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Prevalence and Causes of Visual Loss Among the Indigenous Peoples of the World
A Systematic Review

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IMPORTANCE Studies have documented a higher disease burden in indigenous compared with nonindigenous populations, but no global data on the epidemiology of visual loss in indigenous peoples are available. A systematic review of literature on visual loss in the world's indigenous populations could identify major gaps and inform interventions to reduce their burden of visual loss.

OBJECTIVE To conduct a systematic review on the prevalence and causes of visual loss among the world's indigenous populations.

EVIDENCE REVIEW A search of databases and alternative sources identified literature on the prevalence and causes of visual loss (visual impairment and blindness) and eye diseases in indigenous populations. Studies from January 1, 1990, through August 1, 2017, that included clinical eye examinations of indigenous participants and, where possible, compared findings with those of nonindigenous populations were included. Methodologic quality of studies was evaluated to reveal gaps in the literature.

FINDINGS Limited data were available worldwide. A total of 85 articles described 64 unique studies from 24 countries that examined 79 598 unique indigenous participants. Nineteen studies reported comparator data on 42 085 nonindigenous individuals. The prevalence of visual loss was reported in 13 countries, with visual impairment ranging from 0.6% in indigenous Australian children to 48.5% in native Tibetans 50 years or older. Uncorrected refractive error was the main cause of visual impairment (21.0%-65.1%) in 5 of 6 studies that measured presenting visual acuity. Cataract was the main cause of visual impairment in all 6 studies measuring best-corrected acuity (25.4%-72.2%). Cataract was the leading cause of blindness in 13 studies (32.0%-79.2%), followed by uncorrected refractive error in 2 studies (33.0% and 35.8%).

CONCLUSIONS AND RELEVANCE Most countries with indigenous peoples do not have data on the burden of visual loss in these populations. Although existing studies vary in methodologic quality and reliability, they suggest that most visual loss in indigenous populations is avoidable. Improvements in quality and frequency of research into the eye health of indigenous communities appear to be required, and coordinated eye care programs should be implemented to specifically target the indigenous peoples of the world.

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Supplemental content

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Surveys on the prevalence of visual impairment and blindness inform national eye health policies and interventions. Most surveys report the overall population prevalence without reporting disaggregated data from heterogeneous ethnic groups within populations[1] despite research showing that visual loss is more prevalent in disadvantaged ethnic communities.[2-4] Surveys that have assumed homogeneity in populations and neglected to investigate the prevalence of visual loss in disadvantaged subpopulations may have underestimated the burden of visual loss. Consequently, policy makers who rely on these data may develop suboptimal interventions.

Population groups likely to be neglected in epidemiologic research include indigenous people, of whom an estimated 370 million reside in 90 countries.[5] Indigenous peoples are among the world's most disadvantaged and marginalized populations.[6] Owing to colonial invasion, oppression, and exploitation, many indigenous peoples are heavily afflicted by poverty[7] and have almost ubiquitously poorer health outcomes than nonindigenous populations.[8] Although limited data have suggested that indigenous populations have higher rates of visual loss and eye disease than their nonindigenous counterparts,[9-11] systematic reviews on the prevalence and causes of visual loss and eye disease have not included data on indigenous populations.[12-15]

We conducted a systematic review on the burden of visual loss and eye diseases in the indigenous peoples of the world. This review aimed to determine the prevalence and causes of visual loss and the prevalence of major eye diseases in indigenous populations. We also intended to compare the eye health of indigenous and nonindigenous populations, evaluate the methodologic quality of existing studies, and identify gaps in the literature. Interventions informed by this review may contribute to reducing the burden of visual loss worldwide.

Key Points

Question What is the burden of visual loss and major eye diseases in the indigenous peoples of the world?

Finding This systematic review of 79 598 participants in 64 unique studies demonstrated that most countries have insufficient data on the burden of visual loss in their indigenous populations. In most cases in which data were available, the prevalence of visual loss and major blinding eye diseases were higher in indigenous than nonindigenous populations.

Meaning These data suggest that indigenous populations around the world are consistently neglected in eye health research and service delivery programs and therefore may have a greater burden of visual loss.

Methods

Search Strategy and Selection Criteria

A detailed protocol for this review was devised in consultation with a library information scientist and has been accepted by the Joanna Briggs Institute.[16] We searched the MEDLINE, Embase, Web of Science, and CINAHL databases to identify relevant literature on the prevalence of visual loss and eye disease in indigenous peoples. Additional sources searched included Global Health, LILACS (Literatura Latino Americana em Ciências da Saúde), Scielo, the World Health Organization, UNESDOC (United Nations Educational, Scientific, and Cultural Organization), Medecins Sans Frontieres Field Research, OpenGrey and GreyNets, and ProQuest Dissertations and Theses Global databases. Reference lists of included studies were searched. Indexed vocabulary and natural language terms were used (examples are shown in eTables 1 and 2 in the Supplement). No language restrictions were set.

Titles and abstracts were screened by 2 independent reviewers (J.F. and M.D.). Only studies from January 1, 1990, through August 1, 2017, were considered because studies conducted before the 1990s were likely to be inapplicable owing to interventions and changes in population parameters since their completion. We considered studies with participants belonging to defined indigenous groups. Because the definition of indigeneity is contentious and variable, we adhered to the United Nations Permanent Forum on Indigenous Issues when possible (eFigure 1 in the Supplement).[17] Studies that examined tribal communities without stating whether participants were indigenous were scrutinized based on geographic and ethnic factors to ascertain indigeneity, and experts were consulted. If no determination was possible, studies were excluded. Studies that investigated indigenous and nonindigenous participants in the same study were considered if data on indigenous and nonindigenous participants were reported separately. No restrictions were placed on age, sex, or geographic location. Because many studies on indigenous peoples have not reported response rates, a minimum response rate limit was not imposed. Instead, an appraisal of the reporting of response rates by studies was included in the review.

Cross-sectional surveys or screening studies that reported the prevalence and causes of visual loss or the prevalence of eye conditions or diseases based on results of an eye examination were considered. A minimum requirement for inclusion was a standardized visual acuity assessment. Self-report studies were excluded. Studies varied in visual acuity thresholds and definitions of visual impairment and blindness, and few studies included presenting visual acuity (PVA) and best-corrected visual acuity (BCVA). Performing a regression between BCVA and PVA to standardize estimates was therefore not possible. Consequently, no restrictions were placed on the definitions of visual impairment and blindness.

