name (printed) ……

Signature …… Date ……

* A member of the research team must provide the explanation and provision of information concerning the research project.

Note: All parties signing the Consent Form must date their own signature.

PARTICIPANT INFORMATION AND CONSENT FORM (PICF)

Version: 4.0 – Dated 28th June 2022

Title	The Australian Eye and Ear Health Survey
Short Title	Australian Eye and Ear Health Survey
Protocol Number	TBC
Ethics Clearance No.	USYD HREC: 2020/818 AIATSIS: EO303-20211008
Project Sponsor	Australian Government, Department of Health
Principal Investigator	Professor Paul Mitchell
Associate Investigator(s)	Associate Professor Gerald Liew, Professor Bamini Gopinath, Professor Lisa Keay, Associate Professor Gian Luca Di Tanna, Ms Colina Waddell, Dr Tim Fricke
Primary Organisation	The Westmead Institute for Medical Research
Duration:	Feb 2022 – June 2024
Site Location	

This Participant Information and Consent Form is **10** pages long.

Please make sure you have all the pages.

Introduction

You are invited to take part in this research project, ***The Australian Eye and Ear Health Survey.*** The research project is aiming to **find out how common major eye diseases and hearing loss are in Australians living in urban, regional and remote areas.**

This Participant Information and Consent Form tells you about the research project. It explains the tests and research involved. Knowing what is involved will help you decide if you want to take part in the research.

Please read this information carefully. Ask questions about anything that you don't understand or want to know more about. Before deciding whether or not to take part, you might want to talk about it with a relative, friend or local doctor.

Participation in this research is voluntary. If you don't wish to take part, you don't have to. You will receive the best possible care whether you take part or not.

If you decide to take part in the research project, you will be asked to sign the consent section. By signing it, you are telling us that you:

- Understand what you have read;
- Consent to take part in the research project and to be contacted about any subsequent follow up projects;
- Consent to the tests and research that are described;
- Consent to the use of your personal and health information as described;

You will be given a copy of this Participant Information and Consent Form to keep.

Purpose and Background

The purpose of this project is to ***work out the leading eye diseases and conditions causing blindness, and hearing loss in Australia. The following are the objectives and significance of the study:***

Objectives

1. To find out how common vision impairment and blindness, and hearing loss is in in Indigenous Australians aged 40 years and over, and non-Indigenous Australians aged 50 years and over, by gender, age, and geographical area. We will also find out the causes of vision and hearing loss.

2. To find out if treatment is being accessed for eye diseases, including cataract, diabetic retinopathy, glaucoma, age-related macular degeneration and refractive error in both Indigenous and non-Indigenous Australian adults by:
   a) Determining the proportion of Australians with undiagnosed major eye diseases and uncorrected refractive error (need for glasses).
   b) Determining the proportion of Australians with known diabetes who adhere to the recommended retinal examination timeframes set by the National Health and Medical Research Council (NHMRC); once every two years for non-Indigenous Australians and once per year for Indigenous Australians.
   c) Determining an estimation of the coverage rate and quality of treatment outcomes for cataract surgery and the treatment of uncorrected refractive error in Australia

3. Determining the proportion of Australians with undiagnosed hearing loss.

This research is being led by: Professor Paul Mitchell, in association with Associate Professor Gerald Liew from the University of Sydney and Centre for Vision Research (Westmead Institute for Medical Research), Professor Lisa Keay from UNSW School of Optometry, Associate Professor Gian Luca Di Tanna from The George Institute for Global Health, Ms Colina Waddell and Dr Tim Fricke from the Brien Holden Foundation, and Professor Bamini Gopinath from Macquarie University.

This research has been funded by the Australian Government, Department of Health and Macquarie University.

Significance

The Australian Eye and Ear Health Survey will assist in eye and hearing health care in multiple ways, including:

1. helping to measure the progress and impact of eye and hearing health care services in Australia;
2. guiding the use of necessary resources in reducing the number of Australians with avoidable vision and hearing impairment;
3. assisting in developing effective, feasible and cost-effective eye and hearing health care services in Australia;
4. aiding in developing education, awareness and screening programs in communities, including regional and remote areas, for the prevention of eye disease and hearing loss.

A total of ***5000 Australians*** will participate in this project.

Why have I been invited to participate?

You have been invited to participate in this study because you are an Indigenous Australian over the aged 40 or over, or a Non-Indigenous Australian aged 50 years or over living in one of the 30 areas of Australia randomly selected to be included in the study. These age specifications were chosen based on existing knowledge on the age groups most commonly impacted by vision and hearing impairment in Australia. Participants must be cognitively and legally able to provide informed written consent and have reasonable English fluency and/or have a person to interpret for them.

What is Involved?

If you agree to participate in this survey, and you meet the inclusion criteria of the survey determined by age and residence, you will be invited to attend one of the survey testing sites (specified on Page 1) to complete a short questionnaire and undergo a series of eye tests. Testing will take approximately 1-1.5 hours to complete. If you wish to participate in the hearing survey (approximately 30 minutes), you will have the option to schedule this on the same day as the eye survey or on a different day when you make your appointment. This assessment will be a one-off (no follow-up required) and will occur on a day that you participate.

General Questionnaire

The general questionnaire will ask about personal particulars, including age, date of birth, sex, postcode of residence and ethnicity. It will also include a thorough history of your general, eye and hearing health.

Please bring: (1) your glasses if you have a pair and (2) tablets, supplements, eye drops or other medications (or photos of the medication labels) you are currently taking, and a list of any medications regularly taken in the last 5 years.

General Tests

There will be some examinations that will be conducted, these include:

- Weight and height
- Blood pressure
- Random blood glucose (finger prick)

Eye Tests & Dilating Eye Drops

There will be a number of eye tests that will be conducted. There may be slight discomfort associated with some of these tests as outlined below in the *Possible Risk* section. It is very important that we have a clear view inside your eye to check it is healthy. To do this we will need to put some drops in each eye to dilate your pupil. These might sting a little but will go very quickly and not cause lasting discomfort. Your vision may remain blurry for approximately 2 hours, you should not drive until your vision returns to normal and/or organize for someone to drive you home. The tests include:

- Checking your eye pressure
- Testing both distance and near vision
- Further non-invasive eye tests will be completed:
    - How clear your vision is and if you could benefit from glasses
    - Photos and scans of the back of your eyes including blood vessels
    - A visual field test to check your peripheral (side) vision
    - The front of your eyes to gauge general health of your eyes and eye lids

Hearing Tests

- Checking the condition of your ears
- Testing your hearing
- Testing the condition of your middle ear and mobility of your eardrum

Take-home questionnaire

An optional take-home questionnaire is provided to all participants. This questionnaire is also available online and can be accessed by scanning the QR code. The purpose of this take-home questionnaire is to collect additional information about the impact and lifestyle risk factors of eye conditions. Included questions ask about vision function, environmental noise exposure, physical activity and diet. If you need help to complete this questionnaire please ask.

Possible Benefits

We cannot guarantee or promise that you will receive any benefits from this research, however if an eye condition or hearing loss is identified by the survey you will be provided with an appropriate referral recommendation to an eye care professional or audiologist.

Possible benefits may include better guidance on eye care interventions for the broader community determined by this survey's results. Also, the Government will be better informed on the allocation of necessary eye and hearing health care services in Australia.
There are **no costs** associated with participating in this research project, nor will you be paid. However, participants will receive a pair of sunglasses upon completion of the examination.

Possible Risks

While this research does not involve any treatment, test procedures may cause some side effects. You may have none, some or all of the effects listed below, and they may be mild, moderate or severe. If you have any of these side effects, or are worried about them, talk with your study researcher. Your study researcher will also be looking out for side effects.

There may be side effects that the researchers do not expect or do not know about and that may be serious. Tell your study researcher immediately about any new or unusual symptoms that you get. Many side effects go away shortly after treatment ends. However, sometimes side effects can be serious, long lasting or permanent. If a severe side effect or reaction occurs, your study researcher may need to stop your involvement with the study. Your study researcher will discuss the best way of managing any side effects with you and a doctor if necessary.

Possible risks, side effects and discomforts include:

With eye drops, you may experience a stinging sensation for several seconds. The eye drops may also cause light sensitivity and will blur your vision (when looking at objects up close) for several hours. In rare situations (studies estimate it at 1 in 10000 people), the use of these drops can trigger a sharp increase in pressure in the eye causing pain and a red eye. If such an event occurs, please call the number listed below or seek eye care specialist services will be required immediately so that this can be treated. We do not advise you to drive if your vision is blurred and other arrangements for transport should be put in place. We also advise you to bring sunglasses to the examination for comfort in daylight.

To avoid any physical discomfort with seating positions during eye and/or ear testing, we will ensure that you are comfortable at all times, however if you feel any discomfort at all during the testing please inform one of the examiners. Also, you will be offered frequent breaks to ensure optimal comfort during the entire course of the testing.

With some of the eye tests, particularly the camera used to take photos of the back of the eye, discomfort may be experienced with the flash used with the camera. This flash is the same as what you would experience using a regular camera. You will be given regular breaks to minimise any eye discomfort from these types of tests, but please do not hesitate to inform the examiner if longer breaks are required.

Participants can suspend or even end their participation at any time in the project if distress occurs.

There may be additional unforeseen or unknown risks that the researchers do not expect or do not know about. Tell a member of the research team immediately about any new or unusual symptoms that you get. You may also learn that you have an eye or ear condition that you were not previously aware of which may cause you some distress or anxiety. If you experience these feelings, please contact one of the support services listed on the last page of this form or speak to a member of the project team.

Other Treatments Whilst on Study

While you are participating in this research project, you will not need to stop any of your current treatment(s).

Alternatives to Participation

There is no standard procedure or treatment that is being withheld as a result of your participation in this study. You do not have to take part in this research project to receive treatment for any health condition you may have.

Participation is Voluntary

Participation in any research project is voluntary. If you do not wish to take part, you do not have to. If you decide to take part and later change your mind, you are free to withdraw from the project at any stage. If you do decide to take part, you will be given this Participant Information and Consent Form to sign and you will be given a copy to keep.

Your decision whether to take part or not to take part, or to take part and then withdraw, will not affect your routine treatment, your relationship with those treating you or your relationship with the University of Sydney, The University of NSW, The George Institute for Global Health, Brien Holden Foundation or Macquarie University.

Before you make your decision, a member of the research team will be available so that you can ask any questions you have about the research project. You can ask for any information you want. Sign the Consent Form only after you have had a chance to ask your questions and have received satisfactory answers.

If you decide to withdraw from this project, please notify a member of the research team as soon as possible via the contact details listed on page 8, or, if you decide to withdraw during the examination, please inform any available team member before leaving. This notice will allow that person or the research supervisor to discuss any health risks or special requirements linked to withdrawing.

If you do withdraw your consent during the research project, the study doctor and relevant study staff will not collect additional personal information from you, although personal information already

collected will be retained to ensure that the results of the research project can be measured properly. Please be aware that data collected, including any linked health information, by the researchers up to the time you withdraw will form part of the research project results. If you do not want them to do this, please tell them before you join the research project.

Results of Project

Participants will be informed via their preferred form of contact of the results when the research project is complete, and the data is published. Also, media release, progress reports and associated newsletters will be accessible to all participants online.

Our study findings will be presented to the World Health Organisation (WHO), alongside the data from other countries who we actively work with to eliminate the burden of avoidable blindness worldwide. The current survey will provide useful information for policy planning and better direct the allocation of funds. De-identified data may also be published in scientific journals or other public forums. Authors of publications will be one or more members of the research team included the investigators listed in this document.

Privacy, Confidentiality and Disclosure of Information

By signing the consent form, you consent to the study doctor and relevant research staff collecting and using personal information about you for the research project. **Any information obtained in connection with this research project that can identify you will remain confidential.** Your information can only be used for the purpose of this research project and it will only be disclosed with your permission, except as required by law.

It is anticipated that the results of this research project will be published and/or presented in a variety of forums. In any publication and/or presentation, information will be provided in such a way that you cannot be identified, except with your permission.

In accordance with relevant Australian privacy and other relevant laws, you have the right to request access to your information collected and stored by the research team. Data will be stored for 5 years after study completion. You also have the right to request that any information with which you disagree be corrected. Please contact the study team member named at the end of this document if you would like to access your information. Culturally restricted information will not be collected.

Any information obtained for the purpose of this research project that can identify you will be treated as confidential and securely stored on a secured database or in a locked storage facility at the Westmead Institute for Medical Research. It will be disclosed only with your permission, as or required by law. Identifiable data will only be accessible by select members of the research team.

Linking your personal and health information

What does it mean to provide consent to using my health information?

The AIHW, Services Australia and Cancer Institutes use personal and health information extracted from health records to run the health system. The health information exists in a number of NSW and Commonwealth administrative datasets and are **de-identified** to ensure your personal privacy is protected. By supporting this research study, you are agreeing to the use of **your health information** as held in the administrative databases that have come from **your health records**. On behalf of the research team, the National Death Index, Services Australia and cancer registries will **link your health information** from the following sources:

- Public and private hospital admissions, emergency departments, ambulance services, and death registry records.
- Cancer registries
- Medicare Benefits Scheme (MBS) records (i.e., your visits to health professionals);
- Pharmaceutical Benefits Scheme (PBS) records (i.e., your use of prescription medicines)

The linked health information provided to the research team will be in a form that will not identify you. Any health information used from these data sources are managed completely confidentially and are used only for the purpose of the research as described for this study. With your agreement, **your health information** (as drawn from your health records into the administrative datasets listed above) will be included in the linked health information.

To participate in the study, do I have to consent to linking my health information?

No. If you want **to opt-out** of the linking of your health information, there is an option to indicate this choice on the consent form by ticking the box for opt-out.

Will my participation involve any risk or discomfort for me? How do I know my health information is kept confidential?

For the linking of your health information there is a small risk to your privacy because personal information is used in the record linkage process. This risk is minimised by separating the processes of record linkage and data analysis. The record linkage only uses personal information such as name, date of birth, and home address. At the time of linkage, a unique personal identification number will replace your personal information.

The linked health information provided to the researchers contains personal identification numbers and health information but no names, dates of birth or home addresses. All privacy measures have been put in place to **ensure that the confidentiality of your personal and health information are maintained**, including removal of identifying information, the use of unique study numbers and adherence to strict guidelines regarding data transfer, storage and access.

How will information from the study be used to help others and me?

In order for the wider community to benefit from the study, we plan to produce reports and/or articles that are publicly available. We will ensure that in any publication or presentation of these reports, information are presented in a **non-identified and summary form**, so that you or anyone else cannot be identified. Your privacy will be protected at all times.

How will my personal and health information be managed?

The linked health information as provided by the AIHW, Services Australia, Cancer Institutes and hospitals will not be shared beyond the research team.

The linked health information does not include any identifying information and therefore cannot be connected back with other records for you or any other participant.

The linked health information will be retained for 20 years and will be destroyed at the completion of this data retention period after the end of the study.

Injury

If you suffer any injuries or complications as a result of this research project, you should contact the study team as soon as possible and you will be assisted with arranging appropriate medical treatment. Support services available, should you need them at any time, are listed at the end of this document.

Who is organising and funding the research?

This research project is being conducted by ***Professor Paul Mitchell from the University of Sydney and Centre for Vision Research (Westmead Institute for Medical Research). The Australian Government Department of Health and Macquarie University have funded the project***.

There are no financial benefits that might arise from the conduct of the research. *The Westmead Institute for Medical Research* will receive a payment from *the Department of Health* for undertaking this research project. No member of the research team will receive a personal financial benefit from your involvement in this research project (other than their ordinary wages).

Ethical Guidelines

All research in Australia involving humans is reviewed by an independent group of people called a Human Research Ethics Committee (HREC). The ethical aspects of this research project have been approved by the HREC of the University of Sydney and AIATSIS Research Ethics Committee

This project will be carried out according to the National Statement on Ethical Conduct in Human Research (2007). This statement has been developed to protect the interests of people who agree to participate in human research studies.

Who can I Contact?

