Global Mapping of Optometry Workforce

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Abstract

BACKGROUND:

The growing global burden of vision impairment makes it imperative that there are appropriately trained human resources. Optometrists play a critical role in alleviating this burden, but the low number of optometrists available or the numbers in different countries has always been a challenge for eye care planning. Despite this, there have been limited studies conducted to quantify the deficits in the number of optometrists globally.

Methods:

A standardised English language questionnaire was used in this cross-sectional study to determine the number and distribution of optometrists globally between February 2017 and May 2020. The survey was translated where necessary and completed by key informants. Using the World Council of Optometry's scope of practice guidelines, optometrists were defined at levels 2 to 4. Optometrist-to-population ratios were calculated for all countries and regions and compared to targets of 1:50 000 (in developing contexts) or 1:10 000 (in developed contexts).

Results:

An overall response rate of 80.9% was achieved with responses from 123 of the 152 countries invited. Most (40.7%) key informants were academics. The total number of optometrists across 21 Global Burden of Disease (GBD) regions was 331,781 as of 2019. Sixty-six (53.7%) of 123 countries met the 1:50,000 Optometrist-to-population ratio. A strong ($r=0.7$) direct positive relationship existed between age-standardised prevalences of blindness and mild- and severe-vision impairment and optometrist-to-population ratios. Strong inverse relationships were observed between country GDP and optometrist-to-population ratio.

Conclusion:

High-income countries met the target for optometrist-to-patient ratios, while low-to-, middle-income countries and low-income countries did not meet the targets. Low optometrist-to-patient ratios were strongly associated with a higher magnitude of blindness and vision impairment.

Background

Skilled and motivated health workers in sufficient numbers located appropriately in places with unmet needs are critical to deliver effective health services and improve health outcomes.[1] The World Report on Vision highlighted the need for an increase in eye health human resources to address the enormous magnitude of vision and eye health problems[2] – at least 2.2 billion people globally have a vision impairment, of which about 1 billion is preventable or yet to be addressed.[2] While budgets define the ability of countries to provide resources, even with enough finances, the paucity of relevant and appropriately trained human resources, especially optometrists and ophthalmologists,[3] are still a barrier to equitable access to quality eye care. Hence, 90% of the burden caused by vision impairment is found in developing countries.

Holden *et al.*[4] estimated that 2.6 billion people were living with myopia, while Frick *et al.*[5] reported 1.8 billion people living with presbyopia. Holden *et al.*[4] also established the alarming projection of 5 billion people living with myopia by 2050. This looming crisis will not only add to the number of people with uncorrected refractive error (URE) but also the number of people with other potentially blinding conditions such as glaucoma, retinal detachment and cataracts. Furthermore, conditions such as diabetic retinopathy, age-related macular degeneration and ailments arising from evolving visually demanding lifestyles (dry eye and binocularity problems) will increase the need for vision care and further amplify a global burden, which already exceeds the human resources for eye health currently available worldwide.

An optometrist, whose core function is detecting, measuring and correcting refractive error, and detecting and managing primary eye care and other conditions of public health concern that add to the global burden of vision impairment, is best placed to contribute to the disease control strategy. The World Council of Optometry defines an optometrist as a healthcare profession that is autonomous, educated, and regulated (licensed or registered). Optometrists are the primary healthcare practitioners of the eye and visual system who provide comprehensive eye and vision care, which includes refraction and dispensing, detection/diagnosis and management of eye disease, and visual system rehabilitation.[6] The importance of optometry was highlighted as an essential workforce in the Universal Eye Health: A Global Action Plan 2014–2019.[7] However, the insufficient number of optometrists means limited screening and reduced accessibility to refractiveservices and optical correction. This has contributed to a large number vision impairment due to URE, a condition that can be safely and inexpensively corrected, yet has become the primary cause of vision impairment.[8]