Assessment of Methodologic Quality, Data Extraction, and Synthesis

The 2 independent reviewers (J.F. and M.D.) used standardized instruments to assess the quality of studies (eMethods 1 in the Supplement) and to extract relevant information (eMethods 2 in the Supplement).[18] Owing to the sparseness of literature and differences in methodologic quality between studies, no studies were excluded based on concerns about sampling bias, representativeness, or sample size. Instead, we highlighted this heterogeneity and emphasized the resulting gaps.

Studies that used random sampling protocols were considered to be most representative. Some studies intentionally and nonrandomly selected samples to address specific objectives that could not have been adequately addressed with random sampling, such as determining the prevalence of visual loss in geographically isolated tribes. We defined this as *purposive sampling*, and although less reliable than random sampling, its use is justified given certain research settings. Studies that inappropriately used convenience

sampling when random sampling was feasible and would have been more appropriate were considered to be the least reliable studies. Sampling methods of each study were included in **Table 1**.

The prevalence, causes, and risk factors of visual impairment and blindness and the prevalence of major eye diseases are presented herein. The prevalence of visual loss in indigenous and nonindigenous populations was compared if studies included both groups. For studies that compared findings in indigenous populations with historical nonindigenous data from previous studies, we tabulated those data. If no comparisons were made, we searched the literature for studies in the same country with comparable study designs and participant age distributions and tabulated their prevalence estimates.

Results

Search Results

The database search yielded 21 475 citations, of which 20 947 were excluded. We screened the full texts of 528 records for relevance and excluded 281. The remaining 247 articles were examined thoroughly, and if provided, the names of ethnic groups were investigated for their status as indigenous or nonindigenous. Seventy of these articles were included. An additional 6 relevant articles were identified in the reference lists of included studies, and 9 studies were identified from other sources. Translations were required for 7 studies, including 4 in Portuguese,[72,73,76,82] 1 in Mandarin,[26] 1 in Spanish,[85] and 1 in Malay.[30] eFigure 2 and eTable 3 in the Supplement include the PRISMA flowchart and checklist.

The 85 included articles[19-76,78-104] described 64 unique studies that examined a total of 79 598 unique indigenous participants in 24 countries during the past 28 years (Table 1). Considering that indigenous populations inhabit approximately 90 countries, this indicates that the burden of visual loss and eye disease in most indigenous peoples around the world has not been adequately investigated. Nineteen of the 64 included studies sampled a total of 42 085 nonindigenous persons.

Methodologic Quality

Methods of the studies varied considerably in terms of design, geographic coverage, population representativeness, sampling, and ophthalmic examinations. Sample sizes ranged from 70 (Nuxalk Nation in Canada) to 12 644 (Tibetans). The extent to which the findings of some studies with small sample sizes can be extrapolated to the wider indigenous community is limited, including studies on diabetic retinopathy in the Maori of New Zealand (n = 144) and refractive errors in the Sioux in the United States (n = 184). Twenty-four studies[23,28-30,32,33,36,51,71,72,74,76,79,82,84-89,91,92,103] did not report response rates. Twenty-three studies[20-22,24-27,37,43,47,59,61,65,66,68,69,81,90,95,97,101,102,104] reported a response rate of greater than 70%, with 8 of these[22,24,26,27,47,68,69,81] achieving rates of greater than 90%.

Five national population-based surveys[24,31,56,63,67] reported nationwide prevalence estimates of visual loss and eye diseases in indigenous populations, including Timor-Leste, Malaysia, Fiji, and Australia (2 studies). In these countries, indigenous populations are distributed over a large geographic range, necessitating large-scale surveys with random sampling. These studies, as well as others that used random sampling protocols, were the most representative. Other countries contain geographically isolated (or semi-isolated) indigenous groups, many of whom reside in dedicated reserves (Native Americans in the United States), parks (Yanomami in Brazil), or islands (Nicobarese in India and the Inuit in Greenland), and the use of purposive sampling in these studies was warranted. However, some studies, such as those investigating the Aeta in the Philippines and Tibetan peoples, where the populations are dispersed over a larger range, may have inappropriately used convenience sampling.

Prevalence of Visual Impairment and Blindness

Twenty studies[19,21,23-26,31,32,34,41,47,51,56,61,63,67,69,74,99,100] reported the prevalence of visual impairment in indigenous populations. Ten of these[23-25,31,51,56,61,63,67,69] defined visual impairment based on PVA, 9[19,21,26,32,34,47,74,99,100] defined visual impairment based on BCVA, and 1[41] used PVA and BCVA (**Table 2**). Seventeen studies[19,21,24-26,31,34,41,47,48,51,56,63,67,74,99,100] reported the prevalence of blindness, with 7[24,31,51,56,63,67] using PVA, 9[19,21,26,47,74,99,100] using BCVA, and 2[25,41] using both definitions (**Table 3**). Studies that reported the prevalence of visual impairment or blindness by eye or in the worse eye[27,28,82,87,102] were excluded from Tables 2 and 3 because these findings were not comparable with the tabulated bilateral visual loss data. Risk factors for visual impairment and blindness are given in eTable 4 in the Supplement.

Owing to heterogeneity in age distributions and definitions of visual impairment and blindness, comparability between studies was limited. Nonetheless, the prevalence of visual impairment was found to be particularly high in some indigenous populations, including Tibetans 50 years or older (48.5%), indigenous Australians 40 years or older residing in Central Australia (25.1%), and the East Timorese (14.9%) using PVA and the Hamar tribespeople in Ethiopia 40 years or older (14.6%) and indigenous Australians of the Northern Territory 40 years or older (17.0%) using BCVA. Blindness was highly prevalent in Tibetan (10.9%), Timorese (7.7%), and Central Australian (3.6%) populations using PVA and in the Turkana people in Kenya (12.5%), the Hamar (8.1%), and indigenous Australians of the Northern Territory (4.1%) using BCVA.