The person you may need to contact will depend on the nature of your query. If you want any further information concerning this project or if you have any medical problems which may be related to your involvement in the project (for example, any side effects), you can contact the **study coordinator on 0408 910 966** or any of the following people:

Name:	Professor Paul Mitchell
Position:	Principal Investigator
Telephone:	+61 (2) 9893 9076
Email:	paul.mitchell@sydney.edu.au
Name:	Professor Bamini Gopinath
Position:	Co-Investigator (Hearing)
Telephone:	+61 (2) 9850 8962
Email:	bamini.gopinath@mq.edu.au

For complaints

If you have any complaints about any aspect of the project, the way it is being conducted or any questions about your rights as a research participant, then you may contact:

Organisation	The University of Sydney
Position:	Human Research Ethics Committee (HREC) Secretary
Telephone:	+61 2 9036 9161
Organisation	AH&MRC Ethics Committee
Position:	The Chairperson
Email:	ethics@ahmrc.org.au

You will need to tell the Secretary the name of one of the researchers listed above.

Reviewing Human Research Ethics Committee (HREC):

The reviewing HREC approving this research and contact details of the Executive Officer are:

Reviewing HREC name:	The University of Sydney
Position:	HREC Secretary
Telephone:	+61 2 9036 9161

Email:	human.ethics@sydney.edu.au
Reviewing HREC name:	AIATSIS Research Ethics Committee
Position:	Ethics Secretariat
Telephone:	(02) 6246 1681
Email:	ethics@aiatsis.gov.au

Support Services:

Support/Social Worker Services:

Well Mob

Social, emotional and cultural wellbeing online resources for Aboriginal and Torres Strait Islander People: https://wellmob.org.au/

Disability Gateway

National support service for all Australians with disability. Provides information on support services available: www.disabilitygateway.gov.au

Carer Gateway

National support service for those caring for a loved one with disability: www.carergateway.gov.au

Access to social worker via Centrelink (call and ask to speak to a social worker):

Older Australians line: 132 300

Indigenous Australians line: 1800 136 380

Other Services include:

Macular Disease Foundation Australia **-** 1800 111 709

Offers both Peer to Peer phone support and community support groups. The Peer-to-Peer program will give you the opportunity to speak to and share experiences with one of our volunteers. They either have been living with vision loss themselves or have a close friend or family member with macular disease. The Peer to Peer program is not a counselling service.

Vision Australia - 1300 84 74 66. Leading national provider of vision loss support and services and work with people of all ages and stages of life.

Beyond Blue: 1300 22 4636 open 24/7

Lifeline: 131 114

Stride Mental Health: https://stride.com.au

Yarn Safe: https://headspace.org.au/yarn-safe/ or https://headspace.org.au/headspace-centres/

Yarn Safe has information for young people who identify as Aboriginal and/or Torres Strait Islander.

Date: _____

The Australian Eye and Ear Health Survey – Referral Letter

Dear _____,

Thank you for seeing _____, who received a vision and hearing test as part of the Australian Eye and Ear Health Survey (AEEHS). The survey is designed to assess the prevalence and main causes of vision and hearing impairment in Indigenous and non-Indigenous Australians. During the eye examination today, we detected a potential abnormality and would like to refer the participant to you for further assessment.

For this participant:

Presenting Visual Acuity

Right Eye: _____ Left Eye: _____

Pinhole Visual Acuity

Right Eye: _____ Left Eye: _____

An abnormality was detected in the: ☐ Right Eye ☐ Left Eye

Summary of abnormalities:

_____

_____

_____

_____

_____

_____

_____

If you have any queries or concerns, please do not hesitate to contact the study team on 0408 910 966 or email us at aeehs@wimr.org.au. Thank you in advance for your time and cooperation.

Yours sincerely,

Professor Paul Mitchell (Principal Investigator)
AO, MBBS, MD, PhD, FRANZCO, FRACS, FRCOphth, FAFPHM

Date: _____

The Australian Eye and Ear Health Survey – Referral Letter

Dear _____,

Thank you for seeing _____, who received a vision and hearing test as part of the Australian Eye and Ear Health Survey (AEEHS). The survey is designed to assess the prevalence and main causes of vision and hearing impairment in Indigenous and non-Indigenous Australians. During the ear examination today, we detected a potential abnormality and would like to refer the participant to you for further assessment.

An abnormality was detected in the: ☐ Right Ear ☐ Left Ear

Summary of abnormalities:

_____

_____

_____

_____

_____

_____

If you have any queries or concerns, please do not hesitate to contact the study team on 0408 910 966 or email us at aeehs@wimr.org.au. Thank you in advance for your time and cooperation.

Yours sincerely,

Professor Paul Mitchell (Principal Investigator)
AO, MBBS, MD, PhD, FRANZCO, FRACS, FRCOphth, FAFPHM

Prof Paul Mitchell
Westmead Institute for Medical Res; Faculty of Medicine and Health
Email: paul.mitchell@sydney.edu.au

Dear Paul,

The University of Sydney Human Research Ethics Committee (HREC) has considered your application.

I am pleased to inform you that after consideration of your response, your project has been approved.

Details of the approval are as follows:

Project No.:	**2020/818**
Project Title:	**Australian Eye Health Survey**
Authorised Personnel:	**Mitchell Paul; Tang Diana; Liew Gerald; Gopinath Bamini; Keay Lisa; Di Tanna Gian Luca; Fricke T; Waddell C;**
Approval Period:	**30/06/2021** to **30/06/2025**
First Annual Report Due:	**30/06/2022**

Documents Approved:

Date Uploaded	Version Number	Document Name
21/06/2021	Version 1	Automated SMS attendance reminder
21/06/2021	Version 2	Participant Info Statement (clean)
03/11/2020	Version 1	Consent forms
03/11/2020	Version 1	Flyer
03/11/2020	Version 1	On-site questionnaire
03/11/2020	Version 1	On-site questionnaire
03/11/2020	Version 1	On-site questionnaire
03/11/2020	Version 1	On-site questionnaire
03/11/2020	Version 1	Take-home questionnaire
03/11/2020	Version 1	Study flow
03/11/2020	Version 1	Safety Protocol
03/11/2020	Version 1	Sampling protocol

Special Condition/s of Approval

- NACCHO will contribute to the formation of an Aboriginal Advisory Committee; it is accepted that this consultation will inform the recruitment process which will be stipulated in a modification request.
- It will remain a condition that the approval of the Chief Health Officer is obtained and retained.

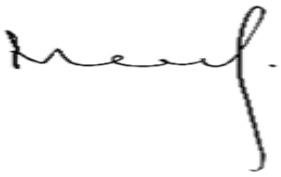
Condition/s of Approval

- Research must be conducted according to the approved proposal.
- An annual progress report must be submitted to the Ethics Office on or before the anniversary of approval and on completion of the project.
- You must report as soon as practicable anything that might warrant review of ethical approval of the project including:
  - Serious or unexpected adverse events (which should be reported within 72 hours).
  - Unforeseen events that might affect continued ethical acceptability of the project.
- Any changes to the proposal must be approved prior to their implementation (except where an amendment is undertaken to eliminate *immediate* risk to participants).
- Personnel working on this project must be sufficiently qualified by education, training and experience for their role, or adequately supervised. Changes to personnel must be reported and approved.
- Personnel must disclose any actual or potential conflicts of interest, including any financial or other interest or affiliation, as relevant to this project.
- Data and primary materials must be retained and stored in accordance with the relevant legislation and University guidelines.
- Ethics approval is dependent upon ongoing compliance of the research with the *National Statement on Ethical Conduct in Human Research*, the *Australian Code for the Responsible Conduct of Research*, applicable legal requirements, and with University policies, procedures and governance requirements.
- The Ethics Office may conduct audits on approved projects.
- The Chief Investigator has ultimate responsibility for the conduct of the research and is responsible for ensuring all others involved will conduct the research in accordance with the above.

This letter constitutes ethical approval only.

Please contact the Ethics Office should you require further information or clarification.

Sincerely,



Associate Professor Mark Arnold
Chair, Human Research Ethics Committee (HREC 2)

The University of Sydney of Sydney HRECs are constituted and operate in accordance with the National Health and Medical Research Council's (NHMRC) National Statement on Ethical Conduct in Human Research (2018) and the NHMRC's Australian Code for the Responsible Conduct of Research (2018)

Professor Paul Mitchell
Miss Shanelle Sorbello
Westmead Institute for Medical Research,
The University of Sydney, 176 Hawkesbury Rd
Westmead NSW 2145

Shanelle.sorbello@sydney.edu.au

REC Reference Number: EO303-20211008
Project Title: Australian Eye and Ear Health Survey

Dear Professor Paul Mitchell

Thank you for submitting the above research project for ethical review. This project was considered by the AIATSIS Research Ethics Committee.

I am pleased to advise you that the above research project meets the requirements of the *National Statement on Ethical Conduct in Human Research* (2007) and the *AIATSIS Code of Ethics for Aboriginal and Torres Strait Islander Research* (2020). Ethical approval for this research project has been granted by the AIATSIS Research Ethics Committee.

Approval of this Variation from AIATSIS Research Ethics Committee is valid from 2/02/2022 to 31/12/2023 subject to the following conditions being met:

1. The Coordinating Principal Investigator will immediately report anything that might warrant review of ethical approval of the project.

2. The Coordinating Principal Investigator will notify the AIATSIS Research Ethics Committee of any event that requires a modification to the project or project documents and submit any required amendments in accordance with the instructions provided by AIATSIS. These instructions can be found at https://aiatsis.gov.au/research/ethical-research.

3. The Coordinating Principal Investigator will submit any necessary reports related to the safety of research participants in accordance with AIATSIS Research Ethics Committee procedures. These instructions can be found at https://www.aiatsis.gov.au/research/ethical-research.

4. The Coordinating Principal Investigator will submit an annual report to the AIATSIS Research Ethics Committee one year from the date approval was granted. Annual reports must be submitted in the specified format, available at https://www.aiatsis.gov.au/research/ethical-research.

5. The AIATSIS Research Ethics Committee must also be notified when the project is completed at all sites no later than one month after completion.

6. The Coordinating Principal Investigator will notify the AIATSIS Research Ethics Committee if the project is discontinued at a participating site before the expected completion date, with reasons provided.

7. The Coordinating Principal Investigator will notify the AIATSIS Research Ethics Committee of any plan to extend the duration of the project past the approval period listed above and will submit any associated required documentation. The instructions for obtaining an extension of approval can be found at https://https://aiatsis.gov.au/research/ethical-research.

8. The Coordinating Principal Investigator will notify the AIATSIS Research Ethics Committee of his or her inability to continue as Coordinating Principal Investigator including the name of and contact information for a replacement.

This letter constitutes ethical approval only. This project cannot proceed at any site until separate research governance authorisation has been obtained from the CEO or the Delegate of the institution under whose auspices the research will be conducted at that site.

Should you have any queries about the AIATSIS Research Ethics Committee's consideration of your project, please contact the Secretary of the AIATSIS Research Ethics Committee, by emailing ethics@aiatsis.gov.au. For more information, please visit https://aiatsis.gov.au/research/ethical-research.

The AIATSIS Research Ethics Committee wishes you every success in your research.

Yours sincerely,

Ms Mandy Downing
Co-Chairperson

18 February 2022

This HREC is constituted and operates in accordance with the National Health and Medical Research Council's (NHMRC) National Statement on Ethical Conduct in Human Research (2007) and the Australian Institute of Aboriginal and Torres Strait Islander Studies (AIATSIS) Code of Ethics for Aboriginal and Torres Strait Islander Research (2020).

16 November 2021

Email: Shanelle.sorbello@sydney.edu.au

Dear Professor Mitchell

Re: The Australian Eye and Ear Health Survey – AIATSIS Ethics Submission

The National Aboriginal Community Controlled Health Organisation (NACCHO) is writing to provide support to the University of Sydney managed *'Australian Eye and Ear Health Survey'.*

NACCHO is the national leadership body representing 143 Aboriginal Community Controlled Health Organisations (ACCHOs) across the country on Aboriginal and Torres Strait Islander health and wellbeing issues. ACCHOs provide comprehensive primary health care to more than half the Aboriginal and Torres Strait Islander population through nearly 600 Aboriginal medical clinics throughout Australia. NACCHO has eight Affiliates who represent the ACCHO membership in their jurisdictions.

NACCHO supports the Australia Eye and Ear Health Survey (AEEHS) being undertaken by Professor Mitchell and his team, to understand more about the prevalence and major causes of hearing, deafness, vision impairment and blindness in Aboriginal and Torres Strait Islander peoples nationally.

NACCHO has been in consultation with the AEEHS team to ensure that Aboriginal and Torres Strait Islander people are engaged and participate in the survey, and that the study is delivered in a culturally safe way. NACCHO has suggested the AEEHS team undertake the following activities to ensure a rigorous governance structure around the survey's delivery. These are:

- Recruitment of two Aboriginal and/or Torres Strait Islander Project Officers for both eye and ear health components of the study
- Review and amendment of the study protocols to ensure cultural awareness and cultural safety for Aboriginal and Torres Strait Islander participants.
- Ensure ACCHOs are engaged and supported to help identify participants for the survey and are involved as support for participants and referral pathways
- Establishment of an Aboriginal and Torres Strait Islander Advisory Committee to oversee the AEEHS that includes representatives from our Affiliates.

NACCHO supports the University of Sydney's Centre for Vision Research, Westmead Institute for Medical Research's submission to AIATSIS for ethics approval. NACCHO will continue to engage with the research team to ensure collaboration across the ACCHO sector as the AEEHS is developed and implemented.

Yours sincerely,

Dr Dawn Casey PSM FAHA
Deputy CEO

16/10/2024

Professor Paul Mitchell
Westmead Institute Medical Research

AH&MRC Ethics
Committee
02 9212 4777
ethics@ahmrc.org.au

Dear Professor Paul Mitchell,

HREC Reference Number: 1938/22
Project Title: Australian Eye and Ear Health Survey

The annual report for this project submitted on 11/10/2024 was approved by the AH&MRC HREC on 16/10/2024.

The documents listed below are approved:
Annual-Progress-Report-Form for 193822.pdf

You must forward a copy of this letter to all Principal Investigators and to your institution.

Approval of this annual report from AH&MRC Ethics Committee is valid from 16/10/2024 to 16/10/2025.

Please note that all requirements of the original ethical approval for this project still apply.

Should you wish to discuss this matter, please contact ethics on 02 9212 4777 or ethics@ahmrc.org.au .

The AH&MRC Ethics Committee wishes you every continued success in your research.

Yours faithfully,

Dr. Michael Doyle
Co-Chair
AH&MRC Ethics Committee

Dr. Paul Gray
Acting Co-Chair
AH&MRC Ethics Committee

Ms Alemka Davis
Aboriginal Eye Health Project Officer
Brien Holden Foundation

a.davis@brienholdenfoundation.org

Dear Ms Davis

21/04/2023

Dear QAIHC Policy and Research Officer,

I write to you on behalf of Queensland Aboriginal and Islander Health Council - QAIHC to advise that we support the project Australian Eye and Ear Health Survey to be conducted at our QAIHC member sites**.** As QAIHC does not have an official Human Research Ethics Committee, QIAHC are supportive of the protocols and ethics approved by the AIATSIS Ethics committee.

We have been in contact with yourself to discuss the project. We are satisfied that the project has been explained to us in detail and we have had the opportunity to ask questions and discuss any required changes.

We look forward to regular communication with the Australian Eye and Ear Health site team when in Queensland and receiving updates on the progress at each site. We would also ask that you continue to work with our local members around the implementation of this project, particularly in developing local agreed processes and open partnership.

We understand that the Australian Eye and Ear Health Survey may stay in contact with us to confirm this support and that the researchers must advise us of and negotiate any changes to this research proposal.

Kind Regards,

Greg R Richards

General Manager: Policy and Research
QAIHC
22 July 2023

Email: gregory.richards@qaihc.com.au Telephone: (07) 3328 8513

Approval Letter

Date: 24 September 2024

HREC Reference number: HREC1354

Project title: Australian Eye and Ear Health Survey

Dear Professor Paul Mitchell

Thank you for submitting the above research project for ethics approval. The WA Aboriginal Health Ethics Committee (WAAHEC) considered the research project. I am pleased to advise that the WAAHEC has reviewed and approved the following documents submitted for this project:

Documents:

Response to Concerns.pdf

AEEHS Participant Information Sheet with WAAHEC details.pdf

AEEHS_WAAHEC application form_16JUL2024.pdf

1. AEEHS Protocol 281021.pdf

2. AEEHS Survey Assessment Forms.pdf

4. AEEHS Consent form_v2.pdf

5. AEEHS Distress Protocol.pdf

6. AEEHS Pamphlet.pdf

7. USYD HREC Approval.pdf

8. AIATSIS Ethics Approval.pdf

Noted Documents:

AEEHS_Letter of support_BRAMS.pdf

KAHPF Letter of Support.pdf

The WAAHEC has approved this research project, pending your agreement on the following conditions.

