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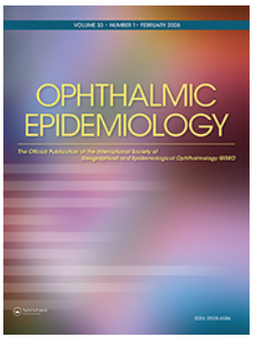
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Prevalence of Vision Loss in High-Income Countries and in Eastern and Central Europe in 2020: Magnitude and Temporal Trends

Vision Loss Expert Group of the Global Burden of Disease Study and the GBD 2019 Blindness and Vision Impairment Collaborators

ABSTRACT

Purpose: To estimate the prevalence of vision loss for 2020 in high-income countries (HICs) and Central/Eastern Europe and analyse evolving trends since 1990.

Methods: Based on a systematic review of medical literature, prevalence of blindness, moderate and severe vision impairment (MSVI), mild vision impairment (VI), moderate VI and presbyopia were estimated for 1990, 2000, 2010, and 2020.

Results: The study included 68 population-based studies. In the whole study region, the age-standardized prevalence (all ages) of blindness, MSVI, moderate VI, severe VI, mild VI, and presbyopia-related VI was 0.17% (95% CI:0.15–0.19), 2.27% (2.05–2.49), 2.06% (1.84–2.29), 0.21% (0.18–0.23), 1.79% (1.62–1.99), and 2.61% (1.88–3.48) respectively, with slightly higher rates for women than men. The prevalence rates were higher in Central/Eastern Europe than in the HIC, and lower than the global rates. Stratified between Australasia, high-income Asia Pacific region, high-income North America, Western Europe, Central Europe, and Eastern Europe, the age-standardized prevalence of blindness changed between 2000 and 2020 for men aged 50+ years by −7.95% (−8.11/−7.78), −14.51% (−14.64/−14.38), +13.18% (+13.00/+13.36), −12.07% (−12.23/−11.91), −14.39% (−14.54/−14.23), and −23.59% (−23.72/−23.46), respectively, without significant sex-related differences. Highest increase was in high-income North America (+13.18% (+13.00/+13.36)) and most marked reduction in Eastern Europe (−23.59% (−23.72/−23.46)). Estimated blind individuals were stratified as follows: Australasia, 68,866 (54,913–84,527), high-income Asia Pacific region, 535,124 (439,912–640,330), high-income North America, 711,990 (575,977–867,402), Western Europe, 1,533,752 (1,218,371–1,898,343), Central Europe, 327,352 (264,513–398,083) and Eastern Europe, 789,618 (663,130–923,121).

Conclusions: Age-standardized prevalence of blindness and MSVI have further decreased in HIC and Eastern/Central Europe (except for high-income North America with an increase).

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Introduction

Vision impairment (VI) and blindness as part of sensory deficits is of high importance for public health of countries and for the individual patient. In the recent Global Burden of Disease Study GBD 2019, blindness and vision loss ranked in the list of level 3 causes of global DALYs (disability adjusted life years) at the 19th position in the age group of 50 to 74 years, and at 15th position in the age group of 75+ years.[1] In a previous meta-analysis, 43.3 million people were blind (worldwide) in 2020 and 295 million people had a moderate and severe vision impairment (MSVI), and 258 million had mild vision impairment.[2] Blindness was defined as presenting visual acuity <3/60 in the better eye, MSVI as presenting visual acuity <6/18 but ≥3/60 in the better eye, and mild vision impairment was characterized by a presenting visual acuity of ≥6/18 and <6/12).

Since the demographic structure of the populations is constantly changing due to the increase in the population size, ageing and changes in the socioeconomic parameters, continuous updating of the prevalence of blindness and vision impairment is a demand to detect tendencies early, to keep policy makers informed, to better allocate funds for further improvement in public heath, and to assess the effect of new therapies or other measures on the prevalence of blindness and vision impairment. We therefore undertook this study to update the prevalence of blindness and vision impairment in the world region of high-income countries and Central and Eastern Europe.[3] In comparison to the recent assessment of blindness prevalence in the world region of high-income countries, we applied an improved statistical model, incorporated more and more recent data sources, and refined the data of the prevalence of presbyopia.

