

# Vision impairment and refractive errors in refugees presenting to community optometry clinics in Victoria, Australia

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The United Nations High Commission for Refugees defines a refugee as a person who has left their home country on account of suffering (or fearing) persecution due to race, religion, nationality, political opinion, or membership of a persecuted social group or because they are fleeing from war.<sup>1</sup> An asylum seeker is a person who is seeking protection as a refugee and is waiting to have their claim assessed. In Australia, this differentiation proves to be crucial in determining

**Background:** There is a paucity of data relating to refugee eye health in Australia. This study aimed at investigating the spectrum of vision impairment and other ocular conditions in refugees utilising the Victorian Eyecare Service operated by the Australian College of Optometry.

**Methods:** A cross-sectional study of electronic clinical records of 518 individuals (adults and children) recognised as refugees by the Australian College of Optometry and treated between January 2013 and May 2014 were identified. Extracted data included presenting visual acuities, best-corrected visual acuities, and final refraction values (using spherical equivalents), for both eyes. Diagnoses of presenting ocular conditions were also extracted.

**Results:** Of all refugees examined, 129 (27.2 per cent) had some degree of vision impairment ( $\leq 6/9.5$ ) based on presenting visual acuities in their better eye; five (1.0 per cent) being of a severe ( $\leq 6/60$ ) or profound ( $\leq 6/120$ ) nature. In contrast, 27 (6.3 per cent) refugees had some degree of vision impairment based on best-corrected visual acuities in their better eye; two (0.4 per cent) being of a severe or profound nature. The prevalence of myopia ( $\geq -0.50$  D) in the better eye was 23.0 per cent ( $n = 114$ ); 25 (5.0 per cent) being moderate ( $\geq -3.00$  D) to high ( $\geq -6.00$  D). The prevalence of hypermetropia ( $\geq +2.00$  D) in the better eye was 3.2 per cent ( $n = 16$ ); 12 (2.4 per cent) being moderate ( $\geq +2.25$  D) to high ( $\geq +5.25$  D). The most common ocular conditions diagnosed at initial presentation were refractive error ( $n = 104$ , 20.1 per cent) and dry eyes ( $n = 57$ , 11.0 per cent).

**Conclusion:** Mild vision impairment and refractive error are significant issues for refugees attending the Australian College of Optometry, emphasising the need for optometry, particularly refractive, services in this population.

the level of access that refugees and asylum seekers have to health services. While all those seeking asylum are entitled to free medical care in Victorian hospitals, refugees and asylum seekers have varying access to Medicare depending on the type of visa held.<sup>2</sup> This then adversely and significantly affects their eligibility to essential services including eye-health services.<sup>3</sup>

In 2017–2018, 16,250 visas were granted to individuals seeking entry to Australia as

refugees. Of these, 14,825 were offshore and 1,425 onshore visas as defined under the Australian Humanitarian Program.<sup>4</sup> The offshore component included 7,909 (53 per cent) Refugee and 6,916 (47 per cent) Special Humanitarian Program visas. Of the offshore visas, 56 per cent were granted to people born in the Middle East, followed by 26 per cent to people born in Asia and 18 per cent to people born in Africa. The countries of origin of the three main groups of individuals

who were resettled were Syria, Iraq, and Myanmar. Over 58 per cent were in the working age group of 18–69 years followed by nearly 40 per cent in the age group of 0–17 years. The proportion of those granted Humanitarian Program visas was around 50 per cent for both males and females.<sup>4</sup> These characteristics of people granted Humanitarian Program visas have remained steady over the last five years.

Between 2006 and 2018 the number of Australian residents born overseas has increased from 5.0 to 7.3 million, with the estimated number now representing over 29 per cent of the total Australian population.<sup>5</sup> Research has shown that most migrants, on arrival, benefit from health that is as good as, if not better than, that of the Australian-born population, in terms of lower death and hospitalisation rates, as well as lower rates of disability and lifestyle-related risk factors.<sup>6</sup> This trend known as the 'healthy migrant' does not apply to all overseas-born people.

