Continuing Medical Education:

Prevalence and associations of presenting near-vision impairment in the Australian National Eye Health Survey

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Learning Objectives

Upon completion of this activity, participants will be able to:

1. Describe the prevalence and associations of near vision impairment (NVI) in Indigenous Australians, based on an analysis from the population-based National Eye Health Survey.
2. Discuss the prevalence and associations of NVI in non-Indigenous Australians.
3. Determine the clinical and public health implications regarding the prevalence and associations of NVI in Indigenous and non-Indigenous Australians.

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Prevalence and associations of presenting near-vision impairment in the Australian National Eye Health Survey

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Abstract

Purpose To describe the prevalence and associations of presenting near vision impairment (NVI) in Indigenous and non-Indigenous Australians.

Methods A sample of 3098 non-Indigenous Australians (aged 50–98 years) and 1738 Indigenous Australians (aged 40–92 years) living in 30 randomly selected Australian sites were examined as part of the population-based National Eye Health Survey (NEHS). Binocular presenting NVI was defined as near vision worse than N8 (20/50). **Results** In total, 4817 participants (99.6% of the total sample, comprising 3084 non-Indigenous Australians and 1733 Indigenous Australians) had complete data on near visual acuity. The overall weighted prevalence of presenting NVI was 21.6% (95% CI: 19.6, 23.8) in non-Indigenous Australians and 34.7% (95% CI: 29.2, 40.8) among Indigenous Australians. In the non-Indigenous population, higher odds of presenting NVI were associated with older age (OR = 1.68 per 10 years, $P < 0.001$), fewer years of education (OR = 0.95 per year, $P < 0.001$) and residing in Remote geographical areas (OR = 1.71, $P = 0.003$) after multivariate adjustments. Among Indigenous Australians, older age (OR = 1.69 per 10 years, $P < 0.001$), fewer years of education (OR = 0.91 per year, $P = 0.003$) and residing in Inner Regional (OR = 2.01, $P = 0.008$), Outer Regional (OR = 2.17, $P < 0.001$) and Remote geographical areas (OR = 1.72, $P = 0.03$) were associated with greater odds of presenting NVI.

Conclusions NVI represents a notable public health concern in Australia, affecting approximately 20% of non-Indigenous

Australian and one-third of Indigenous Australian adults.

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Introduction

Near vision impairment (NVI) is an important public health problem in our aging society. The prevalence of NVI increases substantially with age, with the majority of cases attributed to presbyopia. NVI significantly impacts on quality of life (QoL),^{1–3} and poses a considerable financial burden with an estimated global productivity loss of over \$25 billion.⁴ Currently, there is a paucity of reliable data on the prevalence of NVI from population-based surveys conducted in Australia. As the majority of NVI is readily treatable with spectacle correction, this data is useful to quantify Australia's burden of NVI and inform targeted resource allocation.

Until recently, very few countries had estimated the prevalence NVI, with the majority focusing solely on distance visual impairment and its causes. To date, the most robust epidemiological data can be derived from He and co-workers (2014)⁵ who assessed the prevalence of NVI ($\leq 20/40$) across multiple countries, including China, India, Nepal, Niger, South Africa and the United States. The prevalence of best-corrected NVI was reported to range from 10% in urban China to 23% in urban India. More recently, the National Health and Nutrition Survey (NHANS) conducted in the United States reported the prevalence of presenting NVI ($< 20/40$) to be 13.6% among

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adults 50 years and over.⁶ In Australia, only one population-based study conducted in 1992, the Melbourne Visual Impairment Project (VIP), has provided estimates of the distribution of NVI in non-Indigenous adults.⁷ Adopting the slightly more conservative definition than NHANS, $<20/50$, the VIP⁸ reported the prevalence of presenting NVI to be 19% in Australian adults aged 40 years or over. Considerably higher rates have been reported in a nationally representative cohort of Indigenous Australian adults, with Taylor *et al* (2008)⁹ reporting the prevalence of 40% for presenting NVI. Despite this, robust comparisons between these studies are problematic due to differences in testing protocols employed and age distributions of participants. Furthermore, given the continual aging of Australia's population and an increasing reliance on adequate near vision to engage in daily activities such as the use of computers and hand-held devices, up-to-date data on the prevalence of NVI in Australia are warranted.