450 Beaufort Street, Highgate WA 6003 / PO Box 8493, Stirling Street, Perth WA 6849
Phone: (08) 9227 1631 **Fax:** (08) 9228 1099 **Email:** ethics@ahcwa.org **Web:** www.ahcwa.org.au
ABN: 48 114 220 478 **ACN:** 114 220 478

It should be noted that all requirements of the original approval still apply.
Failure to abide by these conditions may:

- result in suspension or discontinuation of approval
- result in your sponsoring institution/funder being notified of the breach
- This is a relevant consideration that WAAHEC considers when considering your future applications.

Conditions:

1. If the project is discontinued before the expected completion date, the WAAHEC will be notified in writing, giving reasons.
2. The approval period is 20/09/2024 to 20/09/2027. Research projects should commence and conclude within that period. Projects must be resubmitted if an extension over three years is necessary, and any required documentation must be submitted. A request for an extension should be submitted before the expiry date.
3. Information about publications and/or conference presentations is incorporated into Progress and Final Reports, enabling the WAAHEC to maintain a publications record.
4. Aboriginal and Torres Strait Islander communities are formally acknowledged for contributing to this research project by reporting for Publications, Reports, and Presentations.
5. Projects that do not commence within 12 months of approval may have their approval withdrawn and the project closed. The Chief Investigator must outline why the project approval should remain.
6. The Chief Investigator will provide a Progress Report in the specified format by 30 June each year.
7. The Chief Investigator will notify the HREC of any event that requires modifying the protocol or other project documents and submit any amendments necessary to approved documents or any new documents for ethics approval. Amendments can only be implemented once ethics approval is given.
8. The HREC has the authority to audit the conduct of any project without notice if some irregularity has occurred, a complaint is received from a third party, or the HREC decides to undertake an audit for quality improvement purposes.
9. The HREC may conduct random monitoring of any project. The Chief Investigator will be notified if their project has been selected.
10. All adverse events to participants, local organisations, and communities must be reported immediately. These may include any severe or unexpected effect, unforeseen events, and information that may compromise or invalidate the ethical integrity of the study.
11. The investigators recognise that the reviewing HREC is registered with the National Health and Medical Research Council and complies with the current version of the National Statement on Ethical Conduct in Human Research.
12. The Chief Investigator is responsible for conducting the research and ensuring that all others involved will conduct the study according to the above.

Should you require any further information, please get in touch with the Human Research Ethics Officer at (08) 9227 1631 or ethics@ahcwa.org.

Kind regards

450 Beaufort Street, Highgate WA 6003 / PO Box 8493, Stirling Street, Perth WA 6849
Phone: (08) 9227 1631 **Fax:** (08) 9228 1099 **Email:** ethics@ahcwa.org **Web:** www.ahcwa.org.au
ABN: 48 114 220 478 **ACN:** 114 220 478

Peter Miller
For **Vicki O'Donnell**
Chairperson, WAAHEC

This HREC is registered and operates in accordance with the National Health and Medical Research Council's (NHMRC) National Statement on Ethical Conduct in Human Research 2023, Australian Code for the Responsible Conduct of Research 2018 and the ICH Guideline for Good Clinical Practice.

450 Beaufort Street, Highgate WA 6003 / PO Box 8493, Stirling Street, Perth WA 6849
Phone: (08) 9227 1631 **Fax:** (08) 9228 1099 **Email:** ethics@ahcwa.org **Web:** www.ahcwa.org.au
ABN: 48 114 220 478 **ACN:** 114 220 478

Aboriginal Health Council
of South Australia Ltd.

29 October 2021

Attention: Shanelle Sorbello

Westmead Institute for Medical Research
The University of Sydney

Email: Shanelle.sorbello@sydney.edu.au

Project:
Australian Eye and Ear Health Survey

Name of Supporting Organisation:
Aboriginal Health Council of South Australia (AHCSA)

Chief Investigator:
Professor Paul Mitchell
Director of the Centre For Vision Research
Email: paul.mitchell@sydney.edu.au

Co-Investigators:
Professor Bamini Gopinath
Cochlear Chair in Hearing and Health and Professor
Macquarie University

Professor Lisa Keay
Head of School, School of Optometry and Vision Science

Associate Professor Gerald Liew
Clinical Associate Professor
Centre for Vision Research, Westmead Institute for Medical Research

Associate Professor Gian-Luca DiTanna
Head (Australia), Biostatistics, Biostatistics and Data Science Division
The George Institute for Global Health

Ms Colina Waddell
Head of Australia Programs
Brien Holden Foundation

Mr Tim Fricke
Consultant
Brien Holden Foundation

HREC: AIATSIS Research Ethics Committee

The Australian Eye and Ear Health Survey (AEEHS) is a cross-sectional study intended to document the prevalence of vision and hearing impairment among 1,750 Indigenous and 3,250 non-Indigenous Australians across 30 nation-wide sites, selected to approximate the proportions of urban, outer and inner regional and remote-living Australians as distributed in the 2016 Census, across all states. This study follows the National Eye Health Survey (NEHS)[1] conducted in 2015/6 in a similar number of indigenous and non-indigenous Australians, and aims to establish a time series for the purposes of trend analysis in changes in eye diseases. It is also a unique survey of ear health.

As well as updating NEHS, our AEEHS design will address key issues in the first survey: 1) Improved representativeness of the population via higher participation rates, and site distribution that is reflective of the Australian population; 2) Improved eye disease detection, using pupil dilation plus new non-

invasive, objective imaging technologies, and 3) Additional data collection, informing links between vision loss/ eye disease/ ear disease with critical health/ social outcomes.

The ear health component will also help to fulfil key priorities and actions outlined in the Australian Government's Roadmap for Hearing Health. Specifically, it is likely to inform the: 1) Development of a national database on hearing loss; 2) Facilitate the standardised national reporting of hearing loss; and 3) Development of a national set of key performance indicators for Aboriginal and Torres Strait Islander ear and hearing health.

To determine the current burden of eye disease and hearing loss in Australia and establish a time series for the purposes of trend analysis by building on the National Eye Health Survey (NEHS) conducted in 2015/6.

To determine the prevalence and causes of vision impairment and blindness, and hearing loss in Indigenous Australians aged 40 years and over, and non-Indigenous Australians aged 50 years and over, by gender, age, and geographical area.

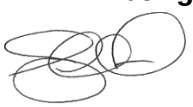
To measure the detection and treatment coverage rate of major eye diseases and conditions, including cataract, diabetic retinopathy, glaucoma, age-related macular degeneration and refractive error in both Indigenous and non-Indigenous Australian adults by:

- Determining the proportion of Australians with undiagnosed major eye diseases and uncorrected refractive error.
- Determining the proportion of Australians with known diabetes who adhere to the recommended retinal examination timeframes set by the National Health and Medical Research Council (NHMRC); once every two years for non-Indigenous Australians and once per year for Indigenous Australians.
- Determining an estimation of the coverage rate and quality of treatment outcomes for cataract surgery and the treatment of uncorrected refractive error in Australia

The AEEHS will recruit two Aboriginal Project Officers for Eyes and Ears and will utilise available opportunities to enhance the skills and knowledge of Aboriginal people, communities and organisations that are participating in this survey.

In principle, I support the above research protocol and consent to communities being invited to participate in this survey.

Signed on behalf of **Aboriginal Health Council of South Australia**

Signature: 

Name & Position in the organisation: Shane Mohor, Chief Executive Officer
Date: 29 October 2021

Witnessed by:

Signed 

Name **Chris Rektsinis, Eye Health Project Officer**

PID: _____

Station One

'Thank you for attending The Australian Eye Health Survey. Before we start the eye exam, we'd like to collect some general information about you. All information you provide is strictly confidential. If you have any queries or don't understand any questions, please ask.'

'The first questions I am going to ask you are to confirm your identity, address, and details of your GP so that we can forward your results to you and your GP if you wish. Remember that all the information you provide is kept strictly confidential and there is no possibility that this information will be linked to your name in any published reports of the study.'

Interview Initials: _____ Date and Time of Examination: _____

1. Identity

1-1 Title: ☐1 Mr ☐2 Mrs ☐3 Ms ☐4 Miss ☐5 Dr

1-2 First name(s): _____

1-3 Surname: _____

1-4 Gender: ☐1 Male ☐2 Female ☐3 Prefer not to say

1-5 Date of birth: _ _ (dd)/ _ _ (mm)/ _ _ _ _ (yyyy)

1-6 Age (years): _____

1-7 Do you identify as Aboriginal or Torres Strait Islander?
☐1 No
☐2 Aboriginal
☐3 Torres Strait Islander
☐4 Aboriginal and Torres Strait Islander

1-8. What form of contact lead to the participant being recruited?
☐1 Doorknock
☐2 Personally contacted/approached AHEES (e.g. walk-in, phone call, social media etc.)

1-9. Has the participant (or their household) received a doorknock prior to contacting AHEES?
☐1 Yes
☐2 No / Don't know

'We would like to contact you to send you a report about your eyes and the study. If you would like a copy, please provide your:'

1-10 Current postal address:

1-8.1 Street address:
_____(e.g. 12 Test Road)

1-8.2 Suburb: _____ (e.g. Westmead)

1-8.3 Postcode: _____

1-11 Looking at the address, does this participant reside in one of the currently selected SA1 sites for the study?
☐1 Yes
☐2 No

Contact details

1-12 Phone number: _____

1-13 What is your preferred email address? _____

1-14 Are you happy to receive your study results via email (rather than posted by mail)?
☐1 Yes
☐2 No

1-15 How would you like to complete the Take-home questionnaire?
☐1 Online
☐2 Hardcopy
☐3 No preference
☐4 Don't know

2. Ocular History

'I will now be asking you some questions about your eye health history. Some answers may be a bit tricky to remember, but just do your best.'

2-1 Have you ever had your eyes examined? ☐1 Yes ☐2 No

2-2 If yes, approximately how recently? (in months) _____ months

2-3 Who was the last person you saw for your eyes?
☐1 Optometrist
☐2 Ophthalmologist/Eye Doctor
☐3 GP/Local Doctor
☐4 Nurse
☐5 Health Worker/Practitioner
☐6 Ophthalmic Nurse/Technician
☐7 Other, please specify: _____

2-4 Have you seen an optometrist in the past? ☐1 Yes ☐2 No

3. Refractive Correction

'Do you wear glasses or contact lenses of any kind?'

3-1 Do you wear glasses or contact lenses of any kind?

☐1 Yes, currently wearing
☐2 Yes, brought separately
☐3 Yes, currently wearing and brought a separate pair
☐4 Yes, but forgot to bring them
☐5 No, but wears contact lenses
☐6 Does not wear glasses nor contacts lenses

'Have you had surgery to correct your vision, for example laser eye surgery? This does not include any cataract surgery.'

3-2 If **NO** glasses/contacts, have you had surgery to correct your vision (refractive surgery)?
This does NOT include cataract surgery. ☐1 Yes ☐2 No

'Do you know what type of glasses they are? For example, reading glasses, distance glasses, bifocals or multifocals?'

3-3 If using glasses, what kind of glasses are they?

Glasses Pair #1

☐1 Distance only
☐2 Readers only
☐3 Multifocal
☐4 Bifocal

(An option must be chosen to see Lensometry questions)

Glasses Pair #2

☐1 Distance only
☐2 Readers only
☐3 Multifocal
☐4 Bifocal

(An option must be chosen to see Lensometry questions)

4. Lensometry

'I am going to measure the power of your glasses. Could I please have all your glasses.'

4-1 Lensometry – RIGHT eye: Current distance glasses

Sphere (RE) _____
Cylinder (RE) _____
Axis (RE) _____
Reading Add (RE) _____

4-2 Lensometry – LEFT eye: Current distance glasses

Sphere (LE) _____
Cylinder (LE) _____
Axis (LE) _____
Reading Add (LE) _____

4-3 Lensometry – RIGHT eye: Separate readers

Sphere (RE) _____

*Attach **Zeiss VISULENS 550** printout below:*

Cylinder (RE) _____

Axis (RE) _____

Reading Add (RE) _____

4-4 Lensometry – LEFT eye: Separate readers

Sphere (RE) _____

Cylinder (RE) _____

Axis (RE) _____

Reading Add (RE) _____

4-5 If not completed, reason why: _____

5. Autorefraction

'I am going to measure the focusing power of your eyes. It will involve you sitting in front of this machine with your chin on the chin and forehead resting here (point to chin and forehead rest). Keep looking at the hot air balloon at the end of the long road throughout the scan. It will go blur in and out of focus. Blink whenever you need to and try to relax your eyes.'

5-1 Have you completed auto-refraction? ☐1 Yes ☐2 No

5-2 Autorefraction – RIGHT eye

Sphere (RE) _____

Cylinder (RE) _____

Axis (RE) _____

5-3 Autorefraction – LEFT eye

Sphere (LE) _____

Cylinder (LE) _____

Axis (LE) _____

5-4 If not completed, reason why: _____

*Attach **Zeiss VISUREF 150** printout below:*

6. Habitual Distance Visual Acuity

'I am going to assess how well your eyes can see by getting you to read letters off this chart. I am going to be testing one eye at a time. You can blink as many times as you need to during the test, and you can move your head side to side if it helps you to see the letters. However, you cannot lean forward in your chair or squint to see the letters.'

'I will start with your distance vision. Do you wear glasses or contact lenses for distance vision e.g. when driving, watching TV or movies?'

6-1 Habitual distance correction:

☐1 Unaided
☐2 With distance/multifocal/bifocal glasses
☐3 With contact lenses

6-2 Habitual distance visual acuity **RIGHT EYE**

	EDTRS Chart RE (letters may differ)					**No. correct**
6/60	H	V	Z	D	S	
6/48	N	C	V	K	D	
6/36	C	Z	S	H	N	
6/30	O	N	V	S	R	
6/24	K	D	N	R	O	
6/18	Z	K	C	S	V	
6/15	D	V	O	H	C	
6/12	O	H	V	C	K	
6/9.5	H	Z	C	K	O	
6/7.5	N	C	K	H	D	
6/6	Z	H	C	S	R	
6/4.8	S	Z	R	D	N	
6/3.8	H	C	D	R	O	
6/3	R	D	O	S	N	
					Total number of letters read correctly: (If no letters were seen, put down 0)	

6-3 If RVA **worse than 6/60**, change to Snellen chart and increase optotype size and record (5/60; 4/60; 3/60; 2/60; 1/60 equivalent):

☐1 5/60
☐2 4/60
☐3 3/60
☐4 2/60
☐5 1/60

"I'm going to hold up some fingers in front of you, can you tell me how many you can see, if any?"

"Let me know if you can see my hand moving in front of you".

"I am going to shine a light in front of you, let me know if you can see the light".

6-4 If RVA **worse than 1/60**, indicate if:

☐1 CF
☐2 HM
☐3 LP
☐4 NPL

6-5 If RE <6/9.5, did visual acuity improve with pinhole? ☐1 Yes ☐2 No

6-6 If yes, record total numbers read correctly with PH: _____

6-7 Habitual distance visual acuity **LEFT EYE**

	EDTRS Chart LE (letters may differ)					**No. correct**
6/60	H	V	Z	D	S	
6/48	N	C	V	K	D	
6/36	C	Z	S	H	N	
6/30	O	N	V	S	R	
6/24	K	D	N	R	O	
6/18	Z	K	C	S	V	
6/15	D	V	O	H	C	
6/12	O	H	V	C	K	
6/9.5	H	Z	C	K	O	

6/7.5	N	C	K	H	D	
6/6	Z	H	C	S	R	
6/4.8	S	Z	R	D	N	
6/3.8	H	C	D	R	O	
6/3	R	D	O	S	N	
						Total number of letters read correctly: (If no letters were seen, put down 0)

6-8 If LVA **worse than 6/60**, change to Snellen chart and increase optotype size and record (5/60; 4/60; 3/60; 2/60; 1/60 equivalent):

☐1 5/60
☐2 4/60
☐3 3/60
☐4 2/60
☐5 1/60

"I'm going to hold up some fingers in front of you, can you tell me how many you can see, if any?"