Refugees are a disadvantaged group having differing health requirements as compared to the broader migrant population as well as the general population.<sup>7</sup> Disparity in health can originate from living in areas poor in health resources both in the country of origin and also in the countries of transition, including detention, and the effects of torture, trauma and persecution.<sup>8</sup> Refugees experience a wide range of psychosocial issues due to their displacement.<sup>9</sup> They also face multiple barriers to essential health-care services such as poor understanding of the health-care systems in host countries<sup>10</sup> and speaking a language different from that of the host country.<sup>11</sup> As an example, Victorians born in refugee-source countries showed lower rates of hospital admissions and emergency presentations than other Australians due to their lack of understanding of the Australian health-care system.<sup>12</sup>

While a number of studies have investigated particular aspects of refugee health in Australia, the authors were unable to identify any study of their eye-health status and their use of eye-health services. There are, in addition, very few peer-reviewed epidemiological, or similar, studies concerning eye health of refugees that have been conducted internationally. Of these, a 1998 study reported that the leading causes of vision impairment in a group of Afghan refugees in Pakistan were uncorrected refractive error (46.2 per cent), cataract (32.7 per cent) and corneal opacities (4.8 per cent).<sup>13</sup>

More recently, a 2014 study on Ethiopian refugees reported cataract (37.6 per cent), trichomatous corneal opacity (18.1 per cent), and refractive error (12.9 per cent) as the most common causes of vision impairment.<sup>14</sup> Further, a 2016 Malawian study also reported similar causes of vision impairment in their cohort of refugees and emphasised the importance of comprehensive eye-care services, particularly optometric, for refugees in settlement camps.<sup>15</sup>

Studies on refugee eye health are also important because they can influence both the strategic planning and local delivery of eye-care practice which can then translate into better service provision and resource utilisation. For example, successful training of refugee health workers in basic optics have led to efficient screening services for uncorrected refractive error and the on-site provision of glasses across refugee camps located in the Thailand-Burma border.<sup>16</sup> With the bulk of refugees entering Australia falling within the working age group (16–64 years),<sup>17</sup> and knowledge of the adverse impacts of vision impairment on personal and social spheres,<sup>18–20</sup> there is a greater value to investigate the trends of eye conditions of refugees resettling in Australia so that essential eye-care services can be appropriately targeted.

This study aims to identify trends of vision impairment, refractive error, and the service needs of refugees attending the Victorian Eyecare Service operated by the Australian College of Optometry (ACO) at its community and outreach sites.

## Methods

### Setting: Victorian Eyecare Service and the ACO

Services to refugees are provided as part of the role of Victorian Eyecare Service as the key provider of comprehensive public eye-care services in Victoria. This is operated by the ACO, an independent, not-for-profit, membership-based organisation. The Victorian Eyecare Service was established in 1985, by the Victorian Government to provide eye-care services to people experiencing financial and other disadvantages. It now principally serves Victorian residents holding Pensioner Concession Cards and Health Care Cards.<sup>21</sup> Patient visits are on a referral basis (including self-referral) rather than as a result of screening. Optometry examinations are provided at no cost to clients either through

Medicare (government health insurance scheme) or through the Victorian Eyecare Service if the patient is not eligible through Medicare. Glasses are subsidised.

The Victorian Eyecare Service was later extended to include refugees as well. Victorian Eyecare Service usage by refugees has increased considerably over the past 10 years.<sup>22</sup> This is thought to be the only service arrangement in Victoria where refugees are able to access public optometry services. Interpreter services funded by the Victorian Eyecare Service are available at ACO clinics. Subsidised glasses are provided to refugees. This support may not be available to other optometry providers.

Corporate optometry services such as OPSM and Specsavers neither provide interpreter services nor subsidised glasses for refugees (Selvarajah S, 2019, unpublished data). There is inadequate information available on what level of eye care is provided to refugees in other states, apart from the basic vision and hearing examinations undertaken on arrival as part of the initial health assessments (and some services provided through private optometry volunteer services).