Seven studies[20,23,32,61,63,67,90] statistically compared the prevalence of visual loss between indigenous and nonindigenous populations. Visual impairment was more prevalent in indigenous adults than in their nonindigenous counterparts in a nationally representative sample in Australia (adjusted prevalence, 17.7% vs 6.4%; $P < .001$) and in Mexico (adjusted prevalence, 10.0% vs 5.1%; $P < .001$). The odds of being blind were 2.5 times higher in indigenous Kalenjin people than in the nonindigenous population of Nakuru, Kenya. Countries in which nonindigenous adults had a higher prevalence of visual impairment than indigenous populations included Fiji (adjusted prevalence, 6.2% vs 9.5%; $P = .02$) and Singapore (adjusted prevalence, 3.9% vs 4.6%; no statistical comparison), although both countries had no difference in the prevalence of blindness. Indigenous children tended to have a lower prevalence of visual loss compared with nonindigenous children. This difference was observed in Egypt (1.1% vs 2.9%; $P = .007$) and Australia (age-standardized prevalence, 1.4% vs 6.4%).[56]

Indirect interstudy comparisons between indigenous populations and nonindigenous populations in the same country, although not standardized to account for heterogeneity between

Table 1. Studies on the Prevalence of Vision Impairment, Blindness, or Ocular Morbidity in Indigenous Peoples Included in This Systematic Review

Source	Country	Indigenous Group	Study Design/ Sampling Method	Sample Size		Main Outcome Measures
				Indigenous	Nonindigenous	
Africa						
Loewenthal and Pe'er,[19] 1990	Kenya	Turkana	Survey/random	900	0	Prevalence of VI and blindness; causes of blindness; prevalence of eye diseases; severity of trachoma
Mathenge et al,[20] 2012	Kenya	Kalenjin tribes	Survey/random cluster, PPS	1014	3396	Prevalence of VI and blindness; risk factors for blindness
Courtright et al,[21] 1993	Ethiopia	Hamar	Survey/random cluster, PPS	1007	0	Prevalence of VI and blindness
Ashaye et al,[22] 2013	Nigeria	Yoruba	Survey/random-stratified cluster, PPS	811	0	Distribution of IOP; prevalence of glaucoma and its subtypes
Yamamah et al,[23] 2015	Egypt	Bedouin	Survey/multistage stratified	1031	1039	Prevalence and causes of VI; prevalence of refractive errors
Asia						
Brian et al,[24] 2006	Timor-Leste	Timorese	RACSS survey/random cluster, PPS	1414	0	Prevalence of VI, blindness, cataract blindness, and cataract surgery coverage
Dunzhu et al,[25] 2003	China	Tibetans	Survey/multistage random cluster, PPS	12 644	0	Prevalence and causes of VI and blindness
Luobuciren and Li,[26] 2007	China	Tibetans	Survey/random cluster	735	0	Prevalence and causes of VI and blindness; prevalence of eye diseases
Lu et al,[27] 2008	China	Tibetans	Survey/convenience	1084	0	Prevalence of VI, blindness, and eye diseases; causes of VI; severity of refractive errors
Wang et al,[28] 2013	China	Tibetans	Survey/convenience	1115	0	Prevalence and causes of VI and blindness by eye; prevalence of eye diseases
Allingham,[29] 2008	Philippines	Aeta	Screening study/convenience	225	0	Prevalence of VI and blindness; causes of blindness; ocular disease
Norlaila et al,[30] 2002	Malaysia	Orang Asli	Survey/convenience	113	NA	Prevalence of refractive errors
Zainal et al,[31] 2002	Malaysia	Kadazans, Muruts, Dusuns, Ibans, Bajaus, Bidayuhs, and Orang Asli	Survey/multistage stratified random cluster, PPS	1740	16 287	Prevalence and causes of VI and blindness
Bakar et al,[32] 2012	Malaysia	Native Iban	School screening study/convenience	174	119	Childhood prevalence of refractive errors; prevalence of VI
Hsu et al,[33] 2008	Taiwan	Bunun and Rukai tribes	Screening study/convenience	383	0	Prevalence of refractive errors
Huang et al,[34] 2010; Chen et al,[35] 2012	Taiwan	Amis Aborigines	Survey/purposive	2316	0	Prevalence and causes of VI and blindness; prevalence of eye diseases
Vashist et al,[36] 2013	India	Nicobarese	TRA survey/purposive	1486	0	Prevalence and risk factors of trachoma and each of its stages
Malhotra et al,[37] 2016	India	Nicobarese	TRA survey/purposive	3544	0	Prevalence and risk factors of trachoma and each of its stages
Shen et al,[38] 2008; Saw et al,[39] 2008; Wong et al,[40,41] 2008; Rosman et al,[42] 2009; Cajucom-Uy et al,[43] 2010; Wong et al,[44] 2012	Singapore	Malay	Survey/stratified random cluster	3280	0	Prevalence, causes, and risk factors of VI and blindness; prevalence and risk factors of eye diseases
Oceania						
Mak et al,[45] 2001	Australia	Indigenous Australians (WA)	Screening study/convenience	597	0	Prevalence of trachomatous trichiasis
Durkin et al,[46] 2006	Australia	Indigenous Australians (SA)	Screening study/purposive	552	0	Prevalence of trachoma
Wright et al,[47] 2009	Australia	Indigenous Australians (NT)	Survey/convenience	260	0	Prevalence and causes of VI and blindness; prevalence of trachoma and its stages
Clark et al,[48] 2010	Australia	Indigenous Australians (WA)	Survey/purposive	920	0	Prevalence of VI, blindness, and DR

(continued)

Table 1. Studies on the Prevalence of Vision Impairment, Blindness, or Ocular Morbidity in Indigenous Peoples Included in This Systematic Review (continued)