"Let me know if you can see my hand moving in front of you".

"I am going to shine a light in front of you, let me know if you can see the light".

6-9 If LVA **worse than 1/60**, indicate if:

☐1 CF
☐2 HM
☐3 LP
☐4 NPL

6-10 If LE <6/9.5, did visual acuity improve with pinhole? ☐1 Yes ☐2 No

6-11 If yes, record total numbers read correctly with PH: _____

If one eye weaker than the other (at least 2-line difference):

"Are you aware whether your right/left eye has always been slightly weaker than your left/right eye?"

6-12 Has your right/left eye always been weaker?

☐1 Yes, right eye
☐2 Yes, left eye
☐3 No
☐4 Don't know

6a. Distance Visual Acuity (Unaided)

If Habitual Distance Visual Acuity tested Unaided, do not complete this section

'I will now test your distance vision without glasses. Please remove your glasses.'

6a-1 Unaided distance visual acuity **RIGHT EYE** at 4m

	EDTRS Chart RE (letters may differ)	No. correct
6/12	O H V C K	
Total number of letters read correctly:		

6a-2 RE: Can the 6/12 line be read at 4 metres? ☐1 Yes ☐2 No

6a-3 Unaided distance visual acuity **LEFT EYE** at 4m

	EDTRS Chart LE (letters may differ)	No. correct
6/12	O H V C K	
Total number of letters read correctly:		

6a-4 LE: Can the 6/12 line be read at 4 metres? ☐1 Yes ☐2 No

6b. Distance Visual Acuity (Corrected)

If habitual distance visual acuity is better than 6/9.5 in either eye OR there is no improvement with pinhole in either eye, no further measurements of vision are needed.
Do not complete this section. Go to Question 8 (Near Visual Acuity)

If habitual distance vision is worse than 6/9.5 AND shows improvement with pinhole in either eye, perform corrected distance visual acuity.

'I am now going to see if I can try to improve your distance vision with some updated glasses. I will put some lenses in this trial frame (indicate the trial frame) and recheck your vision. The trial frames are slightly heavy.'

Instructions:

1. Put autorefraction results in a trial frame and check distance visual acuity for either right eye, left eye or both (depending on above findings).
2. If visual acuity with autorefraction is better than 6/9.5, stop testing and record the results.
3. If visual acuity with autorefraction remains worse than 6/9.5, check visual acuity with pinhole to assess if threshold visual acuity improves.
4. If pinhole visual acuity remains worse than 6/9.5, stop testing and record the better visual acuity (i.e. pinhole or autorefraction).

5. If pinhole visual acuity is better than 6/9.5, perform a subjective refraction for either the right eye, left eye or both (depending on above findings).
6. Record subjective refraction results and best corrected visual acuity.

6b-1 Type of correction used (RE):

☐1 Autorefraction

☐2 Subjective refraction

6b-2 Subjective refraction script (RE):

Sphere (RE) _____

Cylinder (RE) _____

Axis (RE) _____

6b-3 Corrected distance visual acuity **RIGHT EYE**

	EDTRS Chart RE (letters may differ)					No. correct
6/60	H	V	Z	D	S	
6/48	N	C	V	K	D	
6/36	C	Z	S	H	N	
6/30	O	N	V	S	R	
6/24	K	D	N	R	O	
6/18	Z	K	C	S	V	
6/15	D	V	O	H	C	
6/12	O	H	V	C	K	
6/9.5	H	Z	C	K	O	
6/7.5	N	C	K	H	D	
6/6	Z	H	C	S	R	
6/4.8	S	Z	R	D	N	
6/3.8	H	C	D	R	O	
6/3	R	D	O	S	N	

Total number of letters read correctly: (if no letters were seen, put down 0)

6b-4 If RVA **worse than 6/60**, change to Snellen chart and increase optotype size and record (5/60; 4/60; 3/60; 2/60; 1/60 equivalent):

☐1 5/60
☐2 4/60
☐3 3/60
☐4 2/60
☐5 1/60

"I'm going to hold up some fingers in front of you, can you tell me how many you can see, if any?"

"Let me know if you can see my hand moving in front of you".

"I am going to shine a light in front of you, let me know if you can see the light".

6b-5 If RVA **worse than 1/60**, indicate if:

☐1 CF
☐2 HM
☐3 LP
☐4 NPL

6b-6 Type of correction used (LE):

☐1 Autorefraction
☐2 Subjective refraction

6b-7 Subjective refraction script (LE):

Sphere (RE) _____
Cylinder (RE) _____
Axis (RE) _____

6b-8 Corrected distance visual acuity **LEFT EYE**

	EDTRS Chart RE (letters may differ)					**No. correct**
6/60	H	V	Z	D	S	
6/48	N	C	V	K	D	

6/36	C	Z	S	H	N	
6/30	O	N	V	S	R	
6/24	K	D	N	R	O	
6/18	Z	K	C	S	V	
6/15	D	V	O	H	C	
6/12	O	H	V	C	K	
6/9.5	H	Z	C	K	O	
6/7.5	N	C	K	H	D	
6/6	Z	H	C	S	R	
6/4.8	S	Z	R	D	N	
6/3.8	H	C	D	R	O	
6/3	R	D	O	S	N	
						Total number of letters read correctly: (if no letters were seen, put down 0)

6b-9 If LVA **worse than 6/60**, change to Snellen chart and increase optotype size and record (5/60; 4/60; 3/60; 2/60; 1/60 equivalent):

☐1 5/60
☐2 4/60
☐3 3/60
☐4 2/60
☐5 1/60

"I'm going to hold up some fingers in front of you, can you tell me how many you can see, if any?"

"Let me know if you can see my hand moving in front of you".

"I am going to shine a light in front of you, let me know if you can see the light".

6b-10 If LVA **worse than 1/60**, indicate if:

☐1 CF
☐2 HM

☐3 LP

☐4 NPL

7. Near Visual Acuity

'Now I am going to see how well your eyes can see when looking up close by getting you to read some sentences from this chart. Do you wear glasses or contact lenses for near vision e.g. when reading, crafting, or using your phone?'

7-1 Is the participant wearing (or bring along) near correction? ☐1 Yes ☐2 No

7-2 Habitual Near Vision **BOTH EYES**

	Near Chart					No. correct
6/60	H	V	Z	D	S	
6/48	N	C	V	K	D	
6/36	C	Z	S	H	N	
6/30	O	N	V	S	R	
6/24	K	D	N	R	O	
6/18	Z	K	C	S	V	
6/15	D	V	O	H	C	
6/12	O	H	V	C	K	
6/9.5	H	Z	C	K	O	
6/7.5	N	C	K	H	D	
6/6	Z	H	C	S	R	
6/4.8	S	Z	R	D	N	
6/3.8	H	C	D	R	O	
6/3	R	D	O	S	N	

Total number of letters read correctly: _____

****If participant was wearing contact lenses, these can now be removed and stored until the end of the assessment. Perform autorefraction.****

7a. Near Visual Acuity (Unaided)

If Habitual Near Visual Acuity tested Unaided, do not complete this section

'I will now test your reading vision without glasses. Please remove your glasses.'

7a-1 Unaided near visual acuity **BOTH EYES**

	Near Chart	No. correct
6/12	O H V C K	
Total number of letters read correctly:		

7a-2 Can the 6/12 line be read at 40cm? ☐1 Yes ☐2 No

8. Visual Field Assessment (SITA-Faster: 24-2)

'I will now set you up to perform the visual field test. This test will check your peripheral (or side) vision, which is a good check for your risk of glaucoma. It is done one eye at a time. I am going to put a patch over your left eye so we can test your right eye first. Here is the buzzer (indicate the buzzer) for you to hold onto. You will be pressing this during the test. Please come closer and put your chin on the chinrest and your forehead against the forehead bar. Make sure you are comfortable – let me know if you would like me to adjust the height of the machine. The test usually takes around 2 minutes per eye. You will need to keep looking straight ahead at the yellow light in the middle of the bowl for the entire test. During the test, you will notice spots of light in any position around the bowl, in your side vision. Some of these spots of light can be big and others can be small, some can be bright and others very faint. When you think you see a spot of light, press the buzzer in your hand. Importantly, try not to look around for the spots of light, just keep focused on the central yellow light. You can blink normally during the test.'

8-1 For which eyes have you completed SITA Faster testing?

☐1 Both eyes
☐2 Right eye
☐3 Left eye
☐4 Neither eye

8-2 Reason why SITA testing was not done in both/either eyes: _____

9. IOL Master

'I am going to take some measurements of your eye that will tell us its' length and curvature. It will involve you sitting in front of this machine with your chin and forehead resting here (point to chin and forehead rest). Some parts of the test will require you to keep your eyes open without blinking for a few seconds. I will tell you when to do this and remind you of what to do.'

9-1 Has participant worn contact lenses in the last 3 days? ☐1 Yes ☐2 No

9-2 Axial length (AXL)

- ☐ Right eye: _____ mm
- ☐ Left eye: _____ mm

9-3 Central corneal thickness (CCT)

- ☐ Right eye: _____ mm
- ☐ Left eye: _____ mm

9-4 Anterior chamber depth (ACD)

- ☐ Right eye: _____ mm
- ☐ Left eye: _____ mm

9-5 Lens thickness (LT)

- ☐ Right eye: _____ mm
- ☐ Left eye: _____ mm

10. Anterior Segment Examination (Pre-dilation)

****Gross assessment of: Iris colour, Pterygium, Pupil abnormalities and Lid abnormalities****

'I am going to examine the front of your eye. I will shine a light into your eyes, which may be a bit bright. I may also need to touch or lift your eyelids with a cotton bud to examine them. This will not hurt but may be slightly uncomfortable. Let me know at any time if you need a break. Please try to keep looking straight ahead and blink when you need to.'

10-1 **Iris colour** (use standard photos as per BMES):

Right eye:	Left eye:
☐ < std #1 (blue)	☐ < std #1 (blue)
☐ < std #2 (hazel/green)	☐ < std #2 (hazel/green)
☐ < std #3 (tan/brown)	☐ < std #3 (tan/brown)
☐ > std #3 (dark brown)	☐ > std #3 (dark brown)
☐ Cannot judge/Not done	☐ Cannot judge/Not done

10-2 **Pterygium:**

Right eye:	Left eye:
☐ Absent	☐ Absent
☐ Questionable	☐ Questionable
☐ Present	☐ Present
☐ Present, axis involved	☐ Present, axis involved

10-3 **Pupil Abnormalities:**

Right eye:	Left eye:
☐ Unequal pupil	☐ Unequal pupil
☐ Non-reactive to light	☐ Non-reactive to light
☐ Polycoria	☐ Polycoria
☐ Eccentric pupil	☐ Eccentric pupil
☐ Other, please specify:	☐ Other, please specify:
_____	_____

10-4 **Lid Abnormalities:**

Right eye:	Left eye:
☐ Ectropion	☐ Ectropion
☐ Entropion	☐ Entropion
☐ Ptosis	☐ Ptosis
☐ Suspicious growth (SCC/BCC)	☐ Suspicious growth (SCC/BCC)
☐ Other, please specify:	☐ Other, please specify:
_____	_____

11. Pentorch Anterior Chamber Depth Test

'I am going to measure the depth of the front of your eye. To do this, I will shine a bright light into your eye from the side. Please keep looking straight ahead and blink when you need to.'

11-1 Pen torch grade (RE):

☐ Grade 1 *	☐ Grade 1 *	Iris 1/3 illuminated
☐ Grade 2	☐ Grade 2	Iris 1/3 to 2/3 illuminated
☐ Grade 3	☐ Grade 3	Iris >2/3 illuminated
☐ Grade 4	☐ Grade 4	Iris fully illuminated

*If **Grade 0 or 1 (narrow angles)**, perform anterior segment OCT scan and dilate with Tropicamide 0.5%.

11-2 Pen torch grade (LE):

☐ Grade 1 *	☐ Grade 1 *	Iris 1/3 illuminated
☐ Grade 2	☐ Grade 2	Iris 1/3 to 2/3 illuminated
☐ Grade 3	☐ Grade 3	Iris >2/3 illuminated
☐ Grade 4	☐ Grade 4	Iris fully illuminated

*If **Grade 1 (narrow angles)**, perform anterior segment OCT scan and dilate with Tropicamide 0.5%.

12. IOP (iCare)

'I am going to check your eye pressure now. This is a quick check for risk of glaucoma. Keep looking straight ahead. I will come in very close. You may feel a slight tickle against your eyelashes when I take the measurement but no pain. Blink when you need to. I will take 6 very quick measurements.'

12-1 iCare IOP RE: _____ mmHg

12-2 iCare IOP LE: _____ mmHg

****If IOP is greater that 25mmHg or there is a difference of >5mmHg between eyes, senior clinician to perform applanation tonometry.****

12a. IOP (Applanation)

'I am going to re-check your eye pressure now. I will give you some anaesthetic drops so that you do not feel anything. I will come in very close to your eye and you may feel the prism (indicate the tonometer prism) brush against your lashes. It will not hurt. I may need to lift your eyelids slightly to take a good measurement. Try to hold as still as you can, try not to blink and keep both your eyes as wide open as you can. Keep looking straight ahead throughout the entire measurement.'

12a-1 Time applanation IOP was taken: _____ am/pm

12a-2 Applanation IOP RE: _____ mmHg

12a-3 Applanation IOP LE: _____ mmHg

13. Proceed with Pupil Dilation

'I am now going to put some drops into your eyes which make your pupils, the black part of the eye, very large. During this time, your vision may become quite blurry, especially up close, and everything will appear brighter than usual. The drops also sting slightly – blinking and gently wiping your eyes will help. The drops usually last a couple of hours and then your vision will return to normal.'

Proceed with dilation in both eyes using:
If angles shallow/narrow = Tropicamide 0.5%.
All other participants = Tropicamide 1%.

13-1 Were pupils dilated? ☐1 Yes ☐2 No

13-2 Reason for not dilating: _____

Station Two

For all the below sections, ask the participant each question in each section. For questions which require an estimated or approximate answer (e.g. in which year, what was the cost), please reassure the participant that a rough indication is acceptable if they are unsure of the exact answer. Record the results directly into the 'Station 2' section of the REDCap database, or on the respective section of the Case Reporting Form to be transferred into REDCap later.

1. General Demographics

'I am going to ask you some general questions about yourself. Please answer to the best of your ability.'

1-1 What is your present marital status? (Census 2021)

☐ 1 Never married
☐ 2 Widowed
☐ 3 Divorced
☐ 4 Separated but not divorced
☐ 5 Married

1-2 In which country were you born? (Census 2021)

☐ 1 Australia
☐ 2 England
☐ 3 New Zealand
☐ 4 India
☐ 5 Philippines
☐ 6 Vietnam
☐ 7 Italy
☐ 8 Other: _____

1-3 If Australia was not your place of birth, in what year did you first arrive in Australia? (Census 2021)

_____

1-4 Do you speak a language other than English at home? (Census 2021)

☐ 1 No, English only
☐ 2 Yes, Mandarin
☐ 3 Yes, Arabic
☐ 4 Yes, Cantonese
☐ 5 Yes, Vietnamese
☐ 6 Yes, Italian
☐ 7 Yes, Greek
☐ 8 Yes, First Nations Language: _____
☐ 9 Yes, other:_____

1-5 In what country was your mother born? (Census 2021)

☐ 1 Australia
☐ 3 Prefer not to answer

☐ 2 Other: _____ ☐ 4 Don’t know

1-6 In what country was your father born? (Census 2021)

☐ 1 Australia ☐ 3 Prefer not to answer

☐ 2 Other: _____ ☐ 4 Don’t know

1-7 What is the highest year of primary or secondary school you have completed? (Census 2021)

☐ 1 Year 12 or equivalent ☐ 4 Year 9 or equivalent

☐ 2 Year 11 or equivalent ☐ 5 Year 8 or below

☐ 3 Year 10 or equivalent ☐ 6 Did not go to school

1-8 What is the level of the highest qualification you have completed? (Census 2021)

☐ 1 Postgraduate degree ☐ 6 Certificate I/II

☐ 2 Graduate diploma/Certificate ☐ 7 Year 12

☐ 3 Bachelor’s degree ☐ 8 Certificate not further defined

☐ 4 Advanced Diploma/Diploma ☐ 9 Never attended school and no non-school qualification

☐ 5 Certificate III/IV ☐ 10 Don't know

1-9 Are you retired or still employed? (BMES)

☐ 1 Employed Full-Time ☐ 4 Retired

☐ 2 Employed Part-Time ☐ 5 Other, please specify:

☐ 3 Seeking opportunities _____

1-10 If retired, how old were you when you retired? _____ years (BMES)

1-11 If employed, what is your present occupation? (BMES)

_____

1-12 In your working life, what was your main job? (BMES)

1-13 If you receive a pension, what sort of pension is it? (BMES)

☐ 1 Not receiving a pension
☐ 2 Age
☐ 3 Disability support
☐ 4 Veteran's
☐ 5 Disability support pension (Blind)
☐ 6 Other (or multiple pensions), please specify: _____

1-14 Have you received support from the National Disability Insurance Scheme (NDIS)?