Refugees are identified and referred to the ACO through facilitated referral pathways that are delivered in partnership and collaboration with refugee agencies such as Monash Health service specialising in refugee health, Adult Migrant Education Services, Victorian Refugee Health Network, Asylum Seeker Resource Centre, Migrant Resource Centres, Australian Red Cross, and through local community health services.<sup>23</sup> This service provision occurs in ACO clinics based in the Victorian suburbs of Carlton, Braybrook, Broadmeadows, East Preston, Berwick and Frankston. It also occurs in outreach, mobile clinics in the practices of primary care providers in metropolitan Melbourne – most particularly, Isis Primary Care and Eastern Access Community Health. Furthermore, the Victorian Eyecare Service provides services to refugees in rural areas in partnership with a network of more than 80 participating private optometry practices in regional Victoria.<sup>21</sup>

### Methodology

Using the Optomate (optical practice management) software system (<http://www.monkeysoftware.com.au>), it was possible to extract relevant clinical, service usage and socio-demographic (electronic) data for all individual ACO clients identified as refugees

by the referring agency and treated in metropolitan ACO clinic sites (other than the central ACO clinic in Carlton where paper-based records were used) over a 17-month period between January 2013 and May 2014. The paper-based records from Carlton were not included in the analysis. Data on vision assessments by optometric staff were recorded for all visits, both initial and follow-up.

Data extracted from the electronic records included history of previous glasses, presenting visual acuities and best-corrected visual acuities, respectively, for distance vision (generally recorded using six-metre equivalent Snellen or logMAR charts) and final refraction values (sphere, cylinder and axis) for both right and left eyes. Presenting visual acuities were recorded with or without glasses, and best-corrected visual acuities following objective and subjective refraction. Final optical prescription was noted and information on prescriptions issued and glasses supplied, were recorded.

Level of vision impairment was assessed using the visual standards assessment and rehabilitation of vision-related functioning of the International Council of Ophthalmology (Table 1).<sup>24</sup> This scale recognises visual acuity ranges in the International Classification of Diseases – the ICD-9, the ICD-9-CM, the ICD-10 and the ICD-11. For refractive error, spherical equivalent in dioptres was calculated as:

Spherical equivalent = sphere + (0.5 × cylinder) from subjective refraction values. Hypermetropia was defined by reference to the American Optometric Association (Table 4),<sup>25</sup> and myopia was similarly defined by reference to the American Optometric Association (Table 4).<sup>26</sup> Data on the presence of astigmatism and anisometropia have also been collated.

Socio-demographic data (date of birth, gender, country of origin, initial presentation to ACO clinics, mode of referral to ACO) were collected. Diagnoses of presenting ocular conditions noted by the ACO optometrists were extracted. Data were analysed using SPSS statistical software (version 22.0; IBM, Armonk, NY, USA). Pearson's chi-squared and Fisher's exact test for categorical variables were used for statistical analysis.

Sub-analysis was performed by the country-of-birth regions (Appendix S1) of refugees, based on the United Nations classification of countries by major area and region of the world.<sup>27</sup> Analysis for country-of-birth regions grouping was only feasible

for southern Asia, South-East Asia and western Asia.

Visual acuity and refractive error results were dichotomised; that is, the presence or absence of vision impairment ( $\leq 6/9.5$ ) (dichotomising normal vision and vision loss, including mild vision loss) using presenting visual acuities and best-corrected visual acuities for better and worse eyes, and the presence or absence of myopia ( $\geq -0.50$  D) and hyperopia ( $\geq +2.00$  D) using final refraction values for better and worse eyes. Results for better and worse eyes are reported.

### Ethics

The ACO Human Research Ethics Committee granted ethics approval for this project (H13-005). It was conducted in accordance with the Declaration of Helsinki of 1975.

## Results

### Demographics

A total of 518 refugees received ACO services (excluding those delivered at the Carlton site) between January 2013 and May 2014. The cohort consisted of both males (56.2 per cent) and females (43.8 per cent). The median and mean ages in the cohort were 32.1 and 31.5 years, respectively, and included 21.2 per cent of children (0–17 years) and 78.8 per cent of adults ( $\geq 18$  years). Twenty-eight per cent of refugees were from Afghanistan, followed by 22.8 per cent from Burma, 12.5 per cent from Iraq, and 9.0 per cent from Sri Lanka, from among the 29 countries of birth represented in our cohort.