Source	Country	Indigenous Group	Study Design/ Sampling Method	Sample Size		Main Outcome Measures
				Indigenous	Nonindigenous	
Landers et al,[49-53] 2010; Landers et al,[54] 2011; Landers et al,[55] 2012	Australia	Indigenous Australians (Central Australia)	Survey/convenience	1884	0	Prevalence, causes, and risk factors of VI and blindness; prevalence and risk factors of eye diseases
Taylor et al,[56-58] 2010; Chua et al,[59] 2011; Xie et al,[60] 2011	Australia	Indigenous Australians (nationwide)	Survey/multistage random cluster	2883	136	Prevalence and causes of VI and blindness, prevalence and risk factors of eye diseases
Hopkins et al,[61] 2016	Australia	Indigenous Australians (Queensland)	Survey/convenience	181	414	Prevalence of VI, refractive error, and strabismus
Dirani et al,[62] 2018; Foreman et al,[63,64] 2017; Keel et al,[65] 2017	Australia	Indigenous Australians (nationwide)	Survey/multistage random cluster, PPS	1738	3098	Prevalence, causes, and risk factors of VI and blindness; prevalence and risk factors of eye diseases
Brian et al,[66] 2010; Ramke et al,[67] 2012	Fiji	Melanesians	Survey/multistage random cluster	832	549	Prevalence of diabetic eye disease in those with diabetes; prevalence and causes of VI and blindness
Lindquist et al,[68] 2011	Fiji	Melanesians	Screening study/purposive	6011	2190	Prevalence of uncorrected refractive error
Simmons et al,[69] 2007	New Zealand	Maori	Survey/purposive and random	144	317	Clinical characteristics of and comorbidities in persons with diabetes; prevalence and risk factors of DR
Collins et al,[70] 1995	Samoa	Polynesians	Survey/purposive	355	0	Prevalence of diabetes complications
Latin America						
Scarpi et al,[71] 1992	Brazil	Amazonians	Survey/purposive	683	0	Prevalence of trachoma and its stages
Carvalho,[72] 1999	Brazil	Arawak, Tukano, Maku, and Yanomami	Survey/convenience	332	0	Prevalence of glaucoma
Buchillet,[73] 1999	Brazil	Arawak, Tukano, Maku, and Yanomami	Survey/convenience	433	0	Prevalence of myopia, cataract, and pterygium
Rehder et al,[74] 1999	Brazil	Bororo, Xavante, and Karaja	Survey/purposive	900	0	Prevalence and causes of VI and blindness
Alves et al,[75] 2002	Brazil	Hüpde, Tukano, and Dãw	Survey/convenience	333	0	Prevalence of trachoma and its stages
do Carmo Paula Pessoa dos Reis et al,[76] 2002	Brazil	Tukano, Maku, and others	Survey/convenience	179	0	Prevalence of trachoma and pterygium
Paula et al,[77] 2002	Brazil	Yanomami	Survey/convenience	613	0	Prevalence of trachoma and its stages
Thorn et al,[78] 2005	Brazil	Arawak, Tukano, Maku, and Yanomami	Survey/convenience	351	98	Distribution of refractive errors; prevalence of myopia
Paula et al,[79] 2006	Brazil	Arawak, Tukano, Maku, and Yanomami	Survey/random and convenience	624	0	Prevalence of cataract and pterygium
Neto et al,[80] 2009	Brazil	Yanomami	Survey/purposive	83	0	Prevalence of eye lesions relating to onchocerciasis
Medina et al,[81] 2011	Brazil	Macuxi, Wapixana, Wai Wai, Tourepang, and Yanomami	Survey/random cluster	1321	6986	Prevalence of trachoma
Biberg-Salum,[82] 2012	Brazil	Kadiwéus	Survey/convenience	177	0	Visual acuities and prevalence of eye diseases
Herzog-Neto et al,[83] 2014	Brazil	Yanomami	Screening study/convenience	86	0	Prevalence of ocular onchocerciasis
Freitas et al,[84] 2016	Brazil	Indigenous people of Brazil	Pooled screening data/case finding and random	9582	0	Prevalence of trachoma and its stages
Miller et al,[85] 2010	Colombia	Colombian Amerindians	Screening study/convenience	114	0	Presence of trachoma in the community

(continued)

Table 1. Studies on the Prevalence of Vision Impairment, Blindness, or Ocular Morbidity in Indigenous Peoples Included in This Systematic Review (continued)

Source	Country	Indigenous Group	Study Design/ Sampling Method	Sample Size		Main Outcome Measures
				Indigenous	Nonindigenous	
Botto et al,[86] 2016	Venezuela	Yanomami	Survey/purposive	1191	0	Physiological (including ophthalmologic) measures of onchocerciasis
Carter et al,[87] 2013	Paraguay	Macca	School screening study/convenience	118	190 (168 mixed)	Visual acuity, prevalence, and risk factors of refractive errors
Cooper et al,[88] 1995	Ecuador	Chachi Amerindians	Survey/convenience	498	287	Prevalence of onchocerciasis
Jimenez et al,[89] 2004	Ecuador	Naporuna	Survey/convenience	507	776	Prevalence of myopia
Jimenez-Corona et al,[90] 2015	Mexico	Indigenous peoples	Survey/purposive and random	512	457	Prevalence and risk factors of VI and blindness
North America						
Thommasen et al,[91] 2004	Canada	Nuxalk Nation	Hospital study/convenience	70	56	Prevalence of comorbidities in persons with diabetes
Ross et al,[92] 2007	Canada	Blackfoot, Stoney, and Sarcee	Screening study/convenience	232	2015	Prevalence, severity, and risk factors of DR
Oster et al,[93] 2009	Canada	First Nations	Survey and screening study/purposive	743	0	Use of health services, diabetes literacy, and clinical characteristics, including diabetes complications
Bourne et al,[94] 2001	Greenland	Inuit	Survey/convenience	79	0	Prevalence of glaucoma, IOP, ACD, and CDR
Andersen et al,[95] 2008	Greenland	Inuit	Survey/convenience	695	0	Prevalence of ARM and AMD
Pensyl et al,[96] 1997	United States	Sioux	Screening study/convenience	184	0	Frequency of refractive errors; distribution of astigmatism
Berinstein et al,[97] 1997	United States	Sioux	Survey/purposive	417	0	Prevalence of DR and its subtypes; DR risk factors
Rearwin et al,[98] 1997	United States	Navajo	Hospital study/convenience	361	0	Causes of blindness
Mansberger et al,[99] 2005	United States	Northwest American and Alaskan Natives	Survey/random cluster	288	0	Prevalence of VI, blindness, and eye diseases
Lee et al,[100] 2005; Butt et al,[101] 2011	United States	Oklahoma Native Americans	Survey/purposive	1019	0	Prevalence of VI, blindness, and eye diseases; risk factors for AMD
Harvey et al,[102] 2006	United States	Tohono O'odham	Screening study/convenience	1327	0	Prevalence of VI and astigmatism
Leston,[103] 2007	United States	Alaskan Natives	Survey with medical records/purposive	3830	0	Prevalence and risk factors of eye diseases; self-reported visual function
Ying et al,[104] 2014	United States	Cherokee, Choctaw, Seminole, Creek, Comanche, Kiowa, Ottaway, and others	School screening study/convenience	343	3697	Prevalence of VI and eye diseases

Abbreviations: ACD, anterior chamber depth; ARM, age-related maculopathy; AMD, age-related macular degeneration; CDR, cup-disc ratio; DR, diabetic retinopathy; IOP, intraocular pressure; NA, not applicable; NT, Northern Territory; PPS, probability proportional to size; RACSS, Rapid Assessment of Cataract Surgical Services; SA, South Australia; TRA, Trachoma Rapid Assessment; VI, vision impairment; WA, Western Australia.