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Methods

Preparation of data included first a systematic review of published (between Jan 1, 1980, and Oct 1, 2018) population-based studies of vision impairment and blindness by the Vision Loss Expert Group (VLEG), that also included grey literature sources. Eligible studies from this review were then combined with data from Rapid Assessment of Avoidable Blindness (RAAB) studies by the VLEG and finally data from the US National Health and Nutrition Examination survey and the WHO Study on Global Ageing and Adult Health were contributed by the GBD team. More details of the methods are published elsewhere and discussed in brief as follows.[4] In total, the VLEG identified 137 studies and extracted data from 68 studies in their 2010 review, and a further 67 studies in their 2014–18 review.[5–10] Studies were primarily national and subnational cross-sectional surveys. Additionally, the VLEG commissioned the preparation of 5-year age-disaggregated RAAB data from the RAAB repository. Studies were included if they met the following criteria: visual acuity data had to be measured using a test chart that could be mapped to the Snellen scale, and the sample had to be representative of the population. Self-report of vision loss was excluded. We used International Classification of Diseases 11th edition criteria for vision loss, as used by the WHO, which categorizes people according to vision in the better eye on presentation, in which mild vision loss is defined as a visual acuity of 6/18 or better but less than 6/12, moderate vision loss as a visual acuity of 6/60 or better but less than 6/18, severe vision loss as a visual acuity of 3/60 or better but less than 6/60 (hence our definition of MSVI is <6/18 to 3/60), and blindness as a visual acuity of less than 3/60 or less than 10° visual field around central fixation (although the visual field definition is rarely used in population-based eye surveys). Vision impairment from undercorrected presbyopia was defined as presenting near vision of worse than N6 or N8 at 40 cm when best-corrected distance visual acuity was 6/12 or better.

First, we separated raw data into datasets including so-called vision-loss envelopes for all-cause mild, moderate, and severe vision loss, and blindness. Studies that only reported male and female sex information combined were split into male-specific and female-specific datapoints by identifying within-study datapoints matched by age, year, and location that reported data for male and female prevalence separately. We then used the log ratio of female to male prevalence from these studies as input data into a mixed-effects meta-regression tool developed by the Institute for Health Metrics and Evaluation (IHME) called MR-BRT (meta regression; Bayesian; regularized; trimmed).[1] We used results from this model and demographic data on population by location to determine male and female prevalence of vision impairment. Next, we used MR-BRT to adjust non-reference data to the reference definition of presenting vision data that fit within the WHO severity categories using data from studies that did not involve RAAB methods.

Disease Modelling Meta-Regression (DisMod-MR) 2.1 modelling used all input data from all locations in a mixed-effects non-linear model for a global estimate of disease burden.[11] We used model outputs (global fit plus fixed effects plus random effects) in a cascade as a prior for estimates in the seven GBD super-regions, which in turn were used as priors for regional estimates, and then country estimates, and finally subnational estimates for a subset of 21 countries.

We ran DisMod-MR 2.1 models for all vision loss severity categories. Final estimates for GBD 2019 are for the years 1990–2019. To estimate the number of individuals for each severity level for the year 2020, we multiplied 1000 draws of estimated prevalence from GBD 2019 for each location by the 2020 population estimates for each location to calculate the number of affected individuals and 95% uncertainty intervals (UIs) in 2020. We age-standardized our estimates using the GBD standard population.

Results

The study included 68 population-based studies, all of which were conducted in a cross-sectional manner, with most of the studies having as inclusion criterion a minimum age of 40 years (Table 1).

In the whole study region, the age-standardized prevalence of blindness for all ages was 0.17% (95% CI: 0.15–0.19), with a prevalence of 2.27% (2.05–2.49) for MSVI, 2.06% (1.84–2.29) for moderate VI, 0.21% (0.18–0.23) for severe VI, and 1.79% (1.62–1.99) for mild VI (Tables 2 and supplementary material Table 1a). The age-standardized prevalence of presbyopia-related VI was 2.61% (1.88–3.48) (Tables 2 and supplementary material Table 1a). Women did not markedly differ from men in the age-standardized figures (Tables 2 and supplementary material Table 1a). In Figures 1 and2 the crude prevalence of blindness and MSVI is displayed for individuals 50 years and older.

Stratified between Australasia, high-income Asia Pacific region, high-income North America, Western Europe, Central Europe, and Eastern Europe, the

Table 1. Countries in the High-income and Eastern and Central Europe region.

Region	Countries
Australasia	Australia, New Zealand
High-income Asia Pacific	Brunei, Japan, Singapore, South Korea
High-income North America	Canada, United States
Western Europe	Andorra, Austria, Belgium, Cyprus, Denmark, Finland, France, Germany, Greece, Greenland, Iceland, Ireland, Israel, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom
Central Europe	Albania, Bosnia and Herzegovina, Croatia, Czech Republic, Hungary, Macedonia, Montenegro, Poland, Romania, Serbia, Slovakia, Slovenia
Eastern Europe	Belarus, Estonia, Latvia, Lithuania, Moldova, Russia, Ukraine

Table 2. Age-standardized prevalence (%) of blindness, moderate and severe vision impairment (MSVI), moderate vision impairment (VI), severe VI, mild VI, and presbyopia-related VI in high-income countries and Central and Eastern Europe in 2020 (all ages).95% uncertainty intervals are given in parentheses.