Of the country-of-birth regions (Appendix S1), 46.7 per cent of refugees were from southern Asia, followed by 21.2 per cent from South-East Asia and 12.2 per cent from western Asia. Less than 8.0 per cent were from African regions. Refugees (83.5 per cent) were predominantly referred to ACO sites from refugee support services such as Adult Migrant Education Services, Asylum Seeker Resource Centre and Australian Red Cross. To a much lesser extent, they were referred through community health services (6.7 per cent). Referral via other community-based services and medical practitioners was low at 3.9 per cent and 3.0 per cent, respectively.

### Presenting visual acuity

In individuals for whom data were available, 129 (27.2 per cent) had vision impairment in their better eye, five (1.0 per cent) being of a severe or profound nature (Table 1). Vision impairment in the worse eye was evident in 202 (42.7 per cent) individuals, 21 (4.4 per cent) being of a severe or profound nature.

### Best-corrected visual acuity

Twenty-seven (6.3 per cent) of the 426 individuals, for whom data were available, had vision impairment in their better eye, two (0.4 per cent) being of a severe or profound nature (Table 1). Sixty-two (14.4 per cent) individuals had vision impairment in their worse eye, seven (1.6 per cent) being of a severe or profound nature.

### Vision impairment

Using Pearson's chi-squared and Fisher's exact tests, there were no statistically significant differences in the distribution of

Vision impairment levels <sup>24</sup>	PVA		BCVA	
	Better eye n (%)	Worse eye n (%)	Better eye n (%)	Worse eye n (%)
No vision impairment (6/3.8–6/7.5)	344 (72.7)	271 (57.3)	399 (93.7)	366 (85.5)
Mild vision impairment (6/9.5–6/19)	109 (23.0)	154 (32.6)	20 (4.7)	48 (11.2)
Moderate vision impairment (6/24–6/48)	15 (3.2)	27 (5.7)	5 (1.2)	7 (1.6)
Severe vision impairment (6/60–6/120)	4 (0.8)	13 (2.7)	1 (0.2)	3 (0.7)
Profound vision impairment or near blindness (> 6/120)	1 (0.2)	8 (1.7)	1 (0.2)	4 (0.9)
Missing	45	45	92	90

BCVA: best-corrected visual acuity, PVA: presenting visual acuity.

**Table 1. Levels for vision impairment (PVA and BCVA) in the sample (n = 518)**

	Better eye, n (%)			Worse eye, n (%)	
	No vision impairment	Vision impairment	Missing data	No vision impairment	Vision impairment
Southern Asia	169 (73.2)	62 (26.8)	11	129 (55.8)	102 (44.2)
South-East Asia	72 (77.4)	21 (22.6)	17	59 (63.4)	34 (36.6)
Western Asia	43 (74.1)	15 (25.9)	5	32 (55.2)	26 (44.8)
Other regions	22	16	4	17	21
Missing	38	15	8	34	19

$\chi^2 = 0.63$ ;  $df = 2$ ;  $p = 0.73$  (excluding missing data). Moderate/severe/profound vision impairment is 7 (3.0%), 5 (5.4%) and 3 (5.2%) for the three main regional groups respectively.

$\chi^2 = 1.73$ ;  $df = 2$ ;  $p = 0.42$  (excluding missing data). Moderate/severe/profound vision impairment is 17 (3.0%), 8 (5.4%) and 7 (5.2%) for the three main regional groups respectively.