☐ 1 Yes ☐ 2 No

1-15 If yes, in what year did your first NDIS plan start? _____ (year)

1-16 If yes, in what month did your first NDIS plan start? _____ (month)

1-17 Are you currently a member of a private health fund? (BMES) ☐ 1 Yes ☐ 2 No

1-18 If yes, which fund are you with? _____

1-19 How many COVID vaccinations have you had? _____

1-20 Have you had COVID?

☐ 1 Yes ☐ 2 No

1-21 If yes, what year did you first have COVID? _____ (year)

1-22 What sort of place do you live in? (BMES)

☐ 1 Own house
☐ 6 Boarding house

☐ 2 Own flat/unit

☐ 3 Rented house

☐ 4 Rented flat/unit

☐ 5 Social housing (public, Aboriginal or community

☐ 7 Nursing home

☐ 8 With relatives

☐ 9 Other, please specify:

_____

☐ 10 Don't know

1-23 Who lives with you (multiple responses accepted)? (BMES)

☐ 1 Nobody

☐ 2 Husband or wife

☐ 3 De facto partner

☐ 4 Child/ren (son/daughter)

☐ 5 Stepchild/ren

☐ 6 Sibling/s (brother/sister)

☐ 7 Unrelated flatmate or co-tenant

☐ 9 Other, please specify:

_____

2. Driving

'I am going to ask you some questions about driving. Please answer to the best of your ability.'

2-1 Do you currently drive?

☐ 1 Yes

☐ 2 No

☐ 3 Never driven

2-2 Have you been in a car accident in the last 12 months where you were the driver, whether or not you were at fault?

☐ 1 Yes

☐ 2 No

2-3 Do you have any difficulties driving at night?

☐ 1 Yes

☐ 2 No

3. Medications History

'I would like to ask about your current medications. Are you currently taking any tablets, vitamins, eyedrops or other medications? If so, how many are you taking in total? What are they?'

3-1 Are you currently taking any tablets, vitamins, eyedrops or other medications?

☐ 1 Yes ☐ 2 No

3-2 Total number of medications (if >10, provide information on the first 10): _____

3-3 If yes, please attach medication list below:

3-4 **Medication 1:**
Name of Medication _____

Strength (mg)/tablet _____

Duration (months) _____

3-5 **Medication 2:**
Name of Medication _____

Strength (mg)/tablet _____

Duration (months) _____

3-6 **Medication 3:**
Name of Medication _____

Strength (mg)/tablet _____

Duration (months) _____

3-7 **Medication 4:**
Name of Medication _____

Strength (mg)/tablet _____

Duration (months) _____

3-8 **Medication 5:**
Name of Medication _____

Strength (mg)/tablet _____

Duration (months) _____

3-9 **Medication 6:**
Name of Medication _____

Strength (mg)/tablet _____

Duration (months) _____

3-10 **Medication 7:**
Name of Medication _____

Strength (mg)/tablet _____

Duration (months) _____

3-11 **Medication 8:**
Name of Medication _____

Strength (mg)/tablet _____

Duration (months) _____

3-12 **Medication 9:**
Name of Medication _____

Strength (mg)/tablet _____

Duration (months) _____

3-13 **Medication 10:**
Name of Medication _____

Strength (mg)/tablet _____

Duration (months) _____

4. Medical and Surgical History

'I am going to ask you some questions about your medical and surgical history. Please answer to the best of your ability.'

MEDICAL AND SURGICAL HISTORY

General:

4-1 In general would you say that your health is: (National Health Survey 2017-18)

☐1 Excellent ☐2 Good ☐3 Fair ☐4 Poor ☐5 Don't know

4-2 Have you had any admissions (at least overnight) to a hospital in the last 12 months? (BMES)

☐1 Yes ☐2 No ☐3 Don't know

4-3 If yes, how many times were you admitted to hospital? (BMES) _____

Blood pressure:

4-4 Have you ever been told you have high blood pressure or hypertension? (BMES)

☐1 Yes ☐2 No ☐3 Never tested

4-5. At what age were you diagnosed with high blood pressure or hypertension? _____

Cholesterol:

4-6 Have you ever been diagnosed with high cholesterol? (BMES)

☐1 Yes ☐2 No ☐3 Never tested

Diabetes or prediabetes:

4-7 Have you ever been told by a doctor or nurse that you have diabetes? (National Health Survey 2017-18)

☐1 Yes ☐2 No ☐3 Never tested

4-8 At what age were you diagnosed with diabetes? _____

4-9 If yes, how do you manage your diabetes? (BMES)

☐1 Diet ☐3 Insulin

☐2 Tablets ☐4 Other, please specify: _____

Cardiac conditions:

4-10 Have you ever had a heart attack? (BMES)

☐1 Yes ☐2 No

4-11 If yes, how many months ago did the last one occur? _____ (months)

4-12 If yes, what was the treatment for your heart attack? (BMES)

☐1 Bypass (CABG) ☐3 Stent

☐2 Angioplasty (PTCA) ☐4 Other, please specify: _____

4-13 How long ago did you have your treatment (months)? _____ (months)

4-14 Have you ever had angina (without AMI)? (BMES)

☐1 Yes ☐2 No

4-15 Have you ever had other cardiac conditions (e.g. heart failure, arrhythmia)? (BMES)

☐1 Yes ☐2 No

4-16 What was the diagnosis? (BMES) _____

Stroke:

4-17 Have you ever had a stroke or TIA (mini stroke)? (BMES)

☐1 Stroke ☐3 Stroke and TIA

☐2 TIA ☐4 No

4-18 What was the year of your last stroke? _____ (year)

4-19 Did the stroke affect your vision?

☐1 Yes ☐2 No

Smoking History:

4-20 Have you ever smoked cigarettes or vaped regularly (i.e. at least weekly)?

☐1 Cigarettes (Ready-made or roll-your-own) ☐3 Both cigarettes and vaping

☐2 Vaping ☐4 Neither

4-21 Cigarettes:

Age you started: _____

Age you stopped for at least 12 months: (if you haven't stopped, leave blank) _____

Amount smoked per week (number of packs): _____

Number of cigarettes per pack: _____

4-22 Vaping:

Age you started: _____

Age you stopped for at least 12 months: (if you haven't stopped, leave blank) _____

Amount smoked per week (select one):
☐1 Amount in mLs
☐2 Number of vapes

Amount in mLs per week: _____

Number of vapes per week: _____

Size of vape (in puffs): _____

Kidney disease

4-23 Have you ever been told by a doctor or nurse that you have kidney disease? (National Health Survey 2017-18)

☐1 Yes ☐2 No

4-24 What was the highest level of treatment received? (BMES)

☐1 None
☐2 Medications
☐3 Peritoneal dialysis: commenced _____ months ago
☐4 Haemodialysis: commenced _____ months ago
☐5 Kidney transplant: _____ years ago
☐6 Other, please specify: _____

Cancer:

4-25 Have you ever been told by a doctor or nurse that you have cancer? (Census 2021)

☐1 Yes ☐2 No

4-26 If yes, what type of cancer were you diagnosed with? _____

Falls and Fractures:

4-27 During the past 12 months, have you had any falls where you have landed on the ground or floor? (BMES)

☐1 Yes ☐2 No

4-28 If yes, number of falls in the last 12 months? (BMES) _____

4-29 If yes, did any of the falls result in a fracture?

☐1 Yes ☐2 No

4-30 If yes, were any of these falls due to problems with your vision? (BMES)

☐1 Yes ☐2 No

4-31 How afraid are you of falling? (BMES)

☐1 Little ☐3 Very

☐2 Moderately ☐4 Don't know

Other general conditions:

4-32 Are there any other serious illnesses or major operations that you have not told us about yet? (BMES)

☐1 Yes ☐2 No

4-33 If **YES**, please specify illness/s and year (e.g. Positional Vertigo 2012)

_____ Year: _____

_____ Year: _____

_____ Year: _____

_____ Year: _____

_____ Year: _____

_____ Year: _____

_____ Year: _____

_____ Year: _____

5. Eye Disease

'I would like to ask you about your history of eye diseases and conditions.'

Spectacles and Contact Lenses:

5-1 How do you pay for glasses, contact lenses or refractive surgery?

☐1 Private insurance ☐3 Pay out of pocket

☐2 Spectacle subsidy scheme ☐4 Have never needed glasses, contact lenses or refractive surgery

5-2 Out of pocket cost for one year (estimate) (Input number directly, ignore the '$' sign. If no cost, input 0):

_____

Cataract:

5-3 Have you ever had cataract, or been told you had cataract? (BMES)

☐1 Yes ☐2 No

5-4 If yes, have you ever had cataract surgery? (BMES)

☐1 Yes ☐2 No

5-5 If yes, in which eye? (BMES)

☐1 Right eye ☐2 Left eye ☐3 Both eyes

5-6 If yes to cataract surgery – RIGHT EYE:

RE: In which year was the surgery performed (estimate)? _____ (year)

RE: Where did you get surgery? ☐1 Public hospital
☐2 Private hospital

RE: Out of pocket cost (estimate) (Input number directly, ignore the '$' sign. If no cost, input 0) _____

5-7 If yes to cataract surgery – LEFT EYE:

LE: In which year was the surgery performed (estimate)? _____ (year)

LE: Where did you get surgery? ☐1 Public hospital
☐2 Private hospital

LE: Out of pocket cost (estimate) (Input number directly, ignore the '$' sign. If no cost, input 0) _____

Age-related macular degeneration:

5-8 Have you ever been told you have age-related macular degeneration? (BMES)

☐1 Yes ☐2 No

5-9 If yes, what type of AMD do you have?

☐1 Early ☐4 Late (neovascular/wet)
☐2 Intermediate ☐5 Don't know
☐3 Late (atrophic/dry)

5-10 If you have wet macular degeneration, have you ever received treatment (e.g. Injections into your eye)? (BMES)

☐1 Yes, right eye ☐3 Yes, both eyes
☐2 Yes, left eye ☐4 No

5-11 If you have wet macular degeneration but have not received treatment, why not?

☐1 Was not told ☐5 Can't access it

☐2 Missed the appointment ☐6 Other, please specify: _____
☐3 Have no time ☐7 Don't know
☐4 Could not afford it

5-12 If yes, AMD – RIGHT EYE: (BMES)

How long ago did you start receiving treatment for AMD (months)? _____ (months)

Were treatment injections involved? ☐1 Yes ☐2 No

Number of total injections (estimate): _____

Cost of injection per eye (Input number directly, ignore the '$' sign. If no cost, input 0): _____

5-13 If yes, AMD – LEFT EYE: (BMES)

How long ago did you start receiving treatment for AMD (months)? _____ (months)

Were treatment injections involved? ☐1 Yes ☐2 No

Number of total injections (estimate): _____

Cost of injection per eye (Input number directly, ignore the '$' sign. If no cost, input 0): _____

Glaucoma:

5-14 Have you ever been told you have glaucoma? (BMES)

☐1 Yes ☐2 No

5-15 Have you ever used any eye drops for your glaucoma?

☐1 Yes ☐2 No

5-16 If yes, which eyedrop(s) do you use? _____

5-17 Have you had an operation for glaucoma? (BMES)

☐1 Yes ☐2 No ☐3 Don't know

5-18 If you did have an operation, in which eye? (BMES)

☐1 Right eye ☐2 Left eye ☐3 Both eyes

5-19 Have you ever had laser treatment for glaucoma?

☐1 Yes ☐2 No ☐3 Don't know

Diabetic eye disease:

5-20 Have you ever had a diabetic eye check? (If indicated as **having diabetes**)

☐1 Yes ☐2 No ☐3 Don't know

5-21 Have you ever had a photo taken of your eye by an optometrist/eye doctor/nurse?

☐1 Yes ☐2 No

5-22 If no, why not?

☐1 Was never told to have one
☐2 Have no time
☐3 Can't access
☐4 Could not afford it
☐5 Missed the appointment
☐6 Other, please specify:
_____
☐7 Don't know

5-23 If yes, how many months ago did you have your last examination/test? _____ (months)

5-24 If yes, who performed the check?

☐1 Optometrist
☐2 Eye specialist
☐3 GP
☐4 Other doctor
☐5 Nurse
☐6 Other, please specify: _____

5-25 Have you ever had treatment for diabetic eye damage? (BMES)

☐1 Yes ☐2 No

5-26 If yes – RIGHT EYE:

How many months ago did your treatment(s) begin? _____ (months)
Did the treatment involve laser? ☐1 Yes ☐2 No
Treatment with vitrectomy? ☐1 Yes ☐2 No ☐3 Don't know
Did the treatment involve injections? ☐1 Yes ☐2 No

5-27 If yes – LEFT EYE:

How many months ago did your treatment(s) begin? _____ (months)
Did the treatment involve laser? ☐1 Yes ☐2 No
Treatment with vitrectomy? ☐1 Yes

☐2 No
☐3 Don't know

Did the treatment involve injections? ☐1 Yes
☐2 No

Dry Eye:

5-28 Have you ever been diagnosed (by a clinician) as having dry eye syndrome?

☐1 Yes ☐2 No

5-29 How often do your eyes feel dry (not wet enough)?

☐1 Never ☐3 Often
☐2 Sometimes ☐4 Constantly

5-30 How often do your eyes feel irritated?

☐1 Never ☐3 Often
☐2 Sometimes ☐4 Constantly

Other Eye Diseases:

5-31 Are there any other eye diseases that you have not told us about yet? (BMES)

☐1 Yes ☐2 No

5-32 If **YES**, please specify name of condition and age diagnosed (e.g. Amblyopia, 4; Colour blindness, 17)

_____ Age: _____

_____ Age: _____

_____ Age: _____

_____ Age: _____

_____ Age: _____

_____ Age: _____

Other Eye Surgeries:

5-33 Are there any other eye surgeries that you have not told us about yet? (BMES)

☐1 Yes ☐2 No

5-34 If **YES**, please specify name of surgery and year performed (e.g. Retinal tear, 2001; Corneal graft, 2011)

_____ Year: _____

_____ Year: _____

_____ Year: _____

_____ Year: _____

_____ Year: _____

6. Anthropometry:

'I am now going to perform some tests to measure your height, weight and waist circumference as well as your blood pressure when sitting down, your blood sugar level and your current heart rate.'

6-1 Height: _____ cm

6-2 Weight: _____ kg

6-3 Waist: _____ cm

6-4 Systolic BP: _____ mmHg

6-5 Diastolic BP: _____ mmHg

6-6 Heart rate: _____ beats per minute

Blood Sugar:

6-7 Random blood glucose (finger prick): _____ mmol/L

6-8 Fasting status at time of finger prick:

☐1 Fasting ☐2 Not fasting

Station Three

1. Imaging – Fundus Photography

'I would now like to take some scans and photographs of your eyes/eyelids to assess for any abnormalities.'

1-1 Were all photographs/scans taken?

☐1 Yes ☐2 No

1-2 If not completed, reason why: _____

2. Slit Lamp Exam (Post-dilation)

'I am going to examine the front of your eye. I am going to shine a beam of bright light into your eye. I will also need to touch or lift your eyelids with a cotton bud to examine them. This will not hurt but may be slightly uncomfortable. Let me know at any time if you need a break. Please keep looking straight at my ear and blink when you need to.'