There have been attempts to quantify the global number of optometrists previously, but they did not provide a robust estimate, partly because these results were generated from a few countries where optometry is well-defined and regulated. The World Council of Optometry, which represents a large proportion of optometrists globally, suggests that it represents 200,000 optometrists from 89 member organisations in over 48 countries.[9] Fricke *et al.*[10] estimated the number of “functional clinical refractionists” (person who spends 100% of clinical time providing refraction services) to be 167,013 - a figure that is probably biased towards optometrists. The gross estimate of 300,000 optometrists is often used as the existing number of optometrists globally, but this estimate is not based on a formal evaluation. The estimate is further affected by the varying definitions of the profession of optometry that are used across countries. The result is an inaccurate estimate of an “optometry pool” of eye care workers of varying educational backgrounds providing refraction and/or refractive services at different levels of care and competency. This raises the following questions: *i) how many optometry personnel are there globally? ii) where are they distributed, and iii) at what level of competency are they practising?* Unless these questions are answered, developing adequate strategies to overcome this burden will be difficult to achieve.

The primary objectives of this study were to determine the ratio of optometrists to the population according to Global Burden of Disease Regions and its association to the gross domestic product (GDP) per capita and prevalence of blindness and moderate and severe vision impairment. We also investigated the number of training institutes and optometry graduates in the countries. We hypothesised that in countries with a lower number of optometry workforces, the prevalence of blindness and vision impairment would be higher than in countries where the number of optometry workforces is meeting the recommended practitioner-to-population ratio.

Methodology

A cross-sectional study utilising quantitative methods was conducted from February 2017 to May 2020. Non-random, purposive sampling and a key informant strategy was employed. The key informants were linked to either the World Council of Optometry members, other ophthalmic groups, prominent academics or individuals playing a key role in eye health development. These individuals were invited to complete the survey, which focussed on ascertaining the quantity and distribution of optometrists globally. When necessary, clarification on the survey questions was provided via direct communication, either verbally or via digital communications. A standardised English language questionnaire was designed to obtain the key indicators needed. Concerted efforts were made to reach those countries that initially did not respond. If the original key informant could not respond to the survey, they were asked for referrals to other individuals who could provide the necessary information.

The original English language survey was translated into Spanish, French, and Mandarin for ease of completion for those whose primary language was not English and were not comfortable responding to an English survey. Translators were used to translate the responses to English if they were self-administered in languages other than English. The survey was distributed via an email link (online survey) or on paper or Microsoft Office Word format for internet-limited settings. Respondents provided consent to participate in the survey before answering the specific research questions.

According to the Institute for Health Metric and Evaluation (IHME), there were 200 Global Burden of Disease countries (<http://ghdx.healthdata.org/countries>). However, 152 countries were included in the survey, with 48 countries being excluded due to unobtainable key informants as optometry does not formally exist in all countries. Data collected was reviewed, missing data were identified, and key informants were approached to provide the missing data or clarification, where possible.

The main questions presented to respondents were as follows (see Appendix 1 for further details):

1. What was the source of the information provided?
2. What was the number of professionals functioning at the various WCO Competency levels?
3. How many Optometry training institutions were there in the country?
4. How many optometrists did the optometry training institutions graduate per annum?
5. Was Optometry regulated?

The WCO Competency Model was used to define optometry with four categories of services which were:

1. **Category 1: Optical Technology Services:** Management and dispensing of ophthalmic lenses, ophthalmic frames and other ophthalmic devices that correct defects of the visual system
2. **Category 2: Visual Function Services:** Investigation, examination, measurement, diagnosis and correction/management of defects of the visual system
3. **Category 3: Ocular Diagnostic Services:** Investigation, examination and evaluation of the eye and adnexa and associated systemic factors to detect, diagnose and manage the disease
4. **Category 4: Ocular Therapeutic Services:** Use of pharmaceutical agents and other procedures to manage ocular conditions/disease

Based on this optometry workforce scope of practice, practitioners practising at Category 2 and above were considered to be defined as Optometrists. Our analysis excluded practitioners functioning at Category 1, who are based solely on dispensing spectacles, without investigation, examination, measurement, diagnosis and correction or management of the visual system defects.