studies, suggest that visual loss tends to be more prevalent in indigenous than nonindigenous populations. This prevalence was observed in comparisons between indigenous Tibetans[25] and Shunyi Chinese[105] (48.5% vs 18.2%); Hamar tribes[21] and the general population of Jimma Zone, Ethiopia[108] (8.1% vs 3.8%); and the Amis Aborigines[35] and the Han Chinese of Taiwan (4.1% vs 2.8%).[109]

Causes of Visual Impairment and Blindness

Data on the causes of visual impairment in indigenous peoples were available from only 7 countries[24,28,35,41,47,48,51,56,63,67,74] and varied in reliability owing to methodologic differences (**Table 4**). For example, the Timor-Leste study[24] focused specifically on cataract blindness, and therefore only determined the proportion of visual impairment (25.1%) and blindness (76.1%) attributable to cataract, whereas a US study[98] attributed the causes of visual loss in a nonrandom sample of Navajo presenting at a hospital.

Uncorrected refractive error (URE) was the leading cause of visual impairment in all studies that used PVA apart from indigenous Australians of remote Western Australia, accounting for 54.0% to 65.1% of visual impairment. Cataract was the second leading cause, accounting for 20.1% to 29.3% of cases. Cataract was the leading cause of visual impairment in all studies that used BCVA, with 72.2%

Table 2. Prevalence of VI in Indigenous Peoples and Comparator Nonindigenous Populations Within the Same Country

Indigenous Population/Country	Age, y	Year Published	VI Threshold	Prevalence, % (95% CI)[a]	Nonindigenous Population[b]	Age. y	Year Published	Prevalence, % (95% CI)[a]	*P* Value[c]
VI Based on PVA									
Adult populations									
Tibetans/China[25]	≥50	2003	6/24-6/60	48.5 (46.1-50.9)	Chinese of Shunyi County[105]	≥50	1998	18.2	NA
East Timorese/Timor-Leste[24]	≥40	2006	<6/18	14.9	NA	NA	NA	NA	NA
Malay/Singapore[41]	40-79	2008	<6/12-6/60	4.4 (4.3-4.5)	NA	NA	NA	NA	NA
Indigenous Australians (Central Australia)[51]	≥40	2010	<6/12	25.1	NA	NA	NA	NA	NA
Indigenous Australians (nationwide 2010)[56]	≥40	2010	<6/12-6/60	8.6 (6.9-10.7)	Nonindigenous population of Melbourne and Sydney[106]	≥40	2005	5.2	NA
Indigenous Australians (nationwide 2017)[63]	≥40	2017	<6/12-6/60	11.2 (9.5-13.1)	Nonindigenous Australians nationwide	≥50	2017	6.5 (5.3-7.9)	<.001
Melanesians/Fiji[67]	≥40	2012	<6/18-6/60	6.2 (4.5-7.8)	Indo-Fijians	≥40	2012	9.5 (6.9-12.0)	0.02
Indigenous peoples of Mexico[90]	≥20	2015	<6/18-6/60	10.0 (6.9-14.4)	Nonindigenous population	≥20	2015	5.1 (2.8-8.9)	<.001
Children or mixed populations									
Bedouin/Egypt[23]	5-17	2015	<6/18-3/60	1.1	Urban Egyptians	5-17	2015	2.9	0.007
Kadazans, Muruts, Dusuns, Ibans, Bajaus, Bidayuhs, and Orang Asli/Malaysia[31]	0-96	2002	<6/18-3/60	3.32	Malay, Chinese, Indian	0-96 for all	NA	NA	NA
Tibetans/China[25]	All	2003	6/24-6/60	10.9 (10.5-11.2)	NA	NA	NA	NA	NA
Indigenous Australians (nationwide)[56]	5-15	2010	<6/12-6/60	2.0 (1.3-2.9)	Nonindigenous children of Sydney[107]	6-12	2006	6.4 (6.3-6.4)	NA
Indigenous Australians (QLD)[61]	5-13	2016	<6/12	0.6	Nonindigenous Australians of QLD	5-13	2016	1.7	0.27
VI Based on BCVA									
Adult populations									
Hamar/Ethiopia[21]	≥40	1993	<6/18-3/60	14.6	Population of Jimma Zone[108]	≥40	1997	6.7	NA
Tibetans/China[26]	0-80	2007	<6/18-3/60	5.4	NA	NA	NA	NA	NA
Malay/Singapore[41]	40-79	2008	<6/12-6/60	3.9	Chinese Singaporeans[44]	≥40	2012	4.6	NA
Amis Aborigines/Taiwan[35]	≥65	2012	<6/18-3/60	4.1 (3.3-4.6)	Han Chinese of Taiwan[109]	≥65	2004	2.8	NA
Indigenous Australians (NT)[47]	≥40	2009	<6/18 to 6/60	17	NA	NA	NA	NA	NA
Oklahoma Native Americans/United States[100]	48-82	2005	<6/12-≥6/60	2.5	Population of Beaver Dam[110]	NA	NA	2.3	NA
Northwest and Alaskan Native Americans/United States[99]	≥40	2005	≤6/12	3.1 (1.0-5.0)	Population of Beaver Dam[110]	NA	NA	2.3	NA
Children or mixed populations									
Turkana/Kenya[19]	All	1990	<6/18-3/60	1.6	NA	NA	NA	NA	NA
Native Iban/Malaysia[32]	7-15	2012	≤6/12	1.8	Malay	7-15	2012	0	>.05
Bororo, Xavante, and Karaja/Brazil[74]	1-94	1999	<6/12-6/45	2	Population of Botucatu[111]	1-91	2009	1.3 (0.9-1.7)	NA

Abbreviations: BCVA, best-corrected visual acuity; NA, not applicable; NT, Northern Territory; PVA, presenting visual acuity; QLD, Queensland; VI, visual impairment.

[a] The 95% CIs were not available in all studies.

[b] Reference citations included for data extracted from studies separate from those of the indigenous population. Where possible, studies on nonindigenous populations were chosen that were similar in year published, geographic location, and study design.

[c] Extracted from the same studies as those of the indigenous population.