2-1 **Corneal Opacities:**

Right eye:	Left eye:
☐ Absent	☐ Absent
☐ Questionable	☐ Questionable
☐ Present	☐ Present
☐ Present, axis involved	☐ Present, axis involved

2-2 **Pseudoexfoliation**

Right eye:	Left eye:
☐ Absent	☐ Absent
☐ Questionable	☐ Questionable
☐ Present	☐ Present

2-3 **Pigment dispersion**

Right eye:	Left eye:
☐ Absent	☐ Absent
☐ Questionable	☐ Questionable

☐ Present ☐ Present

2-4 **Other lens abnormalities**

Right eye:	Left eye:
1 _____	1 _____
2 _____	2 _____
3 _____	3 _____
4 _____	4 _____
5 _____	5 _____

3. Cataract assessment

3-1 Was cross sectional crystalline lens photo taken?

☐1 Yes ☐2 No

3-2 If not completed, reason why: _____

3-3 **Lens presence**

Right eye:	Left eye:
☐ Phakic	☐ Phakic
☐ Aphakic, no lens	☐ Aphakic, no lens
☐ Pseudophakic, PC IOL	☐ Pseudophakic, PC IOL
☐ Pseudophakic, AC IOL	☐ Pseudophakic, AC IOL
☐ Posterior capsular opacity	☐ Posterior capsular opacity
☐ Enucleated	☐ Enucleated

3-4 **Nuclear opalescence (NO)** (compared to standard photo in LOCS III)

Right eye:	Left eye:
☐ NO _____ (0.1 - 6.9)	☐ NO _____ (0.1 - 6.9)

3-5 **Cortical cataract (C)** (compared to standard photo in LOCS III)

Right eye:	Left eye:

☐ C _____ (0.1 - 5.9) ☐ C _____ (0.1 - 5.9)

3-6 **Posterior subcapsular cataract (P)** (compared to standard photo in LOCS III)

Right eye: Left eye:

☐ P _____ (0.1 - 5.9) ☐ P _____ (0.1 - 5.9)

****Based on Fundus Photography, perform Fundoscopy if any abnormalities observed****

'I am going to examine the back of your eye. I am going to shine a beam of bright light into your eye and look through a lens, which I will hold up in front of your eye. Please keep looking straight at my ear and blink when you need to.'

4. Diabetic retinopathy assessment

Right Eye	Left Eye
4-1 Microaneurysms ☐ Absent ☐ Questionable ☐ Present	4-6 Microaneurysms ☐ Absent ☐ Questionable ☐ Present
4-2 Haemorrhage ☐ Absent ☐ Questionable ☐ Present	4-7 Haemorrhage ☐ Absent ☐ Questionable ☐ Present
4-3 Cotton wool spots ☐ Absent ☐ Questionable ☐ Present	4-8 Cotton wool spots ☐ Absent ☐ Questionable ☐ Present
4-4 Hard exudates ☐ Absent ☐ Questionable ☐ Present	4-9 Hard exudates ☐ Absent ☐ Questionable ☐ Present
4-5 Neovascularisation ☐ Absent ☐ Questionable ☐ Present If Present, location (e.g. disc): _____	4.10 Neovascularisation ☐ Absent ☐ Questionable ☐ Present If Present, location (e.g. disc): _____

5. Diabetic retinopathy assessment

Right Eye	Left Eye
5-1 Druplets: small drusen ≤63 microns ☐ Absent ☐ Questionable ☐ Present	5-7 Druplets: small drusen ≤63 microns ☐ Absent ☐ Questionable ☐ Present
5-2 Medium drusen: >63 and ≤125 microns ☐ Absent ☐ Questionable ☐ Present	5-8 Medium drusen: >63 and ≤125 microns ☐ Absent ☐ Questionable ☐ Present
5-3 Large drusen: >125 microns	5-9 Large drusen: >125 microns

☐ Absent ☐ Questionable ☐ Present	☐ Absent ☐ Questionable ☐ Present
5-4 AMD pigmentary abnormalities ☐ Absent ☐ Questionable ☐ Present	5-10 AMD pigmentary abnormalities ☐ Absent ☐ Questionable ☐ Present
5-5 Geographic atrophy ☐ Absent ☐ Questionable ☐ Present	5-11 Geographic atrophy ☐ Absent ☐ Questionable ☐ Present
5-6 Neovascular AMD ☐ Absent ☐ Questionable ☐ Present	5-12 Neovascular AMD ☐ Absent ☐ Questionable ☐ Present

6. Other retinal or optic disc abnormalities

Right eye:	Left eye:
1 _____	1 _____
2 _____	2 _____
3 _____	3 _____
4 _____	4 _____

7. Provisional diagnoses / Clinical impression:

Station Four - Hearing Questionnaire

'Hi my name is ____. Thank you for agreeing to participate in the Ear Health Survey. For this Survey, I'll be asking you some questions about your ears and hearing. Once we've completed the questionnaire, I'll check the inside of your ears as well as your hearing. I'll describe each test in more detail when we get to them.'

1. Hearing Loss

1-1 Do you feel you have a hearing loss?

- ☐ 1 Yes
- ☐ 2 No (go to 3-1)
- ☐ 3Don't know
- ☐ 4Missing

1-2 Does it affect your:

- ☐ 1Right
- ☐ 2Left
- ☐ 3Both
- ☐ 4Missing

1-3 How long do you feel you've had a problem with your hearing?

- ☐ 1 Less than 1 year
- ☐ 2 1-5 years
- ☐ 3 5-10 years
- ☐ 4 More than 10 years
- ☐ Missing

1-4 Was the onset of the hearing loss gradual or sudden?

- ☐ 1 Gradual
- ☐ 2 Sudden
- ☐ 3 Don't know
- ☐ 4 Missing

1-5 Do you know what caused it?

- ☐ 1 From birth
- ☐ 2 Accident
- ☐ 3 Noise exposure
- ☐ 4 Disease
- ☐ 5 Age-related
- ☐ 6 Medications/Chemical
- ☐ 7 Hereditary
- ☐ 8 Don't know
- ☐ 9 Missing

1-6 Did you or someone else first notice your hearing loss?

☐ 1Self ☐ 4Friend ☐ 7Unsure

☐ 2Spouse ☐ 5Doctor ☐ 8Missing

☐ 3Relative ☐ 6Other person

1-7 Other details of hearing loss

_____

_____

1-8 Have you sought help or spoken to any professional about your hearing loss?

☐ 1Yes ☐ 3Don't know

☐ 2No ☐ 4Missing

1-9 Which of the following have you contacted? (*multiple responses accepted)*

☐ 1Family doctor ☐ 5Hearing service/ hearing aid provider

☐ 2Audiologist ☐ 6Aboriginal health services (e.g. Aboriginal Medical Services)

☐ 3Self-help group (e.g. BHA, ATA, SHHH) ☐ 7Unsure

☐ 4ENT doctor ☐ 8Missing

1-10 Have you received *treatment or support services for your hearing loss* from any of the following in the past? (*multiple responses accepted)*

☐ 1Family doctor ☐ 5Hearing service/ hearing aid provider

☐ 2Audiologist ☐ 6Aboriginal health services (e.g. Aboriginal Medical Services)

☐ 3Self-help group (e.g. BHA, ATA, 4SHHH) ☐ 7Unsure

☐ 4ENT doctor ☐ 8Missing

1-11 Are you currently being treated or followed by a doctor for any hearing or ear condition?

☐ 1Yes, current ☐ 3No ☐ 5Missing

☐ 2Yes, follow up ☐ 4Unsure

1-12 What is the name of the hearing professional(s) or service(s) you have visited?

1-13 Name 1 .....1-14 How long ago? ..... years

1-15 Name 1 .....1-16How long ago? ..... years

2. HHIE-S (Hearing Handicap Inventory for Elderly - Shortened)

I am going to ask you a series of questions about hearing problems and their effects on your social life.

	1-Yes	***2-Sometimes***	***3-No***	***4-Missing***
2-1 Does a hearing problem cause you to feel embarrassed when you meet new people?	☐	☐	☐	☐
2-2 Does a hearing problem cause you to feel frustrated when talking to members of your family?	☐	☐	☐	☐
2-3 Do you have difficulty hearing when someone speaks in a whisper?	☐	☐	☐	☐

2-4 Do you feel handicapped by a hearing problem?	☐	☐	☐	☐
2-5 Does a hearing problem cause you difficulty when visiting friends, relatives or neighbours?	☐	☐	☐	☐
2-6 Does a hearing problem cause you to attend religious services less often than you would like?	☐	☐	☐	☐
2-7 Does a hearing problem cause you to have arguments with family members?	☐	☐	☐	☐
2-8 Does a hearing problem cause you difficulty when listening to TV or radio?	☐	☐	☐	☐
2-9 Do you feel that any difficulty with your hearing limits or hampers your social life?	☐	☐	☐	☐
2-10 Does a hearing problem cause you difficulty when in a restaurant with relatives or friends?	☐	☐	☐	☐

3. Hearing Devices

3-1 Have you ever had a hearing aid?

☐ 1Yes ☐ 3Unsure

☐ 2No (*Go to Q3-6)* ☐ 4Missing

3-2 Did/do you have a hearing aid for one or both ears?

☐ 1One ☐ 3Unsure

☐ 2Both ☐ 4Missing

3-3 How long have you been using your hearing aid?

☐ 1 Less than 1 year ☐ 5 Don't know

☐ 2 1-5 years ☐ 6 Not using

☐ 3 6-10 years ☐ 7 Missing

☐ 4 More than 10 years

3-4 If you ever had a hearing aid but are not using it, please indicate why.

☐ 1 Uncomfortable ☐ 4 Too embarrassed

☐ 2 Too much maintenance ☐ 5 Other, please specify: _____

☐ 3 Don't want to

3-5 Where did you get your hearing aid(s)?

☐ 1 Hearing Australia ☐ 4 Unsure

☐ 2 Private service provider ☐ 5 Missing

☐ 3 Other: please specify: _____

3-6 Do you have a cochlear implant?

☐ 1 Yes

☐ 2 No (end of questionnaire) ☐ 3 Missing

3-7 Do you have a cochlear implant for one or both ears?

☐ 1 One

☐ 2 Both ☐ 3 Missing

3-8 If you have one cochlear implant, do you have a hearing aid for the other ear?

☐ 1Yes

☐ 2No ☐ 3Missing

3-9 When did you get a cochlear implant?

☐ 1 Less than 1 year ☐ 5 Don't know

☐ 2 1-5 years ☐ 6 Not using

☐ 3 6-10 years ☐ 7 Missing

☐ 4 More than 10 years

3-10 Do you still have your cochlear implant?

☐ 1 Yes ☐ 3 Missing

☐ 2 No, why not?

_____

3-11 Does your cochlear work properly for you?

☐ 1 Yes ☐ 2 No, it is ineffective

4. International Outcome Inventory – Hearing Devices (IOI-HD)

(If answered 'yes' to using a hearing aid and/or cochlear implant)

4-1 Think about how much you used your present hearing device(s) over the past two weeks. On an average day, how many hours did you use the hearing device(s)?

None	Less than 1hr a day	1 to 4hrs a day	4 to 8hrs a day	More than 8hrs a day
☐	☐	☐	☐	☐

4-2 Think about the situation where you most wanted to hear better, before you got your present hearing device(s). Over the past two weeks, how much has the hearing device helped in that situation?

Helped not at all	Helped slightly	Helped moderately	Helped quite a lot	Helped very much
☐	☐	☐	☐	☐

4-3 Think again about the situation where you most wanted to hear better. When you use your present hearing device(s), how much difficulty do you STILL have in that situation?

Very much difficulty	Quite a lot of difficulty	Moderate difficulty	Slight difficulty	No difficulty
☐	☐	☐	☐	☐

4-4 Considering everything, do you think your present hearing device(s) is worth the trouble?

Not at all worth it	Slightly worth it	Moderately worth it	Quite a lot worth it	Very much worth it
☐	☐	☐	☐	☐

4-5 Over the past two weeks, with your present hearing device(s), how much have your hearing difficulties affected the things you can do?

Affected very much	Affected quite a lot	Affected moderately	Affected slightly	Affected not at all
☐	☐	☐	☐	☐

4-6 Over the past two weeks, with your present hearing device(s), how much do you think other people were bothered by your hearing difficulties?

Bothered very much	Bothered quite a lot	Bothered moderately	Bothered slightly	Bothered not at all
☐	☐	☐	☐	☐

4-7 Considering everything, how much has your present hearing device(s) changed your enjoyment of life?

Worse	No change	Slightly better	Quite a lot better	Very much better
☐	☐	☐	☐	☐

5. Video Otoscopy

The first test involves taking a look inside each ear to see if there's any blockage or damage. I will be placing this device into each ear; you will hear a click each time I take a photo (show them the video otoscopy). If at any time you feel any discomfort, please do let me know

5-1 Where the images clear?

☐ Yes, clear images of both ears

☐ Clear image of right ear

☐ Clear image of left ear

☐ Couldn't obtain clear images of both ears

5-2 Results

☐ Normal tympanic membrane

☐ Suspected abnormality in the tympanic membrane

☐ Could not clearly see the tympanic membrane

Attach otoscopy results below:

6. Pure Tone Audiometry

I'm going to place these headphones on your ears and you will hear a "shhh" noise and a series of tones. Ignore the "shushing". Each time you hear a tone, I want you to press the button. The tones will get very soft at times, as if they are far away. I still want you to press the button for the very soft ones. Do you have any questions?

Right Ear	**IP30 Threshold**	**IP30 Masking**	**Left Ear**	**IP30 Threshold**	**IP30 Masking**
1k		40	1K		40
2K		40	2K		40
4K		40	4K		40
8K		40	8K		40
500		40	500		40
250		40	250		40

6-1 Results

☐ No hearing loss detected ☐ Suspected hearing loss detected

Attach audiometry results below:

7. Sound Level Meter

7-1 LaEq ……. _____

7-2 Laf90 …….. _____

7-3 LafMax ……. _____

8. Tymponometry (Optional – time dependent)

I'm going to put this probe in your right ear and then your left, you will hear a noise and get a little bit of pressure, try to stay still and quiet for the test.

Right Ear

8-1 Peak Compliance (Pk) ……. _____

8-2 Gradient (Gr) ……..…….. _____

8-3 Pressure (daPa) …….. _____

8-4 Volume (ECV) …….. _____

8-5 Acoustic Reflex ☐ Present ☐ Absent

8-6 Type:

☐ Type A (Normal Range) ☐ Type Ad (Normal Range)

☐ Type As (Otitis media, otosclerosis or normal) ☐ Type B (Abnormal)

☐ Type C (Abnormal)

Left Ear

8-6 Peak Compliance (Pk) ……. _____

8-7 Gradient (Gr) ……..…….. _____

8-8 Pressure (daPa) …….. _____

8-9 Volume (ECV) …….. _____

8-10 Acoustic Reflex ☐ Present ☐ Absent

8-11 Type:

☐ Type A (Normal Range) ☐ Type Ad (Normal Range)

☐ Type As (Otitis media, otosclerosis or normal) ☐ Type B (Abnormal)

☐ Type C (Abnormal)

8-12 Results

☐ Normal Tympanometry reading

☐ Abnormal Tympanometry reading

Australian Eye and Ear Health Survey

Take-home Questionnaire Booklet

Study ID number: _____

Name: _____

COMPLETION DATE: ☐☐/☐☐/☐☐☐☐

Please return using paid reply envelope provided, within ONE month of your appointment date. If you require assistance to complete this questionnaire, please contact ***0408 910 966***

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1. **Visual Function Questionnaire**

Part 1 - General Vision

1.1. At the present time, how would you describe your eyesight? (both eyes open, and with glasses if worn)

- ☐1 Excellent
- ☐2 Good
- ☐3 Fair
- ☐4 Poor
- ☐5 Very Poor
- ☐6 Completely blind

1.2. How much of the time do you worry about your eyesight?

- ☐1 None of the time
- ☐2 A little of the time
- ☐3 Some of the time
- ☐4 Most of the time
- ☐5 All of the time

1.3. How much pain or discomfort have you had in and around your eyes (for example, burning, itching or aching)? Would you say it is:

- ☐1 None of the time
- ☐2 A little of the time
- ☐3 Some of the time
- ☐4 Most of the time
- ☐5 All of the time

Part 2 - Difficulty with Activities

1.4. How much difficulty do you have, even with glasses, reading common printed forms e.g. applications, newspapers? Would you say you have:

- ☐1 No difficulty at all
- ☐2 A little difficulty
- ☐3 Moderate difficulty
- ☐4 Extreme difficulty
- ☐5 Stopped doing this because of your eyesight
- ☐6 Stopped doing this for other reasons or not interested in doing this

1.5. How much difficulty do you have, even with glasses, doing work or hobbies that require you to see well up close, such as cooking, sewing, fixing things around the house, or using hand tools? Would you say:

- ☐1 No difficulty at all
- ☐2 A little difficulty
- ☐3 Moderate difficulty
- ☐4 Extreme difficulty
- ☐5 Stopped doing this because of your eyesight
- ☐6 Stopped doing this for other reasons or not interested in doing this

1.6. Because of your eyesight, even with glasses, how much difficulty do you have finding something on a crowded shelf?

☐1 No difficulty at all
☐2 A little difficulty
☐3 Moderate difficulty
☐4 Extreme difficulty
☐5 Stopped doing this because of your eyesight
☐6 Stopped doing this for other reasons or not interested in doing this

1.7. How much difficulty do you have, even with glasses, reading street signs or the names of shops?

☐1 No difficulty at all
☐2 A little difficulty
☐3 Moderate difficulty
☐4 Extreme difficulty
☐5 Stopped doing this because of your eyesight
☐6 Stopped doing this for other reasons or not interested in doing this

1.8. Because of your eyesight, even with glasses, how much difficulty do you have going down steps, stairs, or curbs in dim light or at night?