The National Eye Health Survey (NEHS), with its nationally representative sample stratified by Indigenous status, provides an ideal setting in which to investigate the epidemiology of NVI in the Australian population. Herein, we describe the prevalence and associations of NVI in Indigenous Australians aged 40 years and over and non-Indigenous Australians aged 50 years and over.

Materials and methods

Study population

The NEHS is a population-based, cross-sectional survey conducted between March 2015 and April 2016 with the primary objective of determining the prevalence and causes of vision impairment and blindness in non-Indigenous Australians aged 50 years and older, and Indigenous Australians aged 40 years and older. The sampling, recruitment and clinical testing methodologies has been described in detail elsewhere.^{10,11} In brief, a multi-stage, cluster sampling methodology was utilised to select thirty Australian sites across five Remoteness Areas (RAs) which included; Major City, Inner Regional, Outer Regional, Remote and Very Remote geographical areas. Participants were recruited door-to-door and high overall positive response rates and examination rates were achieved (83.5% and 71.5%, respectively). Ethics approval was obtained from the Royal Victorian Eye and Ear Hospital Human Research Ethics Committee (HREC-14/1199H) and additional ethical approvals were obtained at the State level to conduct research within Indigenous communities. Study procedures adhered to the tenets of the Declaration of Helsinki as revised in 2013 and participants provided written informed consent to participate.

Examination procedures

Sociodemographic data including age, gender, Indigenous status, ethnicity, years of education, language spoken at home, utilisation of eye health services, as well as medical and ocular histories were collected via an interviewer-administered questionnaire. Ethnicity was categorised according to the Australian Standard Classification of Cultural and Ethnic Groups (ASCCEG) 2011.¹²

Self-reported use of near, distance or bifocal corrective lenses were recorded at the time of examination. Presenting distance visual acuity was measured in each eye using a logMAR chart (Brien Holden Vision Institute, Australia) in well-lit room conditions. Participants wore their usual distance correction if available at the time of examination. Pinhole testing was performed on participants with visual acuity $<6/12$ in one or both eyes, followed by automated refraction (Nidek ARK-30 Type-R Hand-held auto-refractor/keratometer, Nidek Co., LTD, Tokyo, Japan) if VA improved to $\geq 6/12$ in either eye. Vision loss was defined as a visual acuity of $<6/12$ in the better eye. Participants with vision loss were considered to have uncorrected or under-corrected refractive error if the distance visual acuity improved to $\geq 6/12$ with pinhole testing or auto-refraction in one or both eyes. Vision loss from other causes was defined as a best-corrected visual acuity of $<6/12$ in the better eye. Binocular presenting near vision was assessed using a CERA tumbling E near vision card (Centre for Eye Research Australia, Australia) held at the participant's preferred reading distance. Near correction was worn if normally used and near vision was recorded as N8, N20, N48 or $<N48$. Presenting NVI was defined as near vision worse than N8.

Statistical analysis

Participant demographic characteristics were summarized by mean and SD for normally distributed continuous data, or the median and inter-quartile range for skewed distributed data, and counts and percentages for categorical data. Normality was examined using boxplots, Kolmogorov-Smirnov and Shapiro-Wilks tests. Ninety-five percent confidence intervals (CI), taking into account the sampling design, were calculated for participant demographic characteristics and the prevalence of NVI.

The main outcome was the presence of NVI (yes = 1, no = 0). Key explanatory variables included age, gender, ethnicity, years of education, language spoken at home, remoteness, history of diabetes and history of stroke. Univariate and multivariable binary logistic regression analysis was used to identify factors associated with the

presence of NVI. Lack of multicollinearity between the independent variables in the model was verified by Box-Tidwell transformation. Statistical interaction was tested for all key explanatory variables of NVI. A plot of the residuals compared with estimates was examined to determine whether the assumptions of linearity and homoscedasticity were met. Odds ratios (OR) will be quoted together with their 95% confidence intervals (CI) and *P*-values.

The NEHS employed a multistage cluster sample survey design. Sampling error may be underestimated and the probability of type I error may be increased if the multistage sample design was not taken into consideration in analysis. All analyses were performed by adjusting for stratification and clustering in the sampling procedure, namely incorporating the sampling weights, to obtain unbiased estimates for the NEHS sampling design. Analyses were conducted with Stata version 14.2.0 (Stata Corp, College Station, TX, USA). A two-tailed *P*-value <0.05 was considered statistically significant.