Data was captured in a Microsoft Excel spreadsheet and then exported to Statistical Package for the Social Sciences (SPSS v26.0) for data cleaning and subsequent analysis. Descriptive statistics in the forms of frequencies and distributions were used to assess the response rates across 21 GBD regions, key informant's background and the source of information, country's capacity in training optometrists, regulation and continuous medical education in the respective country. The number of optometrists and the total population in the country were used to calculate the optometrist-to-population ratios, regionally and by country. Spearman's correlation analysis was used to test the association between the optometrist-to-population ratio and the demographic variables such as country's GDP per capita, the age-standardised prevalence of blindness and moderate and severe vision impairment (MSVI), with the significance level set at 5%. Ethics approval was obtained from the Human and Social Sciences Research Ethics Committee (Reference number: HSS/2135/016) from the University of KwaZulu-Natal, Durban, South Africa.

Results

Survey response rate

We received responses from 123 of the 152 countries invited for the survey, resulting in an overall response rate of 80.9%. Forty-eight of the 200 GBD countries were excluded due to unobtainable key informants. Table 1 shows the distribution of responses of countries by GBD region. Regions with lower response rates

were mainly from Sub-Saharan Africa, with the Central region being the lowest with 50.0%, followed by Western and Southern regions with 63.2% and 66.7%, respectively.

Table 1
Total number of countries included in the survey and the response rates (n=152 countries)

Global Burden of Disease Regions	Total number of countries included*	Total number of responded countries	Response rate (%)
Andean Latin America	3	3	100
Australasia	2	2	100
Caribbean	16	11	68.8
Central Asia	2	2	100
Central Europe	5	5	100
Central Latin America	9	6	66.7
Central Sub-Saharan Africa	4	2	50.0
East Asia	2	2	100
Eastern Europe	4	3	75.0
Eastern Sub-Saharan Africa	15	13	86.7
High-income Asia Pacific	4	3	75.0
High-income North America	2	2	100
North Africa and Middle East	14	10	71.4
Oceania	8	7	87.5
South Asia	4	3	75.
Southeast Asia	11	11	100.
Southern Latin America	3	3	100.
Southern Sub-Saharan Africa	6	4	66.7
Tropical Latin America	2	2	100.
Western Europe	17	17	100.
Western Sub-Saharan Africa	19	12	63.2
TOT/AL	152	123	80.9
*Source: Institute for Health Metric and Evaluation (IHME) list of Global Burden of Disease countries (http://ghdx.healthdata.org/countries). Refer to Online Supplementary File 1 for the list of countries.			

Key informant's background and source of information

Most respondents were affiliated with universities or research institutes (53 countries, 43.1%) or professional associations (42 countries, 34.1%) (Table 2). Most key informants were academics (40.7%), followed by association representatives (30.9%). More than half of the respondents' information (55.3%) was from government sources, primarily the Ministry of Health, Health Council Registry, and Medical Council Registry.

Table 2
Affiliations, key informants and source of information (n=123 responded countries)