☐1 No difficulty at all
☐2 A little difficulty
☐3 Moderate difficulty
☐4 Extreme difficulty
☐5 Stopped doing this because of your eyesight
☐6 Stopped doing this for other reasons or not interested in doing this

1.9. Because of your eyesight, even with glasses, how much difficulty do you have noticing objects off to the side while you are walking along?

☐1 No difficulty at all
☐2 A little difficulty
☐3 Moderate difficulty
☐4 Extreme difficulty
☐5 Stopped doing this because of your eyesight
☐6 Stopped doing this for other reasons or not interested in doing this

1.10. Because of your eyesight, even with glasses, how much difficulty do you have seeing how people react to things you say?

☐1 No difficulty at all
☐2 A little difficulty
☐3 Moderate difficulty
☐4 Extreme difficulty
☐5 Stopped doing this because of your eyesight
☐6 Stopped doing this for other reasons or not interested in doing this

1.11. Because of your eyesight, even with glasses, how much difficulty do you have picking out and matching your clothes?

☐1 No difficulty at all
☐2 A little difficulty
☐3 Moderate difficulty
☐4 Extreme difficulty
☐5 Stopped doing this because of your eyesight
☐6 Stopped doing this for other reasons or not interested in doing this

1.12. Because of your eyesight, even with glasses, how much difficulty do you have visiting people in their homes, at parties, or in restaurants?

☐1 No difficulty at all
☐2 A little difficulty
☐3 Moderate difficulty
☐4 Extreme difficulty
☐5 Stopped doing this because of your eyesight
☐6 Stopped doing this for other reasons or not interested in doing this

1.13. Because of your eyesight, even with glasses, how much difficulty do you have going out to see movies, plays, or sports events?

☐1 No difficulty at all
☐2 A little difficulty
☐3 Moderate difficulty
☐4 Extreme difficulty
☐5 Stopped doing this because of your eyesight
☐6 Stopped doing this for other reasons or not interested in doing this

1.14. How much difficulty do you have, even with glasses, reading a large-print book or large print-newspaper or numbers on a telephone?

☐1 No difficulty at all
☐2 A little difficulty
☐3 Moderate difficulty
☐4 Extreme difficulty
☐5 Stopped doing this because of your eyesight
☐6 Stopped doing this for other reasons or not interested in doing this

1.15. How much difficulty do you have, even with glasses, recognising people when they are close to you?

☐1 No difficulty at all
☐2 A little difficulty
☐3 Moderate difficulty
☐4 Extreme difficulty
☐5 Stopped doing this because of your eyesight
☐6 Stopped doing this for other reasons or not interested in doing this

1.16. How much difficulty do you have, even with glasses, writing out cheques or filling out forms?

☐1 No difficulty at all
☐2 A little difficulty
☐3 Moderate difficulty
☐4 Extreme difficulty
☐5 Stopped doing this because of your eyesight
☐6 Stopped doing this for other reasons or not interested in doing this

1.17. How much difficulty do you have, even with glasses, watching television?

☐1 No difficulty at all
☐2 A little difficulty
☐3 Moderate difficulty
☐4 Extreme difficulty
☐5 Stopped doing this because of your eyesight
☐6 Stopped doing this for other reasons or not interested in doing this

1.18. Are you currently driving, at least once in a while?

☐1 Yes **Go to Q1.22**
☐2 No

1.19. If No: Have you never driven a car or have you given up driving?

☐1 Never drove **Go to Q1.32**
☐2 Gave up

1.20. How many years ago did you give up driving? _____ years ago

1.21. Did you give up mainly because of your eyesight, mainly for some other reasons, or because of both your eyesight and other reasons?

☐1 Mainly eyesight **Go to Q1.32**
☐2 Mainly other reasons **Go to Q1.32**
☐3 Both eyesight and other reasons **Go to Q1.32**

1.22. Do you intend to give up driving in the next 12 months?

☐1 Yes
☐2 No **Go to Q1.24**

1.23. Why do you intend to give up driving?

☐1 Mainly eyesight
☐2 Mainly other reasons
☐3 Both eyesight and other reasons

1.24. What type of licence do you have?

☐1 Unconditional
☐2 Conditional, please specify what conditions: _____

1.25. How much difficulty do you have driving during the daytime in familiar places? Would you say you have:

☐1 No difficulty at all
☐2 A little difficulty
☐3 Moderate difficulty
☐4 Extreme difficulty

1.26. How much difficulty do you have driving at night? Would you say you have:

☐1 No difficulty at all
☐2 A little difficulty
☐3 Moderate difficulty
☐4 Extreme difficulty
☐5 Stopped doing this because of your eyesight
☐6 Stopped doing this for other reasons or not interested in doing this

1.26.1. How much difficulty do you have driving in difficult conditions, such as in bad weather, during rush hour, on the freeway, or in city traffic? Would you say you have:

☐1 No difficulty at all
☐2 A little difficulty
☐3 Moderate difficulty
☐4 Extreme difficulty
☐5 Stopped doing this because of your eyesight
☐6 Stopped doing this for other reasons or not interested in doing this

1.26.2. If you have any difficulty driving, have you made any changes? *(multiple responses accepted)*

☐1 Driving less, please specify: _____ times/ week
☐2 Driving slower
☐3 Driving shorter distances
☐4 Other, please specify: _____

1.27. Do you think your driving ability now is as good as it used to be?

☐1 Yes **Go to Q1.29**
☐2 No

1.28. If No, do you think this might be related to your vision?

☐1 Yes
☐2 No

1.29. Have you had any car accidents in the last 12 months?

☐1 Yes
☐2 No **Go to Q1.32**

If Yes:

1.30. How many car accidents have you had? _____

1.31. Do you think your vision was a cause of a car accident?

☐1 Yes
☐2 No

Part 3 – Vision Problems

The next questions are about things affecting your vision. For each one, please tick the number to indicate whether the statement is true for you all, most, some, a little, or none of the time.

	All of the time	**Most of the time**	**Some of the time**	**A little of the time**	**None of the time**
1.32. Do you accomplish less than you would like because of your vision	☐1	☐2	☐3	☐4	☐5
1.33. Are you limited in how long you can work or do other activities because of your vision?	☐1	☐2	☐3	☐4	☐5
1.34. Does pain or discomfort in or around your eyes, for example, burning, itching, or aching, keep you from doing what you'd like to be doing? Would you say:	☐1	☐2	☐3	☐4	☐5

For each of the following statements, please tick the number to indicate whether for you the statement is definitely true, mostly true, mostly false, or definitely false for you or you are not sure.

	Definitely true	Mostly true	Not sure	Mostly false	Definitely false
1.35. I stay home most of the time because of my eyesight	☐1	☐2	☐3	☐4	☐5
1.36. I feel frustrated a lot of the time because of my eyesight	☐1	☐2	☐3	☐4	☐5
1.37. I have much less control over what I do, because of my eyesight	☐1	☐2	☐3	☐4	☐5
1.38. Because of my eyesight, I have to rely too much on what other people tell me	☐1	☐2	☐3	☐4	☐5
1.39. I need a lot of help from others because of my eyesight	☐1	☐2	☐3	☐4	☐5
1.40. I worry about doing things that will embarrass myself or others, because of my eyesight	☐1	☐2	☐3	☐4	☐5

2. Dry Eye

2.1. Have you ever been told you have dry eyes?

☐1 Yes
☐2 No

2.2. If yes, in which eye?

☐1 Right eye ☐2 Left eye ☐3 Both eyes

For Q2.3-14, circle a number from 4 (Constantly) to 0 (Never), based on how accurately it reflects your condition in the given time period.

	Constantly	Mostly	Often	Sometimes	Never
Have you experienced any of the following *during the last week?* *(Circle one)*					
2.3. Eyes that are sensitive to light?	4	3	2	1	0
2.4. Eyes that feel gritty?	4	3	2	1	0
2.5. Painful or sore eyes?	4	3	2	1	0
2.6. Blurred vision?	4	3	2	1	0
2.7. Poor vision?	4	3	2	1	0

Have problems with your eyes limited you in performing any of the following *during the last month?* *(Circle one)*					
2.8. Reading?	4	3	2	1	0
2.9. Driving at night?	4	3	2	1	0
2.10. Working with a computer or bank machine (ATM)?	4	3	2	1	0
2.11. Watching TV?	4	3	2	1	0
Have your eyes felt uncomfortable in any of the following situations *during the last week?* *(Circle one)*					
2.12. Windy conditions?	4	3	2	1	0
2.13. Places or areas with low humidity (very dry)?	4	3	2	1	0
2.14. Areas that are air conditioned?	4	3	2	1	0

3. **Ear infections (Otitis Media) and other ear conditions**

3.1. Have you had a head cold or sinus infection during the last seven days?
- ☐ Yes
- ☐ No
- ☐ Don't know

3.2. Have you ever had an ear infection?
- ☐ Yes
- ☐ No **Go to Q3.8**
- ☐ Don't know **Go to Q3.8**

3.3. Did you have any ear infections as a child (aged < 18 years)?
- ☐ Yes
- ☐ No **Go to Q3.5**
- ☐ Don't know **Go to Q3.5**

3.4. Have you ever received any treatment for your childhood ear infection/s?
- ☐ Yes
- ☐ No
- ☐ Don't know

3.5. Have you had any ear infections in the last 5 years?
- ☐ Yes
- ☐ No **Go to Q3.8**

3.6. In the last 5 years, how often did you have ear infections as an adult?
- ☐ Once
- ☐ At least once a year
- ☐ Two-three times a year
- ☐ Once every few years
- ☐ Other, please specify: _____
- ☐ Don't know

3.7. Have you received any treatment for your adult ear infection/s?
- ☐ Yes
- ☐ No
- ☐ Don't know

3.8. In the last 5 years, has a doctor told you that you had a middle ear condition?

- ☐ Yes
- ☐ No
- ☐ Don't know

3.9. Have you had a discharge (other than wax) from either ear in the last year?

- ☐ Yes, right ear
- ☐ Yes, left ear
- ☐ Yes, both ears
- ☐ No
- ☐ Don't know

4. Ear surgery, general health

4.1. Have you ever had surgery to your ears?

- ☐ Yes
- ☐ No **Go to Q5.1**

4.2. Which ear had the surgery?

- ☐ Right ear
- ☐ Left ear
- ☐ Both ears
- ☐ Don't know

4.3. What surgery was performed on your right ear? *multiple responses accepted*

- ☐ Mastoidectomy
- ☐ Stapedectomy
- ☐ Tympanoplasty
- ☐ Tubes (Grommets) inserted
- ☐ Other, please specify: _____
- ☐ Don't know

4.4. What surgery was performed on your left ear? *multiple responses accepted*

- ☐ Mastoidectomy
- ☐ Stapedectomy
- ☐ Tympanoplasty
- ☐ Tubes (Grommets) inserted
- ☐ Other, please specify: _____
- ☐ Don't know

5. Noise exposure

5.1. Have you ever worked with noisy farm equipment?

- ☐ Yes
- ☐ No **Go to Q7.6**

5.2. Over how long a period did you work with noisy farm equipment?

- ☐ Less than 1 year
- ☐ 1-5 years
- ☐ 5 to 10 years
- ☐ More than 10 years
- ☐ Don't know

5.3. Details: _____

5.4. How would you describe the noise level from farm equipment that you were exposed to on an average day?

- ☐ Mostly quiet
- ☐ Tolerable but able to hear speech
- ☐ Unable to hear anyone speaking
- ☐ Don't know

5.5. When working with noisy farm equipment, how often would you wear hearing protection?

- ☐ Always
- ☐ Rarely
- ☐ Don't know
- ☐ Never

☐ Sometimes

5.6. Have you ever worked in other noisy industries and/or workplace?

☐ Yes
☐ No **Go to Q5.11**

5.7. Over what period have you been in jobs or industries with significant noise exposure?

☐ Less than 1 year
☐ 1-5 years
☐ 5 to 10 years
☐ More than 10 years
☐ Don't know

5.8. Details: _____

5.9. How would you describe the noise level you were exposed to on an average day?

☐ Mostly quiet
☐ Tolerable but able to hear speech
☐ Unable to hear anyone speaking
☐ Don't know

5.10. On average, at these times of noise exposure, how often would you wear hearing protection?

☐ Always
☐ Rarely
☐ Sometimes
☐ Don't know
☐ Never

Have you done any of the following types of work or activities on a regular basis?			
5.11. Musician or played an instrument	☐ Yes	☐ No	☐ Unsure
5.12. Woodworking	☐ Yes	☐ No	☐ Unsure
5.13. Carpentry	☐ Yes	☐ No	☐ Unsure
5.14. Sheet metalwork	☐ Yes	☐ No	☐ Unsure
5.15. Chain sawing	☐ Yes	☐ No	☐ Unsure
5.16. Used power tools	☐ Yes	☐ No	☐ Unsure
5.17. Listened to a personal audio device (e.g., mobile phone) through headphones/earbuds at a volume loud enough that you need to raise your voice	☐ Yes	☐ No	☐ Unsure
5.18. Attended rock concerts or bands regularly	☐ Yes	☐ No	☐ Unsure

6. Health Outcomes – EuroQOL Group EQ-5D-5L

By placing a tick in one box in each group below, select which statement best describes your own health state today.

6.1. Mobility

☐1 I have no problems in walking about
☐2 I have slight problems in walking about
☐3 I have moderate problems in walking about
☐4 I have severe problems in walking about
☐5 I am unable to walk about

6.2. Self-Care

☐1 I have no problems washing or dressing myself
☐2 I have slight problems washing or dressing myself
☐3 I have moderate problems washing or dressing myself
☐4 I have severe problems washing or dressing myself
☐5 I am unable to wash or dress myself

6.3. Usual Activities *(e.g. work, study, housework, family or leisure activities)*

☐1 I have no problems doing my usual activities
☐2 I have slight problems doing my usual activities
☐3 I have moderate problems doing my usual activities
☐4 I have severe problems doing my usual activities
☐5 I am unable to do my usual activities

6.4. Pain

☐1 I have no pain or discomfort
☐2 I have slight pain or discomfort
☐3 I have moderate pain or discomfort
☐4 I have severe pain or discomfort
☐5 I have extreme pain or discomfort

6.5. Anxiety / Depression

☐1 I am not anxious or depressed
☐2 I am slightly anxious or depressed
☐3 I am moderately anxious or depressed
☐4 I am severely anxious or depressed
☐5 I am extremely anxious or depressed

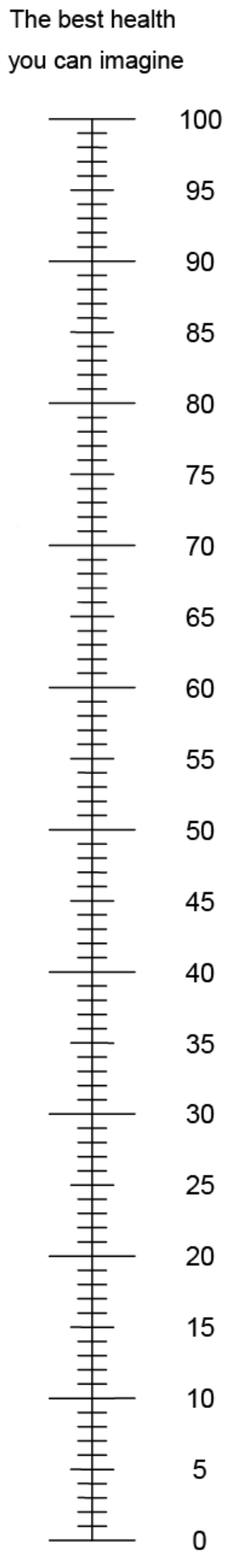
Health Outcomes – EQ-5D Visual Analogue Scale

6.6. We would like to know how good or bad your health is <u>today</u>.

This scale is numbered from 0 to 100.
100 means the **best** health you can imagine.
0 means the **worst** health you can imagine.