Results

Participant characteristics

A total of 4836 individuals were examined in the NEHS, including 3098 non-Indigenous and 1738 Indigenous Australians, respectively. Of these, 4817 (99.6%, 3084 non-Indigenous and 1733 Indigenous) participants had complete data on near visual acuity. The sample of non-Indigenous Australians had a mean age of 66.7 years (SD=9.7) while the mean age of Indigenous participants was 55.0 years (SD=10). Non-Indigenous Australians were 59% female and Indigenous Australians were 54% female. A total of 91.2% (2807/3084) non-Indigenous and 73.7% (1277/1733) Indigenous participants reported using near vision correction.

Prevalence of near vision impairment

Non-Indigenous population In the non-Indigenous population aged 50 years and over, the overall weighted prevalence of presenting NVI was 21.6% (95% CI: 19.6, 23.8; 707/3084). The weighted prevalence of NVI increased with age, with the following age-specific prevalence rates; 14.2% in those 50–59 years, 19.4% in those aged 60–69 years, 24.5% in those aged 70–79 years and 41.5% in those aged ≥ 80 years (Table 1, *P*<0.001). Presenting NVI was found in 23.9% (95% CI: 21.2, 27.1) of males and 19.6% (95% CI: 16.9, 22.5) of females in the non-Indigenous population (*P*=0.26). Of the total 21.6% of non-Indigenous participants with presenting NVI, 66.1% (467/707) used near correction at the time of examination,

Table 1 Crude and weighted prevalence of presenting NVI (<N8) by Indigenous status, age and gender

Variable	n ^a	Crude % (95% CI)	Weighted % (95% CI)
<i>Non-Indigenous</i>			
Female	338	20.5 (18.5, 22.5)	19.6 (16.9, 22.5)
Male	369	25.8 (23.5, 28.1)	24.0 (21.2, 27.1)
<i>Age, years</i>			
50–59	125	15.4 (13.0, 18.0)	14.2 (11.7, 17.1)
60–69	243	20.9 (18.6, 23.3)	19.4 (16.5, 22.7)
70–79	192	25.5 (22.5, 28.7)	24.5 (21.7, 27.5)
80+	147	41.8 (36.7, 47.0)	41.5 (34.2, 49.1)
Total	707	22.9 (21.5, 24.5)	21.6 (19.6, 23.8)
<i>Indigenous</i>			
Female	320	31.3 (28.5, 34.3)	34.2 (28.0, 41.0)
Male	246	34.6 (31.1, 38.2)	35.5 (29.8, 41.6)
<i>Age, years</i>			
40–49	352	29.1 (26.6, 31.7)	30.8 (25.1, 37.1)
50–59	130	36.0 (31.2, 41.1)	37.9 (29.1, 47.5)
60–69	74	54.8 (46.3, 63.0)	57.7 (48.1, 66.7)
70+	10	38.5 (21.8, 58.3)	52.6 (27.6, 76.4)
Total	566	32.7 (30.5, 34.9)	34.7 (29.2, 40.8)

^an, number of participants with NVI.

and 23.3% (165/707) reported using near correction but did not wear corrective lenses at the time of examination. The remaining 10.6% (75/707) of participants with NVI did not wear near corrective lenses at the time of their examination and reported that they did not use near correction. Among those with presenting NVI, 82.3% (582/707) had normal presenting distance vision (>6/12 in the worse eye), 7.9% (56/707) had uncorrected or under-corrected distance refractive error and the remaining 9.8% (69/707) had distance vision loss resulting from other causes.

Indigenous population Among Indigenous Australians aged 40 years and older, the overall weighted prevalence of presenting NVI was 34.7% (95% CI: 29.2, 40.8; 566/1733). The prevalence of NVI was 35.5% for males and 34.2% for females (*P*=0.59). Similarly to the non-Indigenous population, presenting NVI increased with age (40–49 years = 30.8%; 50–59 years = 37.9%; 60–69 years = 57.7%; > 70 years = 52.6%, *P*<0.001). Of those with presenting NVI, 21.2% (120/566) wore near correction at the time of examination and an additional 51.2% (290/566) self-reported using near correction but did not have corrective lenses at the time of examination, with remaining 27.6% (156/566) reporting that they do not use near correction. The majority of Indigenous Australians with presenting NVI had normal distance vision (77.9%, 441/566), with 11% (62/566) having uncorrected or under-corrected refractive error and 11.1%