Table 3. Prevalence of Blindness in Indigenous Peoples and Comparator Nonindigenous Populations Within the Same Country

Indigenous Population/Country	Age, y	Year Published	VI Threshold	Prevalence, % (95% CI)[a]	Nonindigenous Population[b]	Age, y	Year Published	Prevalence, % (95% CI)[a]	*P* Value[c]
Blindness Based on PVA									
Adult populations									
Tibetans/China[25]	≥50	2003	<6/60	10.9 (9.3-12.5)	Chinese of Shunyi County[112]	≥50	1998	2.8 (2.4-3.1)	
East Timorese/Timor-Leste[24]	≥40	2006	<6/60	7.7	NA	NA	NA	NA	NA
Malay/Singapore[41]	40-79	2008	<6/60	0.27 (0.24-0.30)	NA	NA	NA	NA	NA
Indigenous Australians (Central Australia)[51]	≥40	2010	<6/60	3.6	NA	NA	NA	NA	NA
Indigenous Australians (nationwide 2010)[56]	≥40	2010	<6/60	1.8 (0.1-3.3)	NA	NA	NA	NA	NA
Indigenous Australians (nationwide 2017)[63]	≥40	2017	<6/60	0.31 (0.09-1.0)	Nonindigenous Australians nationwide	≥50	2017	0.21 (0.06-0.73)	NA
Melanesians/Fiji[67]	≥40	2012	<6/60	2.4 (1.3-3.4)	Indo-Fijians	≥40	2012	3.2 (1.7-4.7)	0.39
Children or mixed populations									
Kadazans, Muruts, Dusuns, Ibans, Bajaus, Bidayuhs, and Orang Asli/Malaysia[31]	0-96	2002	<3/60	0.64	Malay, Chinese, Indian	0-96 for all	2002	0.24 (Malay), 0.29 (Chinese), 0.23 (Indian)	NA
Tibetans/China[25]	<15	2003	<6/60	0.39 (0.17-0.76)	Chinese of rural Southern China[113]	12-17	2007	0.13 (0.03-0.36)	NA
Indigenous Australians (remote WA)[48]	16-89	2010	<6/60	0.54	NA	NA	NA	NA	NA
Indigenous Australians (nationwide)[56]	5-15	2010	<6/60	0.2 (0.01-0.7)	NA	NA	NA	NA	NA
Blindness Based on BCVA									
Adult populations									
Turkana/Kenya[19]	≥55	1990	<3/60	12.5	NA	NA	NA	NA	NA
Hamar/Ethiopia[21]	≥40	1993	<3/60	8.1	Population of Jimma Zone[108]	≥40	1997	3.8	NA
Malay/Singapore[41]	≥40	2012	<6/60	0.3	Chinese Singaporeans	≥40	2012	0.4	NA
Amis Aborigines/ Taiwan[35]	≥65	2012	<3/60	0.8 (0.45-1.19)	Han Chinese of Taiwan[109]	≥65	2004	0.58	NA
Indigenous Australians (NT)[47]	≥40	2009	<3/60	4.1	NA	NA	NA	NA	NA
Oklahoma Native Americans/United States[100]	48-82	2005	≤6/60	0.6	Population of Beaver Dam, Wisconsin[110]	43-86	1991	0.47	NA
Northwest and Alaskan Native Americans/United States[99]	≥40	2005	≤6/60	0.3 (0.0-1.0)	Population of Beaver Dam, Wisconsin[110]	43-86	1991	0.47	NA
Children or mixed populations									
Tibetans/China[25]	All	2003	<6/60	0.89 (0.84-0.94)	NA	NA	NA	NA	NA
Tibetans/China[26]	0-80	2007	<3/60	2.6	NA	NA	NA	NA	NA
Bororo, Xavante, and Karaja/Brazil[74]	1-94	1999	≤6/60	2.7	Population of Botucatu[111]	1-91	2009	0.4 (0.2-0.7)	NA

Abbreviations: BCVA, best-corrected visual acuity; NA, not applicable; NT, Northern Territory; PVA, presenting visual acuity; VI, visual impairment; WA, Western Australia.

[a] The 95% CIs were not available in all studies.

[b] Reference citations included for data extracted from studies separate from those of the indigenous population. Where possible, studies on nonindigenous populations were chosen that were similar in year published, geographic location, and study design.

[c] Extracted from the same studies as those of the indigenous population.

and 72.1% of visual impairment in the indigenous people of the Brazilian Amazon and Singapore, respectively, being attributable to cataract. Age-related macular degeneration (AMD) was the cause for 18.1% of visual impairment in Tibet but was not a leading cause of visual impairment in other indigenous populations.

Uncorrected refractive error was the leading cause of blindness in indigenous Australian adults in Central Australia (35.8%) and indigenous Australian children nationwide (14.0%) (Table 4). In all other indigenous populations, cataract was the main cause of blindness. Trachoma was associated with a considerable propor-