		Number of countries	%
Affiliations	University/Research Institute	53	43.1
	Association	42	34.1
	<i>Association of Optometry, Association of Optician, College of Optometrist, Society of Technical Opticians, College of Opticians, Contactologists and Optometers, Ophthalmologist's Society</i>		
	Government Ministerial Unit	14	11.4
	<i>Ministry of Health, Ministry of Education, Medical Council, Optical Council</i>		
	Non-governmental Organisation	11	9.0
	Optical Practice	2	1.6
	Did not specify	1	0.8
	Total	123	100
Key informants	Academia	50	40.7
	<i>University Director, Head of Department, Dean of Faculty, Lecturer, Professor</i>		
	Association Representative	38	30.9
	<i>Director, CEO, Chairman, Chair, President, Secretary, Member, Coordinator</i>		
	Eye Care Personnel	15	12.2
	<i>Optometrist, Ophthalmologist</i>		
	Government Representative	9	7.3
	<i>National Eye Care Coordinator, Council Director, Council Secretary, Council Member, Diplomat, Coordinator</i>		
Source of Information	Non-governmental Organisation Representative	9	7.3
	<i>Foundation Director, Foundation Manager, Country Director, Programme Manager</i>		
	Did not specify	2	1.6
	Total	123	100
Source of Information	Government	68	55.3
	<i>Ministry of Health, Health Council Register, Medical Council Register, Health Practitioner Registration Agency, Ministry of Public Health, Patient Safety Authority</i>		
	Associations	11	8.9
	<i>European Academy of Optics and Optometry, College Graduation List, Eye Institute, School of Optometry Register</i>	8	6.5
	WHO Reports	2	1.6
	<i>Biblioteca Regional de Medicina (BIREME), Pan American Health Organisation (PAHO WHO ECSAR)</i>		
	IAPB Vision Atlas	1	0.8
	Other Sources	21	17.1
Source of Information	<i>On the ground research, desktop search, public health study, NGO database, general information, self, private email, personal awareness, trade register, hospital data, manufacturers, syllabus curriculum.</i>		
	Did not specify	12	9.8
	Total	123	100

The distribution of optometrists across Global Burden of Disease Regions

As guided by the World Council of Optometry, practitioners practising at Category 2 to 4 were considered to be optometrists. The reported number of optometrists across 21 GBD regions was 331,781 as of the year 2019, covering 88.5% of the global population (6.79 billion in 123 countries) (Table 3). The number of Category 4 optometrists were three times less than those practising at Category 2 (55,427 and 169,076, respectively). Seven regions reported no optometrists practising at Category 4 referring to Andean Latin America, Southern Latin America, Tropical Latin America, Central Asia, Central and Eastern Europe, and High-income Asia Pacific.

Considering the optometrist-to- opulation ratio, globally, one optometrist is serving an average of 20,479 persons. The unequal workforce distribution across countries and regions showed that in Central Sub-Saharan Africa, one optometrist serves 1,198,141 persons, compared to 3,877 populations in Western Europe. Among the 123 countries, 66 (53.7%) met the World Health Organisation recommended 1 optometrist to 50,000 persons target (1: 50,000),[11] while

only 33 (26.8%) reached the 1: 10,000 target as previously found in many developed countries.[12] All the countries in Australasia, Central Europe, High-income Asia Pacific, and High-income North America regions achieved both the recommended targets (Table 3).

Table 3
The number of optometrists and the ratio of optometrists to the population according to Global Burden of Disease regions

Global Burden of Disease Regions	Number of countries	Number of optometrists according to the scope of practice			Total number of optometrists	2019 Total populations (thousands)*	Optometrist to population ratio	Number of optometrists to reach the recommended 1 optometrist to 50000 population (1:50000) target	Total number of countries reached the recommended 1:50000 target	Number optomet to reach recomm 1 optom to 1000(1:1000) target
		Category 2	Category 3	Category 4						
Andean Latin America	3	3056	40	0	3096	61237	1: 19779	1225	1	6123
Australasia	2	0	2260	3736	5996	29985	1: 5001	600	2	2998
Caribbean	11	40	408	56	504	31467	1: 62435	629	8	3147
Central Asia	2	0	0	0	0	21776	- **	436	0	2178
Central Europe	5	2765	900	0	3665	67341	1: 18374	1348	5	6735
Central Latin America	6	928	12093	2491	15512	213544	1: 13766	4271	5	21354
Central Sub-Saharan Africa	2	97	0	2	99	118616	1: 1198141	2373	0	11862
East Asia	2	2500	800	900	4200	1457558	1: 34704	29151	0	145755
Eastern Europe	3	2700	2	0	2702	151241	1: 55974	3025	1	15124
Eastern Sub-Saharan Africa	13	946	2667	603	4216	436107	1: 103441	8722	2	43610
High-income Asia Pacific	3	47197	100	0	47297	183933	1: 3889	3678	3	18393
High-income North America	2	0	0	42720	42720	366476	1: 8679	7329	2	36648
North Africa and Middle East	10	3120	4095	11	7231	227327	1: 31438	4547	6	23733
Oceania	7	16	16	7	39	10803	1: 277000	216	3	1081
South Asia	3	38950	13590	1078	53618	1611592	1: 30057	32232	2	161159
Southeast Asia	11	3994	13284	38	17346	624422	1: 35998	12488	6	62442
Southern Latin America	3	424	720	0	1144	67195	1: 58737	1344	1	6720
Southern Sub-Saharan Africa	4	10	3984	32	4026	77632	1: 19283	1553	1	7764
Tropical Latin America	2	2000	1500	0	3500	218095	1: 62313	4362	0	21810