Table 2 Sampling weight adjusted multivariable logistic regression analysis investigating associations for NVI in non-Indigenous participants

Risk factor	Univariate OR [95% (CI)]	P ^a	Model 1 OR ^b [95% (CI)]	P	Model 2 OR ^c [95% (CI)]	P
Age (10 years)	1.62 (1.42, 1.85)	<0.001	1.68 (1.46, 1.93)	<0.001	1.69 (1.43, 2.00)	<0.001
Gender (male)	1.29 (1.03, 1.63)	0.03	1.14 (0.91, 1.43)	0.26	1.06 (0.83, 1.36)	0.60
Education (years)	0.92 (0.90, 0.94)	<0.001	0.95 (0.93, 0.97)	<0.001	0.95 (0.93, 0.98)	<0.001
English at home	0.58 (0.39, 0.84)	0.01	0.72 (0.43, 1.19)	0.19	0.61 (0.32, 1.15)	0.12
<i>Ethnicity</i>						
Oceanian	1		1		1	
European	1.22 (0.99, 1.49)	0.06	1.08 (0.90, 1.31)	0.40	1.04 (0.83, 1.31)	0.71
Other	1.22 (0.77, 1.92)	0.38	1.12 (0.73, 1.73)	0.58	1.04 (0.65, 1.66)	0.86
<i>Remoteness</i>						
Major City	1		1			
Inner regional	0.99 (0.76, 1.27)	0.91	1.10 (0.79, 1.52)	0.56	1.08 (0.75, 1.57)	0.66
Outer regional	1.36 (0.88, 2.10)	0.16	1.30 (0.70, 2.40)	0.39	1.26 (0.65, 2.47)	0.48
Remote	1.61 (1.10, 2.35)	0.02	1.71 (1.22, 2.40)	0.003	1.65 (1.18, 2.31)	0.005
Very remote	1.05 (0.85, 1.32)	0.60	1.05 (0.57, 1.95)	0.86	0.84 (0.49, 1.45)	0.52
Self-reported stroke	1.67 (1.16, 2.42)	0.01	1.24 (0.80, 1.91)	0.32	1.24 (0.92, 1.66)	0.15
Self-reported diabetes	1.55 (1.23, 1.97)	0.001	1.27 (0.99, 1.22)	0.06	1.45 (0.87, 2.42)	0.14
Time since last eye examination						
Within 1 year	1		1		1	
1 to 2 years	0.80 (0.65, 0.98)	0.03	0.92 (0.70, 1.22)	0.55	0.92 (0.67, 1.28)	0.62
2 to 5 years	1.02 (0.65, 1.60)	0.93	0.89 (0.55, 1.45)	0.64	0.85 (0.50, 1.44)	0.53
>5years or never	1.60 (1.08, 2.38)	0.02	1.23 (0.83, 1.83)	0.30	1.08 (0.68, 1.71)	0.74
Distance vision						
Normal (>6/12 in the better eye)	1		1		1	
Refractive error	3.65 (2.62, 5.08)	<0.001	3.65 (2.43, 5.47)	<0.001	3.96 (2.57, 6.09)	<0.001
Vision loss (<6/12 in the better eye)	16.72 (9.00, 31.03)	<0.001	9.25 (4.33, 19.78)	<0.001	11.21 (3.95, 31.82)	<0.001
Near-vision correction						
Does not have	1		1		1	
Has corrective lenses	0.69 (0.46, 1.02)	0.06	0.57 (0.38, 0.88)	0.01	0.56 (0.37, 0.86)	0.010
Has but did not wear	4.84 (3.06, 7.64)	<0.001	5.57 (3.25, 9.54)	<0.001	—	—

Abbreviations: CI, confidence interval; OR, odds ratio. ^aStatistical significance was set as a *P*-value of ≤ 0.05 (two tailed). ^bModel 1: includes all study participants, adjusted for all factors in the model. ^cModel 2: excluded participants who self-reported using near correction but did not have corrective lenses at the time of examination, adjusted for all factors in the model.

(63/566) displaying distance vision loss from other causes. Table 1

Extrapolating these findings to the Australian population, we estimate that ~1 274 792 non-Indigenous Australians aged 50 years and over and 46 455 Indigenous Australians aged 40 years and over have NVI.