**Table 2. Comparison of vision impairment based on presenting visual acuity levels in three main country-of-birth regions - better and worse eye (n = 518)**

	Better eye, n (%)			Worse eye, n (%)		
	No vision impairment	Vision impairment	Missing data	No vision impairment	Vision impairment	Missing data
Southern Asia	206 (94.9)	11 (5.1)	25	190 (87.2)	28 (12.8)	24
South-East Asia	79 (97.5)	2 (2.5)	29	73 (90.1)	8 (9.9)	29
Western Asia	41 (85.4)	7 (14.6)	15	35 (72.9)	13 (27.1)	15
Other regions	29	3	10	25	7	10
Missing	44	4	13	43	6	12

$\chi^2$  or Fisher's test unable to be performed. Moderate/ severe/ profound vision impairment in the three main regional groups is 2 (0.9%), 1 (1.2%) and 3 (6.3%) respectively.

$\chi^2 = 8.15$ ;  $df = 2$ ;  $p = 0.02$  (no missing data). Moderate/ severe/ profound vision impairment in the three main regional groups is 5 (2.3%), 3 (3.7%) and 3 (6.3%) respectively.

**Table 3. Comparison of vision impairment based on best-corrected visual acuity levels in three main country-of-birth regions - better and worse eye (n = 518)**

vision impairment based on presenting visual acuities in both the better and worse eyes between the three main country-of-birth regions (that is, between southern Asia, South-East Asia and western Asia) (Table 2).

Similarly, the distribution of vision impairment based on best-corrected visual acuities in the better eye was not significantly different between the three main country-of-birth regions. However, there was a significant difference of vision impairment between them for worse eye ( $p = 0.02$ ), with western Asians having the highest proportion (27.1 per cent) of vision impairment (Table 3).

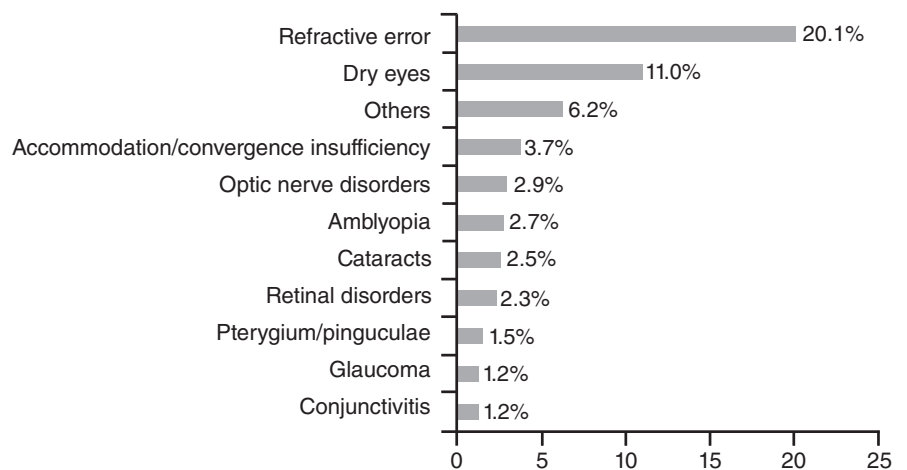
**Ocular conditions**

The most common eye problems which refugees presented with were refractive error (20.1 per cent), dry eyes (11.0 per cent), and accommodation and convergence insufficiencies (3.7 per cent) (Figure 1). Other eye conditions were much less

common. These diagnoses were based on appropriate assessments conducted by the ACO optometrists and as noted by them on Optomate.

**Refractive error**

Refractive error was classified based on the final refraction values measured using spherical equivalents in both eyes (Table 4).



**Figure 1. Distribution of ocular conditions (n = 518)**

Level of refractive error <sup>25,26</sup>	Better eye, n (%)	Worse eye, n (%)
High myopia > (-)6.00	4 (0.8)	8 (1.6)
Moderate myopia (-)3.01 - (-)6.00	21 (4.2)	26 (5.3)
Mild myopia (-)0.50 - (-)3.00	89 (18.0)	127 (25.7)
Emmetropia (-)0.49 - (+)1.99	365 (73.7)	311 (62.8)
Mild hyperopia (+)2.00 - (+)2.24	4 (0.8)	4 (0.8)
Moderate hyperopia (+)2.25 - (+)5.25	7 (1.4)	11 (2.2)
High hyperopia > (+)5.25	5 (1.0)	8 (1.6)
Missing	23	23

**Table 4. Levels of refractive error in the sample (n = 518)**

**MYOPIA**

One hundred and fourteen (23.0 per cent) individuals for whom measurement was available had myopia in their better eye, 25 (5.0 per cent) being moderate to high myopia. The most common refractive error (161, 32.6 per cent) in worse eyes was myopia, 34 (6.9 per cent) exhibiting moderate to high myopia.