*Source: United Nation World Population Prospect 2019 (<https://population.un.org/wpp/Download/Standard/Population/>)

** There was no optometrist in the Central Asia region.

***Refer to Online Supplementary File 2 for details at the country level.

Global Burden of Disease Regions	Number of countries	Number of optometrists according to the scope of practice			Total number of optometrists	2019 Total populations (thousands)*	Optometrist to population ratio	Number of optometrists to reach the recommended 1 optometrist to 50000 population (1:50000) target	Total number of countries reached the recommended 1:50000 target	Number optomet to reach recomm 1 optom to 1000(populati (1:1000(target
		Category 2	Category 3	Category 4						
Western Europe	17	59831	50364	840	111035	430465	1: 3877	8609	17	43047
Western Sub-Saharan Africa	12	508	414	2912	3834	387793	1: 101146	7756	1	38780
TOTAL	123	169076	107272	55427	331781	6794609	1: 20479	135892	66 (53.7%)	679461

*Source: United Nation World Population Prospect 2019 (<https://population.un.org/wpp/Download/Standard/Population/>)

** There was no optometrist in the Central Asia region.

***Refer to Online Supplementary File 2 for details at the country level.

Relationship between the optometrist-to-population ratio and the country demographic characteristics

A higher age-standardised prevalence of blindness was significantly associated with a lower optometrist-to-population ratio at the country level ($p < 0.001$, $r = 0.721$) (Figure 1). This correlation was considered strong as the r -value was more than 0.7. A similar finding was reported for the age-standardised prevalence of mild and severe vision impairment, where a significant moderate direct positive relationship between the burden of disease and the optometrist-to-population ratio was observed ($p < 0.001$, $r = 0.636$) (Figure 2).

A significant inverse relationship was observed between the country gross domestic product per capita and the optometrist-to-population ratio ($p < 0.001$, $r = -0.770$) (Figure 3). Lower country gross domestic product per capita is correlated with a greater deficit of optometrists in the country.

Country's capacity in training optometrist

A total of 19,265 optometrists graduate from 123 countries annually (Table 4). Western Europe trained the highest number of optometrists among the 21 GBD regions (4,594 graduates), followed by South Asia (4,492 graduates), High-income Asia Pacific (2,160 graduates) and East Asia (2,100 graduates). Three regions did not have institutions within the countries to train optometrists, specifically, Central Asia, Central Sub-Saharan Africa, and Oceania.

Country's regulation on optometry and continuous medical education

Out of the 123 countries, less than half of the surveyed countries ($n = 54$, 43.9%) regulated optometry as an eye care professional. (Table 4) Optometry was recognised in all the countries in Australasia, high-income Asia Pacific and High-income North America regions. Forty-two countries (34.1%) imposed mandatory continuing professional education to maintain optometrists' competency level and further equip them with up-to-date practices.