Associations between presenting near vision impairment and selected characteristics

Non-Indigenous population Multivariate logistic regression analysis revealed that older age (OR = 1.68 per 10 years, $P < 0.001$), fewer years of education (OR = 0.95 per year, $P < 0.001$) and residing in Remote geographical areas (OR = 1.71, $P = 0.003$) were associated with presenting NVI (Table 2). Additionally, the prevalence of presenting NVI was higher among participants with

bilateral distance vision loss due to uncorrected refractive error (OR = 3.65, $P < 0.001$) and those with bilateral distance vision loss from other causes (OR = 9.25, $P < 0.001$). After excluding all participants who forgot their near correction, all of these associations remained.

Indigenous population After adjusting for covariates, older age (OR = 1.69 per 10 years, $P < 0.001$), female gender (OR = 0.75, $P = 0.03$), fewer years of education (OR = 0.91 per year, $P = 0.003$) and self-reported stroke (OR = 1.79, $P = 0.004$) were associated with presenting NVI among Indigenous Australians (Table 3). Geographic remoteness was associated with presenting NVI, with participants residing in Inner Regional (OR = 2.01, $P = 0.008$), Outer Regional (OR = 2.17, $P < 0.001$) and Remote areas (OR = 1.72, $P = 0.03$) being more likely to have presenting NVI than those in Major City areas.

Table 3 Sampling weight adjusted multivariable logistic regression analysis investigating associations for NVI in Indigenous participants

<i>Risk factor</i>	<i>Univariate OR (95% (CI))</i>	<i>P-value^a</i>	<i>Model 1 OR^b (95% (CI))</i>	<i>P-value</i>	<i>Model 2 OR^c (95% (CI))</i>	<i>P-value</i>
Age (10 years)	1.50 (1.31, 1.71)	<0.001	1.69 (1.37, 2.07)	<0.001	1.63 (1.26, 2.11)	0.001
Gender (male)	1.06 (0.85, 1.31)	0.59	0.74 (0.56, 0.97)	0.03	0.77 (0.54, 1.10)	0.14
Education (years)	0.87 (0.82, 0.93)	<0.001	0.91 (0.85, 0.96)	0.003	0.90 (0.84, 0.97)	0.01
English at home	0.72 (0.33, 1.59)	0.41	0.93 (0.36, 2.40)	0.88	0.77 (0.35, 1.70)	0.50
<i>Remoteness</i>						
Major City	1		1		1	
Inner Regional	1.57 (0.91, 2.73)	0.10	2.02 (1.22, 3.35)	0.008	1.92 (0.95, 3.87)	0.07
Outer Regional	2.26 (1.62, 3.15)	<0.001	2.17 (1.46, 3.20)	<0.001	2.34 (1.40, 3.92)	0.002
Remote	1.52 (1.05, 2.19)	0.03	1.72 (1.06, 2.80)	0.03	1.65 (0.97, 2.82)	0.07
Very remote	2.47 (0.72, 8.45)	0.14	2.78 (0.46, 16.74)	0.25	3.71 (0.65, 21.30)	0.14
Self-reported stroke	2.19 (1.45, 3.30)	0.001	1.79 (1.23, 2.62)	0.004	1.06 (0.74, 1.51)	0.75
Self-reported diabetes	1.46 (1.09, 1.96)	0.01	0.94 (0.60, 1.47)	0.79	1.40 (0.86, 2.26)	0.17
<i>Time since last eye examination</i>						
Within 1 year	0.82 (0.60, 1.12)	0.21	0.81 (0.61, 1.08)	0.14	1	
1 to 2 years	0.92 (0.69, 1.24)	0.58	0.90 (0.65, 1.26)	0.53	0.79 (0.52, 1.19)	0.24
2 to 5 years	1.08 (0.69, 1.69)	0.73	0.95 (0.62, 1.47)	0.82	0.83 (0.54, 1.27)	0.38
>5years or never					1.19 (0.74, 1.93)	0.46
<i>Distance vision</i>						
Normal (>6/12 in the better eye)	1		1		1	
Refractive error	2.39 (1.56, 3.68)	<0.001	2.13 (1.43, 3.17)	0.001	2.35 (1.37, 4.04)	0.003
Vision loss (<6/12 in the better eye)	21.35 (11.29, 40.38)	<0.001	16.83 (7.39, 38.31)	<0.001	20.50 (7.66, 54.86)	<0.001
<i>Near-vision correction</i>						
Does not have	1		1		1	
Has corrective lenses	0.33 (0.26, 0.42)	<0.001	0.19 (0.13, 0.28)	<0.001	0.22 (0.15, 0.31)	<0.001
Has but did not wear	2.44 (1.57, 3.81)	<0.001	2.56 (1.95, 3.35)	<0.001	—	—