**HYPEROPIA**

Sixteen eyes (3.2 per cent) had hypermetropia, 12 (2.4 per cent) being moderate to high hypermetropia in the better eye. In the worse eye, 23 eyes (4.6 per cent) had hypermetropia, 19 (3.8 per cent) being moderate to high hypermetropia.

**ANISOMETROPIA**

In comparing the refractive status of right and left eyes, only 11 individuals demonstrated an anisometric refractive error (equivalent sphere) difference of ≥ 2.00 D, the maximum difference being 5.00 D.

**ASTIGMATISM**

One hundred and twenty-six eyes exhibited an astigmatic refractive error of ≥ 1.00 D. Of these, 16 demonstrated astigmatism of

≥ 3.00 D, 19 between 2.00 D to 3.00 D, and 91 between 1.00 and 2.00 D. The maximum astigmatism noted was 5.50 D, and the maximum anisometric astigmatism noted was only 2.50 D. Only 20 individuals demonstrated an anisometric astigmatic difference of ≥ 2.00 D.

There were no significant differences between the three main country-of-birth regions for refractive error in either better or worse eyes (Table 5).

**Discussion**

The demographics of the refugee cohort in this study were broadly similar to the resettlement trends in Australia for the period under study (that is, 2013–2014) in terms of sex (male : female ratio), age groups (almost 80 per cent working age), country of refugee origin (Afghanistan, Iraq, Burma), and region of refugee source with Asia constituting nearly half of our cohort and Africa constituting the least. That said, it is not possible to fully compare the composition of this ACO (Victorian) refugee cohort with that of the general refugee population resettling in Australia as not all refugees are

within the ACO catchment areas due to movement within and between states which is subject to constant change.

In this cohort, more than one-quarter had vision impairment (based on presenting visual acuities) in their better eye, of which one per cent was of a severe or profound nature. In comparison, vision impairment in the worse eye was even more pronounced in more than a third of our cohort with over four per cent being of a severe or profound nature. Once corrected, although vision impairment in the better eye showed improvement, nearly a fifth of the cohort continued to demonstrate some form of vision impairment in the poorer eye, with 1.6 per cent being of a severe or profound nature.

One-quarter of the cohort had myopia in their better eye. In the worse eye, one-third had myopia. High myopia in the worse eye was twice that found in the better eye. Likewise, high hypermetropia in the worse eye was almost twice that of the better eye. Of the children in our cohort, nearly a fifth had previous glasses. This clearly indicates a significant number of people, both children and adults, with uncorrected refractive error. However, the small sample numbers within each age group rendered it insignificant in relation to analysis as a sub-group. Nevertheless, it highlights an interesting area for further study as those with childhood potential for amblyopia of any cause were probably less likely to have had orthoptics/occlusion/refractive management in childhood.

Although the prevalence of severe vision impairment is relatively small in this sample, the most significant finding is that the majority of people in the sample had mild vision impairment and needed refractive correction. This is further supported by the commonly presented conditions as assessed

	Better eye, n = 396*				Worse eye, n = 396*		
	Myopia	Hyperopia	Emmetropia	Missing	Myopia	Hyperopia	Emmetropia
Southern Asia	73 (30.8)	6 (2.5)	158 (66.7)	5	86 (35.5)	8 (3.3)	143 (59.1)
South-East Asia	23 (23.2)	2 (2.0)	74 (74.7)	11	27 (24.5)	2 (1.8)	70 (63.6)
Western Asia	19 (31.7)	2 (2.0)	39 (65.0)	3	20 (31.7)	5 (7.9)	35 (55.6)
Other regions	11	2	27	2	13	4	23
Missing	11	4	44	2	15	4	40
	χ <sup>2</sup> = 2.6; df = 4; p = 0.63 (3 main regional groups; no missing data).				χ <sup>2</sup> = 7.3; df = 4; p = 0.12 (3 main regional groups; no missing data).		