Table 4. Main Causes of VI and Blindness in Indigenous Peoples

Indigenous Group/Country	Age, y	Year Published	Definition	Cause[a]							
				URE	Cataract	DR	Glaucoma	AMD	Trachoma	Trauma	Other, Mixed, or Undetermined
Visual Impairment											
Timorese/Timor-Leste[24]	≥40	2006	PVA<6/18	NR	25.1	NR	NR	NR	NR	NR	NR
Amis Aborigines/Taiwan[35]	≥65	2012	BCVA<6/18-3/60	NR	52.1	6.4	2.1	18.1	NR	NR	21.3 (other)
Tibetans/China[28]	≥40	2013	BCVA<6/18-3/60	NR	50.2		1.7	NR	NR	0.4	37.6 (other)
Malay/Singapore[41]	40-79	2008	BCVA<6/12-6/60	NR	72.1	5.1	2.9	3.8	NR	NR	NR
Indigenous Australians (NT)[47]	≥40	2009	BCVA<6/12	NR	44.6	NR	NR	NR	4.1	NR	48.6
Indigenous Australians (remote WA)[48]	16-89	2010	PVA<6/12-6/60	21.1	28.6	28.6	0	NR	2.4	5.4	14.4 (other)
Indigenous Australians (Central Australia)[51]	≥20	2010	PVA<6/12	56.7	29.3	6.0	0.3	NR	2.2	NR	NR
Indigenous Australians (nationwide)[56]	≥40	2010	PVA<6/12-6/60	54.0	27.0	12.0	1.0	2.0	2.0	NR	3.0 (other), 3.0 (unknown)
Indigenous Australians (nationwide)[56]	5-15	2010	PVA<6/12-6/60	56.0	0	0	0	0	0	0	4.0 (congenital nystagmus), 40.0 (other)
Indigenous Australians (nationwide)[63]	≥40	2017	PVA<6/12-6/60	60.8	20.1	5.2	0.7	1.0	0	0	1.2 (other), 2.9 (mixed), 8.1 (undetermined)
Melanesians/Fiji[67]	≥40	2012	PVA<6/12	65.1	25.4	3.2	NR	NR	NR	NR	6.3 (other)
Bororo, Xavante, and Karaja/Brazil[74]	Unknown	1999	BCVA≤6/60	NR	72.2	NR	NR	NR	NR	NR	NR
Blindness											
Hamar/Ethiopia[21]	≥10	1993	BCVA<3/60	NR	47.0	NR	NR	NR	NR	NR	52.0 (other)
Turkana/Kenya[19]	0-≥75	1990	BCVA<3/60	NR	40.0	NR	NR	NR	20.0	NR	30.0 (xerophthalmia), 10.0 (unknown)
Aeta/Philippines[29]	≥40	2008	PVA<6/60	20.0	66.0	NR	NR	NR	NR	7.0	7.0 (other)
Timorese/Timor-Leste[24]	≥40+	2006	PVA<6/60	NR	76.1	NR	NR	NR	NR	NR	NR
Amis Aborigines/Taiwan[35]	≥65	2012	BCVA<3/60	NR	26.3	NR	NR	5.3	NR	NR	68.4 (other)
Tibetans/China[26]	0-≥70	2003	PVA<6/60	4.8	50.7	NR	2.5	15.7	NR	NR	26.3 (other)
Tibetans/China[26]	0-≥80	2007	BCVA<3/60	NR	42.1	NR	15.8	NR	NR	NR	21.1 (opacity)
Navajo/United States[98]	All	1997	BCVA≤6/60	NR	NR	24.6	15.8	8.8	7.0	14.0	29.8
Indigenous Australians (NT)[47]	≥40	2009	BCVA<6/60	NR	0	NR	NR	NR	40.0	NR	60.0
Indigenous Australians (remote WA)[48]	16-89	2010	PVA<6/60	0	38.1	16.7	2.4	NR	2.4	31.0	9.5 (other)
Indigenous Australians (Central Australia)[51]	≥20	2010	PVA<6/60	35.8	26.4	1.9	1.9	NR	13.2	NR	20.8 (other)
Indigenous Australians (nationwide)[56]	≥40	2010	PVA<6/60	14.0	32.0	9.0	0	0	9.0	5.0	24.0 (unknown), 14.0 (other)
Indigenous Australians (nationwide)[56]	5-15	2010	PVA<6/60	33.0	0	0	0	0	0	0	67.0 (unknown)
Indigenous Australians (nationwide)[63]	≥40	2017	PVA<6/60	0	40.0	20.0	0	0	0	0	20.0 (optic atrophy), 20.0 (mixed)
Melanesians/Fiji[67]	≥40	2012	PVA<6/60	8.7	69.5	NR	NR	NR	NR	NR	NR
Bororo, Xavante, and Karaja/Brazil[74]	Unknown	1999	BCVA≤6/60	NR	79.2	4.2	4.2	NR	NR	NR	12.5 (corneal)

Abbreviations: AMD, age-related macular degeneration; BCVA, best-corrected visual acuity; DR, diabetic retinopathy; NR, not reported; NT, Northern Territory; PVA, presenting visual acuity; URE, uncorrected refractive error; VI, visual impairment; WA, Western Australia.

[a] Indicates percentages of VI or blindness caused by each condition.

tion of blindness, particularly in the Turkana people of Kenya (20.0%) and the indigenous Australians of the Northern Territory (40.0%) and Central Australia (13.2%). Diabetic retinopathy was associated with 24.6% of blindness in Navajo and 20.0% of blindness in indig-

enous Australians nationwide. eTable 3 in the Supplement lists risk factors for visual impairment and blindness in indigenous peoples.

Prevalence of Eye Diseases

The prevalence of all eye diseases in the indigenous peoples of the world has been underreported (eTable 5 in the Supplement). Trachoma and its subtypes have received the most attention, with data available from Kenya, India, Australia, Brazil, and Colombia. Trachoma was most prevalent in the Turkana people of Kenya (42.8%) and in Brazilian tribes (30.3% in the Yanomami Indians and 56.4% in the Tiquié of the Upper Rio Negro). Rates of active trachoma varied considerably between populations, affecting 2.8% of indigenous children in Australia (but ≤14.9% in individual communities)[46] and 50.8% of Nicobarese children,[36] although a follow-up study demonstrated a decrease to 6.8% after 3 years of mass drug administration. Late-stage trachoma,[37] including trichiasis and corneal opacification, affected 8.3% of indigenous Australians in Central Australia and 8.0% of Tiquié people in Brazil. Only 3 studies described the prevalence of ocular onchocerciasis in indigenous populations, with 33.5% of Chachi Amerindians in Ecuador[88] and 38.5% to 68.6% of Yanomami Indians in Brazil[80,83] affected.

Data on posterior segment diseases in indigenous populations are rare, with reports on the prevalence of glaucoma and AMD being particularly sparse. The prevalence of glaucoma was low in most populations, with no cases detected in the Kadiwéus of Brazil and only 1.0% to 3.4% of the indigenous people of Taiwan, Australia, and Singapore having the disease. Age-related macular degeneration has only been investigated in the Amis Aborigines of Taiwan (5.2%), indigenous Australians (any AMD, 19.7%; late AMD, 0.17%), Native Americans (18.3% and 35.2%), and the Inuit of Greenland (9.5%).

Although scarcely investigated, the prevalence of myopia and URE varied substantially among populations, tending to be highest in Asia. Native Iban children of Malaysia had a prevalence of URE of 37.6% and a prevalence of myopia of 41.4%, whereas Singaporean Malay adults had a prevalence of URE of 18.3% and myopia of 26.2%. Conversely, no myopia was detected in the Macca of Paraguay and only affected 1.6% to 2.1% of indigenous Brazilians and 10.1% to 11.1% of indigenous Australian adults.