Abbreviations: CI, confidence interval; OR, odds ratio.^aStatistical significance was set as a *P* value of ≤ 0.05 (two tailed).^bModel 1: includes all study participants, adjusted for all factors in the model.^cModel 2: excluded participants who self-reported using near correction but did not have corrective lenses at the time of examination, adjusted for all factors in the model.

Similarly to the non-Indigenous population, participants with bilateral distance vision loss due to uncorrected refractive error (OR=3.65, $P<0.001$) and those with bilateral distance vision loss from other causes (OR=9.25, $P<0.001$) were more likely to have presenting NVI. With the exception of female gender and self-reported stroke, all of the above associations remained after excluding all participants who forgot their near correction.

Discussion

This paper presents the prevalence and associations of presenting NVI in a national sample of non-Indigenous and Indigenous Australian adults. The weighted prevalence of presenting NVI amongst non-Indigenous and Indigenous Australians was 21.6% and 34.7%, respectively. By identifying significant risk factors for NVI, including older age, fewer years of education and residing in regional and remote geographical areas this paper may inform targeted resource allocation to reduce the burden of NVI in high risk groups in the Australian population.

Previous research has suggested that distance visual acuity correlates well with near vision.⁷ In the present study, nearly 90% of all non-Indigenous and Indigenous participants with presenting NVI displayed normal distance vision (>6/12 in the better eye) or uncorrected refractive error. This suggests that a substantial proportion of NVI in Australia may be easily corrected with spectacles.

Among non-Indigenous Australians in the NEHS, the weighted prevalence of presenting NVI (21.6%) was marginally higher than that reported in the Melbourne VIP (19%),⁸ and other population-based reports from developed nations.^{6,13} However, these comparisons must be viewed with caution due to differing definitions of NVI and age distributions of populations. For instance, non-Indigenous NEHS participants were, on average, older (mean age; NEHS=67 years *vs* VIP=60 years) than Melbourne VIP participants. Furthermore, the Melbourne VIP sampled participants from a predominantly urban population, where the availability of eye health care services is highest.^{14,15} Therefore, the higher prevalence reported in the NEHS may be partly attributed to the

well-recognised association between NVI and age, coupled with a more inclusive geographical representation of the Australian population. Nonetheless, it remains that a substantial proportion of adults aged 50 years and over had NVI in the current study, reflecting the need to improve utilisation of eye health services, particularly by those with poorer education and those of older age. This may be achieved, in part, through eye health promotion to improve awareness and eye health literacy within Australian communities.

In recent years, several initiatives have been implemented to close the gap in Indigenous eye health,¹⁶ including those targeted at providing free or subsidised spectacles for refractive errors including presbyopia.¹⁷ For Indigenous Australians aged 40 years and over in the NEHS, the prevalence of presenting NVI (34.7%) was lower than that reported in the National Indigenous Eye Health Survey (2008) (40%).⁹ It must also be noted that among Indigenous NEHS participants with presenting NVI, 51% self-reported using near correction but did not have corrective lenses at the time of examination, suggesting that the prevalence of NVI is likely to be overstated in the present study. This finding, taken in light of the fact that the Indigenous NEHS cohort was, on average, older (mean age; NEHS = 58 years *vs* NIEHS = 50 years) than NIEHS participants, provides evidence for a possible decline in the prevalence of NVI amongst Indigenous Australians. While these findings may point to improvements in the treatment coverage of NVI, it is clear that continued efforts are required to provide equitable access to eye health care services in Indigenous communities.