**Table 5. Levels of refractive error among refugee groups by world regions – better and worse eye**

by the ACO optometrists in our sample (that is, refractive error, dry eyes and accommodation/convergence insufficiencies). This emphasises the importance of making available optometry services to this population, particularly addressing uncorrected refractive error and the desirability of screening of refugees to identify those requiring optometry services. These findings accentuate the important role played by ACO in providing public optometry services to refugees in Victoria. The impact of ACO services is manifest via its provision of new (subsidised) glasses at ACO clinics essentially reducing vision impairment by around 21 and 28 per cent in the better and worse eyes, respectively.

However, difficulties were experienced making comparisons of levels of vision impairment and refractive error for ACO refugee users to other peer-reviewed studies. This was because not only were there no community-based studies of refugee eye health in developed countries, there are few studies of levels of vision problems in optometry clinic-based populations in general.

While lower levels of vision problems may explain much of non-use of services, so too can lower access to these services as a result of, for example, transport difficulties, perceived high service cost, language difficulties, and low eye-health literacy. Moreover, those with severe eye problems may present to eye hospitals and those with less acute conditions may present to optometry clinics such as core ACO or private optometry clinics within the community. Therefore, the prevalence of refugees with uncorrected refractive error presenting to eye-health services may be lower than expected and significantly under-reported. Importantly, persons not yet recognised as refugees by the Australian government (that is, people seeking asylum) may also be under-represented as they may not be eligible for ACO services. However, further research is needed to explore these assumptions.

The current study has some other limitations. First, the dataset does not include data of refugees presenting at the main ACO clinic (Carlton) as electronic records were not available during the data collection period of 2013–2014. Second, prevalence of vision impairment and refractive error cannot be generalised to the refugee population in Victoria as the refugee population attending ACO are a presenting or referred sample with an eye problem. Third, clinical data being non-numerical, short text clinical data

for diagnosis was not recorded as robustly as for visual acuities, refraction values and core socio-demographic variables.

Against a background of the barriers to health-care services that refugees face in Australia, the findings of this study highlight the importance of special arrangements for the provision of optometry (refractive) services for refugees. The argument for this is further strengthened by knowledge that vision impairment can impair the quality of life of the individual, hinder educational attainment and impede employment opportunities.<sup>18–20</sup> Vision impairment can increase the risk of other conditions, restrict social participation and independence, and impair physical and mental health.<sup>19</sup>

In addition, eye disease and vision loss have considerable financial and social costs to the Australian community.<sup>28</sup> People with vision impairment have a higher use of social services and higher admission rates to nursing homes.<sup>29</sup> It has been calculated that the total financial costs of vision impairment in Australia, both direct and indirect, were over \$16.5 billion in 2009.<sup>30</sup> It is estimated that health system costs alone would rise to \$4.8 billion by 2020, an increase from \$2.6 billion in 2009. However, nearly 75 per cent of vision impairment (for example, uncorrected refractive errors, cataracts) is avoidable and treatable and if detected early can be prevented or managed before the vision impairment worsens.<sup>31</sup> Given that the majority of refugees resettling in Australia fall within the working age group, investing in refugee eye health is a worthwhile avenue for governments.

In light of the limited literature on refugee eye health, a comparator population is needed to better interpret findings from this study. To make progress, other studies should consider the relative frequencies of eye conditions and relative proportion of vision impairment and refractive error in refugee and other non-refugee users of the ACO, such as Pensioner Concession Card and Health Care Card holders. Future studies should also consider health service usage for the refugee groups at the ACO.

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## Supporting information

Additional supporting information may be found in the online version of this article at the publisher's website:

**Appendix S1.** Grouping of countries/world regions<sup>27,\*</sup> based on country of birth of cohort (n = 457, missing = 61).