Mark an X on the scale to indicate how your health is <u>today</u>.
Please write the number you marked on the scale in the box below.

Your health <u>today</u> = _____



7. Food Frequency Questionnaire

WE WOULD LIKE TO ASK YOU WHICH FOODS YOU EAT, AND HOW MUCH YOU EAT OF EACH.

On the next page you will see a list of foods with an amount written next to each food. For each food we would like you to indicate with a tick **how often**, on average, you have eaten the **given amount over the last twelve months**. This may vary from never to four or more times as much as the given amount per day.

To help get you started, here is an example of what we mean.

EXAMPLE 1: How often do you eat 1/2 cup of green beans?

Example: If you eat 1/2 cup of green beans every 2 weeks, on average, you would place a tick in the **1-3 per month** column, like this:

		Number of serves consumed over last 12 months								
		Never	Less than 1 per month	1-3 per month	1 per week	2-4 per week	5-6 per week	1 per day	2-3 per day	4+ per day
Green Beans	1/2 cup			✓						

If you eat 1 cup of green beans a **week**, on average, this is the same as eating 1/2 cup of green beans 2 times a week, so you would place a tick in the **2-4 per week** column, like this:

Green Beans	1/2 cup					✓				

Now, please look at the list of foods below. For **each** food listed indicate with a tick how often, on average, you have eaten this food, in the given amount, during the past year. Please try to think carefully about **each** food and **try not to leave any blank lines.**

	Number of times used this amount over last 12 months								
7.1. DAIRY FOODS **Foods** **Amount**	**Never**	**Less than 1 per month**	**1-3 per month**	**1 per week**	**2-4 per week**	**5-6 per week**	**1 per day**	**2-3 per day**	**4+ per day**
1. Milk **250 ml (8oz.) glass** 2. Please circle usual type: *full cream* or *lite* or *skim*									
3. Nut milk e.g. soy, almond **250 ml (8oz.) glass** 4. Please specify usual type: _____									
5. Cream e.g. thickened, pouring **1tblsp.**									
6. Ice cream **½ cup** 7. Please circle usual type: *regular fat* or *reduced fat or sorbet*									
8. Yoghurt, flavoured/plain **1 small carton** 9. Please circle usual type: *regular fat* or *low fat*									
10. Custard **1 small carton**									
11. Cottage or ricotta cheese **½ cup**									
12. Other cheese, e.g. cheddar **1 slice** 13. Please circle usual type: *regular fat* or *reduced fat*									

		Number of times used this amount over last 12 months								
7.1. DAIRY FOODS (continued) **Foods**	**Amount**	**Never**	**Less than 1 per month**	**1-3 per month**	**1 per week**	**2-4 per week**	**5-6 per week**	**1 per day**	**2-3 per day**	**4+ per day**
14. Margarine, added to food or bread: Exclude use in cooking	**1 teasp.**									
15. Butter, added to food or bread: Exclude use in cooking	**1 teasp.**									

16-18. What form of margarine do you use <u>most often</u> for spreading on bread, adding to vegetables etc? (Exclude use in cooking)

☐ Olive oil spread *e.g. Olive Grove, Bertolli*
☐ Mono/poly-unsaturated spread, regular fat *e.g. MeadowLea, Flora*
☐ Mono/poly-unsaturated spread, reduced fat/ light
☐ Coconut oil spread *e.g. Nuttelex Coconut Oil Spread*
☐ Cholesterol-lowering spread *e.g. Flora Pro-activ*
☐ Do not use margarine
☐ Other, please specify: _____

What brand do you use most often? _____

19. What form of butter do you use <u>most often</u> for spreading on bread, adding to vegetables etc? (Exclude use in cooking)

☐ Ordinary butter
☐ Reduced fat butter
☐ Dairy blend
☐ Do not use butter

20. Do you usually add butter or margarine to your cooked vegetables before you eat them?

☐ Yes
☐ No

	Number of times used this amount over last 12 months								
7.2. SEASONAL FRUITS **Foods** **Amount**	**Never**	**Less than 1 per month**	**1-3 per month**	**1 per week**	**2-4 per week**	**5-6 per week**	**1 per day**	**2-3 per day**	**4+ per day**
1. Fresh stone fruit e.g. peaches, apricots 1									
2. Fresh grapes small bunch (about 20)									
3. Fresh berries 1/2 cup									
4. Fresh cantaloupe or rockmelon 1/4 melon									
5. Fresh mangoes 1									
6. Fresh paw-paw 1 slice									
7. Fresh pineapple 1 slice									
8. Watermelon 1 slice									
9. Avocado 1/2 avocado									
10. Fresh apple or pear 1									
11. Fresh citrus fruit e.g. 1 orange or 2 mandarins									
12. Fresh grapefruit 1/2									
13. Fresh banana 1									

		Number of times used this amount over last 12 months								
7.3. DRIED AND TINNED FRUITS **Foods**	**Amount**	**Never**	**Less than 1 per month**	**1-3 per month**	**1 per week**	**2-4 per week**	**5-6 per week**	**1 per day**	**2-3 per day**	**4+ per day**
1. Prunes	**½ cup**									
2. Dried apricots or peaches	**4-5 halves**									
3. Other dried fruits	**1 tblsp.**									
4. Canned apricots or peaches	**1/2 cup**									
5. Other canned fruit	**1/2 cup**									

		Number of times used this amount over last 12 months								
7.4. VEGETABLES **Foods**	**Amount**	**Never**	**Less than 1 per month**	**1-3 per month**	**1 per week**	**2-4 per week**	**5-6 per week**	**1 per day**	**2-3 per day**	**4+ per day**
1. Broccoli	**½ cup**									
2. Cauliflower	**½ cup**									
3. Spinach, Silverbeet, cooked	**½ cup**									
4. Spring onions, shallots	**1 medium**									
5. Potato, boiled or mashed	**1 medium or ½ cup**									
6. Potato, baked	**1 medium**									
7. Hot chips	**1 cup**									
8. Pumpkin, boiled or mashed	**1 med. piece, ½ cup**									
9. Pumpkin, baked	**1 medium piece, ½ cup**									
10. Sweet potato	**½ cup**									
11. Peas	**½ cup**									
12. Green beans	**½ cup**									
13. Cabbage	**½ cup**									
14. Brussel sprouts	**3-5 fresh or frozen**									

		Number of times used this amount over last 12 months								
7.4. VEGETABLES (continued) **Foods**	**Amount**	**Never**	**Less than 1 per month**	**1-3 per month**	**1 per week**	**2-4 per week**	**5-6 per week**	**1 per day**	**2-3 per day**	**4+ per day**
15. Carrots	**1 med. whole or ½ cup cooked**									
16. Sweet corn	**1 cob or ½ cup**									
17. Eggplant, zucchini or squash	**½ cup**									
18. Mushrooms	**6-7 small**									
19. Tomatoes	**1 medium**									
20. Lettuce	**2 medium leaves**									
21. Coleslaw	**½ cup**									
22. Celery	**10cm (4 inch) stick**									
23. Baked beans	**½ cup**									
24. Legumes or pulses e.g. chickpeas, lentils, kidney beans	**½ cup**									

		Number of times used this amount over last 12 months								
7.5. MEATS, FISH & EGGS **Foods**	**Amount**	**Never**	**Less than 1 per month**	**1-3 per month**	**1 per week**	**2-4 per week**	**5-6 per week**	**1 per day**	**2-3 per day**	**4+ per day**
1. Beef, pork or lamb as main dish e.g. steak, roast	**1 small t-bone or 3 slices**									
2. Beef, pork or lamb mixed dish e.g. stew, casserole	**½ cup**									
3. Ham, beef, pork or lamb in sandwich	**1 slice**									
4. Chicken with skin	**1 drumstick or 2 slices**									
5. Chicken without skin	**1 drumstick or 2 slices**									
6. Sausages	**2 thick or 3 thin**									
7. Hamburger patty or rissole	**1**									
8. Mince in sauce e.g. spaghetti sauce	**1 cup**									
9. Other mince dishes	**1 cup**									
10. Bacon	**2 slices**									
11. Liver	**100g (4oz.)**									
12. Meat pie	**1**									

Q.7		Number of times used this amount over last 12 months								
7.5. MEATS, FISH & EGGS (continued) **Foods**	**Amount**	**Never**	**Less than 1 per month**	**1-3 per month**	**1 per week**	**2-4 per week**	**5-6 per week**	**1 per day**	**2-3 per day**	**4+ per day**
13. Processed meats e.g. Devon, Chicken roll	**1 piece or slice**									
14. Frankfurt, saveloy	**1 large or 3 small**									
15. Boiled or poached egg	**1**									
16. Fried egg	**1**									
17. Scrambled egg or omelette	**1**									
18. Tuna canned in oil	**½ cup**									
19. Tuna, salmon canned in water	**½ cup**									
20. Sardines	**½ cup**									
21. Fatty fish e.g. salmon, trout	**1 small fillet**									
22. Other fish e.g. hoki, flathead	**1 small fillet**									
23. Other seafood e.g. prawns, crabs scallops as a main dish	**½ cup**									
24. Tofu	**½ cup**									

		Number of times used this amount over last 12 months								
7.6. BREAD, CEREALS, STARCHES **Foods**	**Amount**	**Never**	**Less than 1 per month**	**1-3 per month**	**1 per week**	**2-4 per week**	**5-6 per week**	**1 per day**	**2-3 per day**	**4+ per day**
1. Cold breakfast cereal	**1 cup**									
2. Cooked oats	**1 cup**									
3. White bread	**1 slice**									
4. Wholemeal/grain/rye/sourdough bread	**1 slice**									
5. White flatbread/wraps	**1 wrap**									
6. Wholegrain flatbread/wraps	**1 wrap**									
7. Scone, crumpet, pancake	**1**									
8. Pasta e.g. spaghetti	**1 cup (cooked)**									
9. White rice	**1 cup (cooked)**									
10. Brown rice	**1 cup (cooked)**									
11. Other grains e.g. quinoa	**1 cup (cooked)**									
12. Crispbread, cracker e.g. Vitawheat, SAO	**1**									

13. What type of breakfast cereal do you use most often (e.g. Toasted Muesli, Corn Flakes): _____

14. Please specify type(s) and brand(s): (e.g. Uncle Toby's, Kellogg's) : _____

		Number of times used this amount over last 12 months								
7.7. BEVERAGES **Foods**	**Amount**	**Never**	**Less than 1 per month**	**1-3 per month**	**1 per week**	**2-4 per week**	**5-6 per week**	**1 per day**	**2-3 per day**	**4+ per day**
1. Orange/ tropical juice	**1 small glass**									
2. Apple juice	**1 small glass**									
3. Other juice e.g. prune, cranberry	**1 small glass**									
4. Diet or 'No Sugar' soft drink	**1 can**									
5. Regular soft drink	**1 can**									
6. Cordial	**1 glass**									
7. Coffee	**1 cup**									
8. Black tea	**1 cup**									
9. Green tea	**1 cup**									
10. Herbal tea e.g. camomile, peppermint	**1 cup**									
11. Water	**1 cup**									
12. Coconut water	**1 cup**									

		Number of times used this amount over last 12 months								
7.8. BEVERAGES WITH ALCOHOL **Foods**	**Amount**	**Never**	**Less than 1 per month**	**1-3 per month**	**1 per week**	**2-4 per week**	**5-6 per week**	**1 per day**	**2-3 per day**	**4+ per day**
1. Beer (ordinary or heavy)	**1 stubbie/can, 375ml**									
2. Beer (low alcohol)	**1 stubbie/can, 375ml**									
3. Red Wine	**1 wine glass, 150ml**									
4. White Wine or Champagne	**1 wine glass, 150ml**									
5. Sherry or Port	**1/2 wine glass, 75ml**									
6. Spirits (e.g. whiskey, gin)	**1 drink or nip, 30ml**									

		Number of times used this amount over last 12 months								
7.9. SWEETS, BAKED GOODS & SNACKS **Foods**	**Amount**	**Never**	**Less than 1 per month**	**1-3 per month**	**1 per week**	**2-4 per week**	**5-6 per week**	**1 per day**	**2-3 per day**	**4+ per day**
1. Cake (slice, muffin)	**1 slice**									
2. Tart or pie	**1 slice**									
3. Sweet roll, bun e.g hot cross bun	**1**									
4. Plain sweet biscuits e.g. Milk Arrowroot	**1**									
5. Fancy biscuits e.g. cream or coated biscuit	**1**									
6. Chocolate	**1**									
7. Lollies	**3-5**									
8. Jam, marmalade, syrup or honey	**1 tblsp.**									
9. Nut butter e.g. peanut	**1 tblsp.**									
10. Vegemite or Marmite	**1 teasp.**									
11. Nuts	**1 matchbox/ 30g**									
12. Seeds	**1 tblsp.**									
13. Potato crisps, corn chips etc	**1 small bag**									
14. Muesli bars	**1**									

		Number of times used this amount over last 12 months								
7.9. SWEETS, BAKED GOODS & SNACKS (cont.) **Foods**	**Amount**	**Never**	**Less than 1 per month**	**1-3 per month**	**1 per week**	**2-4 per week**	**5-6 per week**	**1 per day**	**2-3 per day**	**4+ per day**
15. Pizza	**2 slices**									
16. Olives/gherkins/pickled vegs	**1/3 cup**									
17. Oil-based dressing e.g. French dressing	**1 tblsp.**									
18. Creamy dressing e.g. Mayonnaise	**1 tblsp.**									

7.10. UNLISTED FOODS: Are there any other foods not listed above that you usually eat at least once per week?

Other foods that you usually use at least once per week	**Usual serving size**	**Average consumption per week**
(a)		
(b)		
(c)		

7.11. OTHER FOODS

1. **How many teaspoons of sugar altogether do you add to your food and drink each day? (include sugar added to your tea, coffee, cereal, fruit etc.)**

   Total: _____ teaspoons

2. What do you do with the visible fat on your meat?

☐ Eat most of it
☐ Eat some of it
☐ Eat as little as possible
☐ Don't eat meat

3. What type of oil is used <u>most often</u> in your home? (e.g. Cobram Estate Extra Virgin Olive Oil, ProChef Coconut Oil Spray, Alpha One Rice Bran Oil)

Please specify type and brand: _____

4. How often do you use oil in food preparation (e.g. in salad, on bread)?

☐ Less than once per week
☐ 1-3 times per week
☐ 4-6 times per week
☐ Daily
☐ 2+ times per day
☐ Never

5-6. What kind of fat is used <u>most often</u> in your home for cooking or roasting meat or vegetables?

☐ Butter
☐ Margarine
☐ Canola oil
☐ Olive oil
☐ Other oil e.g. rice bran oil, peanut oil
Please specify: _____
☐ None

7. How often do you eat food that is fried at home? (Include any foods cooked in a pan or on a hot plate e.g. pan frying or dry frying)

☐ Less than once per week
☐ 1-3 times per week
☐ 4-6 times per week
☐ Daily
☐ 2+ times per day
☐ Never

8. How often do you eat take-away that is fried food e.g. hot chips, fried chicken?

☐ Less than once a week
☐ 1-3 times per week
☐ 4-6 times per week
☐ Daily
☐ 2+ times per day
☐ Never

9. Do you add salt to cooking or at the table?

☐ Yes
☐ No

10. If Yes, do you used iodised salt?

☐ Yes
☐ No

Thank you very much for your help

We know that completing this questionnaire has required a lot of your valuable time and effort.

We greatly appreciate your contribution to this Australian Eye and Ear Health Survey.

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