In the present study, non-Indigenous Australians residing in Remote geographical areas and Indigenous Australians residing in Regional and Remote geographical areas were on average 1.5 to 2.5 times more likely to have presenting NVI than participants from urban areas. This finding is perhaps not surprising given that a disproportionately low availability of services and specialists exists in nonmetropolitan areas of Australia.^{18,19} While considerable emphasis has been placed on providing equitable access to eye health services across remoteness strata,²⁰ our findings suggest that improvements in availability of optometric services in Regional and Remote areas may be warranted. Where feasible, these services should be integrated within Aboriginal Medical Services (AMS) to maximise utilisation within Indigenous communities.²¹ Furthermore, given the simplicity of near vision assessment coupled with the low-cost of near-vision corrective spectacles, improvements in the availability of ready-made glasses for presbyopia correction may be effective within primary care settings.

The strengths of this study include its population-based design, stratification by Indigenous status and nearly complete data (99.6%) for near vision. A number of limitations must also be considered. First, participants with presenting NVI did not undergo binocular refraction for near and as a result we were unable to accurately ascertain the met need among those with correctable NVI. Second, near vision was not assessed at a pre-set standard distance, but rather at participant's preferred reading distance. While this may have resulted in an underestimation of the prevalence of presenting NVI, our method is likely to better reflect normal daily functional requirements. Finally, a large proportion of non-Indigenous (23%) and Indigenous Australians (51%) with NVI self-reported using near correction but did not have corrective lenses at the time of examination. If it were assumed that a large proportion of these participants did not have NVI, we may have overestimated the prevalence of NVI in the Australian population. Despite this, the authors feel that the inclusion of these participants within the definition of presenting NVI better reflects current near visual function and glasses utilisation amongst the Australian non-Indigenous and Indigenous adult population.

In summary, NVI represents a notable public health concern in Australia, with ~20% of non-Indigenous and one-third of Indigenous Australian adults displaying a reduction in their presenting near vision. Our data have identified several high-risk groups that may benefit from focused resource allocation including; older Australians and those with fewer years of education, non-Indigenous Australians residing in Remote locations and Indigenous Australians residing in Inner Regional, Outer Regional and Remote geographical areas. Given the considerable burden of NVI, and its feasibility of treatment in most cases, Australia may benefit from prioritisation of uncorrected presbyopia.

Summary

What was known before

- Currently, there is a paucity of reliable data on the prevalence of near vision impairment from population-based surveys conducted in Australia.

What this study adds

- As the majority of NVI is readily treatable with spectacle correction, this data is useful to quantify Australia's burden of near vision impairment and inform targeted resource allocation.
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Conflict of interest

The authors declare no conflict of interest.

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Prevalence and associations of presenting near-vision impairment in the Australian National Eye Health Survey

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1. You are advising a public health department in Australia regarding anticipated healthcare needs for near vision impairment (NVI). According to the analysis from the National Eye Health Survey (NEHS) by Keel and colleagues, which of the following statements about the prevalence and associations of NVI in Indigenous Australians is **correct**?
 - A One-fifth of Indigenous Australians had NVI
 - B Most Indigenous Australians with presenting NVI also had impaired distance vision
 - C Years of education was not a significant risk factor for NVI
 - D Living in Inner Regional (odds ratio [OR], 2.01; $P=0.008$), Outer Regional (OR, 2.17; $P<0.001$), and Remote geographic areas (OR, 1.72; $P=0.03$) was associated with greater odds of presenting NVI
2. According to the analysis from NEHS by Keel and colleagues, which of the following statements about the prevalence and associations of NVI in non-Indigenous Australians is **correct**?
 - A More than one-third of Indigenous Australians had presenting NVI
 - B After multivariate adjustments, area of residence was not a significant risk factor for NVI
 - C Risk factors for presenting NVI were older age (OR, 1.68 per 10 years; $P<0.001$) and less education (OR, 0.95 per year; $P<0.001$)
 - D Prevalence of presenting NVI was lower among participants with bilateral distance vision loss
3. According to the analysis from NEHS by Keel and colleagues, which of the following statements about the clinical and public health implications regarding the prevalence and associations of NVI in Indigenous and non-Indigenous Australians is **correct**?
 - A Identifying risk factors for NVI may inform targeted resource allocation to reduce the burden of NVI in high-risk groups
 - B The findings suggest that a substantial proportion of NVI in Australia may not be easily corrected with spectacles
 - C Indigenous and non-Indigenous communities have equal access to NVI services
 - D Presbyopia correction is not feasible within primary care settings