Table 4

The number of training institutions, graduates per annum, countries with regulation and continuing medical education according to Global Burden of Disease Regions

Global Burden of Disease Regions	Number of countries	Number of institutions providing training			Number of graduates per annum			Total number of graduates per annum	Total number of countries with the optometry profession regulated	Total number of countries with mandatory continuing medical education for optometrists
		Category 2	Category 3	Category 4	Category 2	Category 3	Category 4			
Andean Latin America	3	6	1	0	71	0	0	71	1	0
Australasia	2	0	1	7	0	55	385	440	2	2
Caribbean	11	0	4	1	0	80	50	130	6	5
Central Asia	2	0	0	0	0	0	0	0	0	0
Central Europe	5	13	3	0	315	55	0	370	2	2
Central Latin America	6	4	13	25	125	102	500	727	4	2
Central Sub-Saharan Africa	2	0	0	0	0	0	0	0	0	0
East Asia	2	28	28	19	1500	200	400	2100	0	0
Eastern Europe	3	5	0	0	70	0	0	70	1	1
Eastern Sub-Saharan Africa	13	5	6	9	45	58	150	253	7	6
High-income Asia Pacific	3	71	0	0	2160	0	0	2160	3	2
High-income North America	2	0	0	23	0	0	1900	1900	2	2
North Africa and Middle East	10	4	12	0	90	300	0	390	5	3
Oceania	7	0	0	0	0	0	0	0	2	3
South Asia	3	86	118	12	1600	2570	322	4492	1	0
Southeast Asia	11	10	34	1	279	680	0	959	4	3
Southern Latin America	3	2	12	0	11	80	0	91	1	0
Southern Sub-Saharan Africa	4	0	6	1	0	155	0	155	2	2
Tropical Latin America	2	2	3	0	0	200	0	200	0	0
Western Europe	17	18	51	5	2324	2180	90	4594	8	6
Western Sub-Saharan Africa	12	6	2	7	83	80	0	163	3	3
TOTAL	123	260	294	110	8673	6795	3797	19265	54 (43.9%)	42 (34.1%)

Discussion

Our study quantified the number of optometrists functioning according to the WCO competency level. The optometrist-to-population ratio globally of one optometrist to 20,479 persons appears reasonable when viewed in the developing world context (1:50,000 recommended ratio)[11]. However, this ratio masks the unequal distribution of the workforce across countries or regions. Central Sub-Saharan Africa, for example, is serving 1,198,141 populations, compared to

3,877 populations in Western Europe. Approximately half of the countries (53.7%) met the 1: 50,000 ratio, with all high-income regions meeting the 1: 10,000 ratio.

Anecdotal evidence suggests that the ratio of optometrists to population is critically low in rural and outlying areas and magnifies the deficits displayed in our data. This paucity of optometrists in the developing world is further accentuated when one considers intra-country variations whereby optometrists, like most eye care providers are confined to the major cities. While producing more optometrists is imperative to address the unequal distribution, the workforce must be more effectively distributed, a major challenge given the lack of incentives[13] and facilities in rural and remote areas, making recruitment difficult.

Developing an adequate number for the workforce is a complex task due to numerous factors, including key elements such as the lack of educators, the length of training for professionals, regulatory barriers, and the cost of setting up training institutions. However, Thompson et al. showed that implementing an optometry program de novo in a developing country is cost-effective,[14] which in the best case scenario reaches self-sufficiency in 10-12 years post setup, using conservative approaches and restricted means. A lower country GDP per capita is correlated with a greater shortage of optometrists in countries. As such, resources may not always be available for the establishment of schools of optometry. Strong advocacy supported by a robust evidence base such as the impact of poor vision on productivity[15–17] or learning[18–20], which is documented, is needed to make a case for the value of optometry school development. International collaboration needs to be mobilised to ensure that academic, logistical and material support is provided for new schools, and new policy formulation needs to overcome regulatory barriers. However, the current status in the low-income countries indicates that the deficits seen in the number of optometrists will not be addressed soon. As few new optometrists are being trained, innovative strategies that encompass the following need to be explored:

- **Team approach:** While vision screening is done at a primary level by allied health professionals, linking optometrists in the referral pathway is imperative to ensure a continuum of care. Optical assistants/technicians assisting in refractive services by doing some preliminary testing can help increase the effectiveness of optometrists. Similarly, the referral pathway for available optometrists to ophthalmologists and other specialty services for a higher level of care needs to be facilitated. In adopting a team approach, optometrists can provide the care needed by three types of patients: those who need ongoing care, those at early-stage disease and those with symptomatic conditions without vision impairment but still need services.[21]
- **Technology:** Strategies such as using more cost-effective tools to increase the quality of care and increase the output of optometrists needs to be explored. Furthermore, the optometry workforce needs to be mobilised to reach outlying rural areas via outreach activity or supporting social businesses in under-developed areas. Tele-health overseen by optometry may support distance monitoring and oversight to potentially provide a greater reach for the profession. These strategies, however, need to be carefully developed without compromising the quality of care.
- **Upskilling:** In countries where optometry is not developed, post-graduate and continuing professional education must be explored to expand the knowledge and skills of existing cadres so that they can be integrated into the optometry profession. This takes on increasing importance in an era where other morbidities such as diabetic retinopathy and glaucoma are becoming a significant threat to visual health if detection and treatment are delayed.

The World Report on Vision states that at least 1 billion people in the world with vision impairment could have been prevented or have yet to be addressed.[2] Of this, almost 950 million is related to refractive error and presbyopia; both are key responsibilities of optometrists to address. The correlation between low numbers of optometrists and a high prevalence of vision impairment and blindness in regions thus indicates that unless urgent action is taken to increase the number of optometrists trained and deployed to underserved areas in low-income countries, plans to eliminate preventable vision impairment will remain elusive. In addition, implementing comprehensive eye care will be difficult to provide as this requires a team, with the optometrists as a critical component of that team.

Although optometrists were trained and competent in delivering primary eye care to the populations, more than half of the surveyed countries did not officially regulate this profession as part of the health system. This implies that advocacy work must be undertaken to make optometry visible to the governing bodies, the relevant authorities, and the public. The recognition of the profession is vital to enable funding priority in training an adequate number for the optometry workforce to support the population's needs in eye health services.

While this study had a good response rate, one limitation was the inability to reach all countries where optometry is practised, or where optometric care is delivered under a different technical terminology. There is a need to expand this data collection to all of the 200 GBD countries. However, the data identifies the divide between the low-income and high-income regions and countries in the training and deployment of optometrists. A follow-up study will be conducted to ensure that more countries are included.

Conclusion

Our study found that high-income countries met the target for optometrist-to-patient ratios. Low-to-middle-income countries and low-income countries did not only fail to meet the targets, but they are also far from reaching them. The low optometrist-to-patient ratios are strongly associated with a higher magnitude of blindness and vision impairment.

The number of optometrists worldwide is increasing, but gaps remain in numerous areas around the world. Unless these gaps are addressed, we will not make a significant contribution towards achieving targets related to Universal Health Coverage and the Sustainable Development Goals outlined by the United Nations. According to the World Report on Vision, "Everyone, if they live long enough, will experience at least one eye condition in their lifetime. For example, many people will have had conjunctivitis as a child, will need spectacles due to presbyopia sometime after 40 years of age, or require cataract surgery later in life." This statement amplifies the need for eye care globally. With the lack of optometrists in the low-income areas of the world, optometry training and output will have to be significantly accelerated or upscaled to address the increased demand for eye care.

Declarations

Ethics approval and consent to participate: A statement of ethics committee and the corresponding reference number has been included in the manuscript. A statement of consent to participate was included in the survey.

Consent for publication: All authors grant the publisher the permission to publish the manuscript.

Availability of data and materials: All data generated or analysed during this study are included in this published article (and its supplementary information files).

Competing interests: None

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Figures

Figure 1

The relationship between the optometrist-to-population ratio and the age-standardised prevalence of blindness

Figure 2

The relationship between the optometrist-to-population ratio and the age-standardised prevalence of mild and severe vision impairment

Figure 3

The relationship between the optometrist-to-population ratio and the country gross domestic product per capita

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