Countries in which pathologic ophthalmologic findings were more prevalent in indigenous adult populations compared with nonindigenous populations included New Zealand (moderate to severe diabetic retinopathy, 12.9% vs 4.3%), Australia (URE, 6.7% vs 4.0%; diabetic retinopathy, 39.4% vs 28.5%), Canada (diabetic retinopathy, 17.1% vs 10.7%), Brazil (odds ratio for trachoma, 1.06), and Ecuador (onchocercal microfilaria, 35.1% vs 18.1%).[88]

Indirect interstudy comparisons pointed to higher disease rates in indigenous peoples compared with nonindigenous populations, including in Nigeria (glaucoma, 6.9% vs 5.0%),[114] the United States (cataract, 39.6% vs 17.2%[115]; AMD, 35.2% vs 6.5%[116]; and glaucoma, 12.9% vs 2.1%[117]), Brazil (cataract, 13.7% and 24.5%[79] vs 4.9%[118]; glaucoma, 8.1% vs 3.4%[119]; and pterygium, 5.0%-36.6% vs 8.1%[120]), and Taiwan (pterygium, 44.1% vs 25.2%).[121] Some interstudy comparisons suggest a higher disease prevalence in nonindigenous populations, including in the United States (diabetic retinopathy, 20.1% vs 35.1%),[122] Taiwan (AMD, 5.2% vs 11.1%),[123] and Australia (glaucoma, 1.1% vs 3.0%[124]; myopia, 10.1% vs 17%[125]).

Discussion

This systematic review is the first, to our knowledge, of studies on the prevalence of visual loss and eye diseases in the indigenous peoples of the world. Our search only identified 65 studies published during the past 28 years from a total of 24 of the 90 countries with indigenous populations that met our search criteria.[5] In contrast, population-based surveys and systematic reviews have quantified the burden of visual loss and eye disease in the general populations of at least 100 countries, and most have not included indigenous populations.[1] This disparity, in conjunction with our findings that visual loss and eye diseases tend to be more prevalent in indigenous than in nonindigenous populations, provides evidence that indigenous peoples have been neglected in eye health research and treatment programs globally.

Direct intrastudy comparisons between indigenous and nonindigenous populations as well as indirect interstudy comparisons suggest that the eye health of indigenous peoples tends to be poorer than that of nonindigenous population groups. We acknowledge that nonstandardized interstudy comparisons may be affected by bias due to methodologic, sociodemographic, and temporal differences, and the resulting inferences must be made with caution. Nonetheless, the often substantially higher prevalence of visual loss and disease in indigenous groups within and among studies supports the view that indigenous people have a greater burden of visual loss.

The finding that visual loss and eye disease tend to be more prevalent in indigenous populations is consistent with literature on other health-related measures in indigenous populations.[8] However, this finding was not observed universally, because we found that for certain conditions, indigenous groups had a lower or similar prevalence to that of nonindigenous groups. It is important to consider these disparate findings with an awareness that the available evidence is fragmentary. Studies included in this review spanned almost 3 decades, and findings from earlier studies may no longer be applicable owing to interventions implemented since their completion. The consequence of this lack of applicability, the methodologic differences among studies, and the paucity of literature on most of the world's indigenous groups is that the burden of visual loss in the indigenous peoples of the world is not well established. Therefore, we recommend that where permissible, future studies in countries inhabited by indigenous populations should recruit sufficiently large samples of indigenous people to quantify the prevalence of visual loss in those groups and to ensure that data are disaggregated by indigenous status to allow policy makers to formulate targeted interventions accordingly.

Evidence supports the effectiveness of collaborative eye health programs that directly target indigenous populations. Examples include the Close the Gap for Vision initiative in Australia[126] and the Onchocerciasis Elimination Program for the Americas.[127] Through improved education, eye health promotion, and service availability across indigenous communities in Australia, the Close the Gap for Vision program has reduced the excess rate of blindness in the indigenous population from 6 times[56] to 3 times[63] higher than the rate for the nonindigenous population in 6 years and almost eliminated blinding trachoma.[62] The Onchocerciasis Elimination Program for the Americas eliminated onchocerciasis transmission in 11 of the pre-

vious 13 endemic disease foci in Latin America through repeated mass drug administration.[128] Targeted mass drug administration programs in the indigenous Yanomami of Venezuela have dramatically reduced disease transmission and incidence rates of onchocerciasis.[86] Therefore, we also recommend that specialized collaborative eye health programs that target underserviced indigenous populations be created and funded at the international level and domestically in countries inhabited by indigenous populations. Improvements in the frequency and methodologic quality of epidemiologic research in indigenous communities should provide the evidence base for these indigenous-specific eye care programs to optimize their impact.

Limitations

The major limitation of this review is the possibility that relevant studies were missed by the search strategy. We used a comprehensive list of search terms pertaining to the concept of indigeneity. However, because approximately 5000 distinct indigenous groups are extant,[5] we did not include specific indigenous group names in our list. Any studies that were not indexed according to general vocabulary pertaining to indigeneity and those that might have only used the specific name of the investigated tribe or group may not have been detected. Furthermore, our search generated a large body of epidemiologic literature in countries with recognized indigenous populations, including China,[129] Cameroon,[130] Nigeria,[131] Vanuatu,[132] and Nepal,[133] that did not identify the ethnicity of the sampled populations or identified ethnic groups whose status as indigenous was unclear.[129] Populations may have been indigenous, but the lack of identifiability or clarity necessitated their exclusion from our analysis. The second important limitation was the variation in the methodologic quality of included studies. Although some studies used robust population-sampling techniques, others used convenience sampling, and comparability among studies was therefore limited.

Conclusions

The welfare of indigenous peoples has gained increasing attention in recent years, with the United Nations developing the Permanent Forum on Indigenous Issues and an increasing number of organizations that represent indigenous issues being developed in countries with threatened indigenous groups.[5] In addition, research on the health of indigenous populations has been prioritized in a few countries, with governments such as those in Australia and Latin America allocating resources to health interventions for indigenous people, some with provisions for eye health.[126,127] Although progress has been made in some regions, indigenous peoples remain largely marginalized and excluded from society, with some governments refusing to recognize their existence.[5] The higher rates of morbidity and mortality in many indigenous populations continue to reflect this fact.[8] We have provided evidence that this health disparity includes a greater burden of visual loss and eye disease in indigenous populations, although the sparsity of available evidence has limited our ability to thoroughly assess the status of the eye health of indigenous peoples. The cornerstone of the Vision 2020 initiative developed by the World Health Organization and the International Agency for the Prevention of Blindness is that all people have the "right to sight" and that equitable eye health care services should be provided to those in need. If the international community truly wishes to achieve this objective, future initiatives must include specific and effective programs to target avoidable visual loss in the indigenous peoples of the world.

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