	Blind	MSVI	Moderate VI	Severe VI	Mild VI	Presbyopia-related vision impairment
High-Income countries and Central/Eastern Europe						
Both	0.17 (0.15–0.19)	2.27 (2.05–2.49)	2.06 (1.84–2.29)	0.21 (0.18–0.23)	1.79 (1.62–1.99)	2.61 (1.88–3.48)
Female	0.17 (0.15–0.19)	2.32 (2.10–2.56)	2.11 (1.89–2.34)	0.21 (0.19–0.24)	1.89 (1.70–2.10)	2.72 (1.95–3.62)
Male	0.17 (0.15–0.19)	2.17 (1.96–2.39),	1.97 (1.76–2.19)	0.20 (0.18–0.22)	1.69 (1.53–1.88)	2.46 (1.76–3.29)
World						
Both	0.52 (0.46–0.59)	3.58 (3.24–3.92)	3.16 (2.83–3.49)	0.42 (0.37–0.47)	3.20 (2.89–3.54)	5.97 (4.36–7.81)
Female	0.54 (0.47–0.61)	3.77 (3.42–4.13)	3.32 (2.97–3.68)	0.45 (0.40–0.51)	3.42 (3.10–3.78)	6.27 (4.58–8.16)
Male	0.50 (0.44–0.56)	3.37 (3.05–3.70)	2.98 (2.67–3.30)	0.39 (0.34–0.44)	2.97 (2.68–3.28)	5.64 (4.11–7.41)

age-standardized prevalence of blindness for men aged 50+ years was 0.49% (0.41–0.57), 0.47% (0.41-–0.53), 0.41% (0.36–0.47), 0.55% (0.47–0.63), 0.58% (0.50–0.68), and 0.87% (0.75–1.00), respectively (Table 3).

Comparing the world regions with each other, the prevalence of blindness, MSVI, severe, moderate and mild VI, and presbyopia-related VI were higher in Central/Eastern Europe than in the other regions (Tables 2 and supplementary material Table 1a). In all study regions, the figures of prevalence of blindness and MSVI were lower than the global figures, except for the prevalence of MSVI for women in Eastern Europe (Supplementary material Table 1a).

The age-standardized prevalence of blindness, MSVI, moderate VI, severe VI, mild VI, and presbyopia-related VI in 2020 had the tendency to be slightly higher for women than for men.

Stratified between Australasia, high-income Asia Pacific region, high-income North America, Western Europe, Central Europe, and Eastern Europe, the age-standardized prevalence of blindness changed between 2000 and 2020 for men aged 50+ years by 7.95% (−8.11/−7.78), −14.51% (−14.64/-14.38), +13.18% (+13.00/+13.36), −12.07% (−12.23/−11.91), −14.39% (−14.54/−14.23), and −23.59% (−23.72/-23.46), respectively (Supplementary material Table 1b). Men and women did not differ markedly in these figures. Central/Eastern Europe generally showed a more marked change in all these parameters in direction to a decrease in the prevalence of blindness and VI, with no profound differences in these figures of change between the sexes (Supplementary material Table 1b).

The estimated number of people affected by blindness and MSVI for the years 1990, 2000, 2010 and 2020 are presented in Tables 3 and 4. Stratified between Australasia, high-income Asia Pacific region, high-income North America, Western Europe, Central Europe, and Eastern Europe, blindness affected 68,866 (54,913–84,527) individuals, 535,124 (439,912–640,330) individuals, 711,990 (575,977–867,402) individuals, 1,533,752 (1,218,371–1,898,343) individuals, 327,352 (264,513–398,083) individuals, and 789,618 (663,130–923,121) individuals, respectively.

Discussion

This updated meta-analysis of blindness and VI-related figures in the HICs and Central/Eastern Europe revealed an age-standardized prevalence of blindness for all ages of 0.17%, while the MSVI prevalence was 2.27%, with figures of 2.06%, 0.21%, 1.79%, and 2.61% for moderate VI, severe VI, mild VI, and presbyopia-related VI, respectively, with slightly higher rates for women than men. The prevalence rates were higher in Central/Eastern Europe than in the HIC, and lower than the global rates. Except for high-income North America with an increase of +13.18%, the age-standardized prevalence of blindness decreased without significant sex-related differences in all regions in the study period

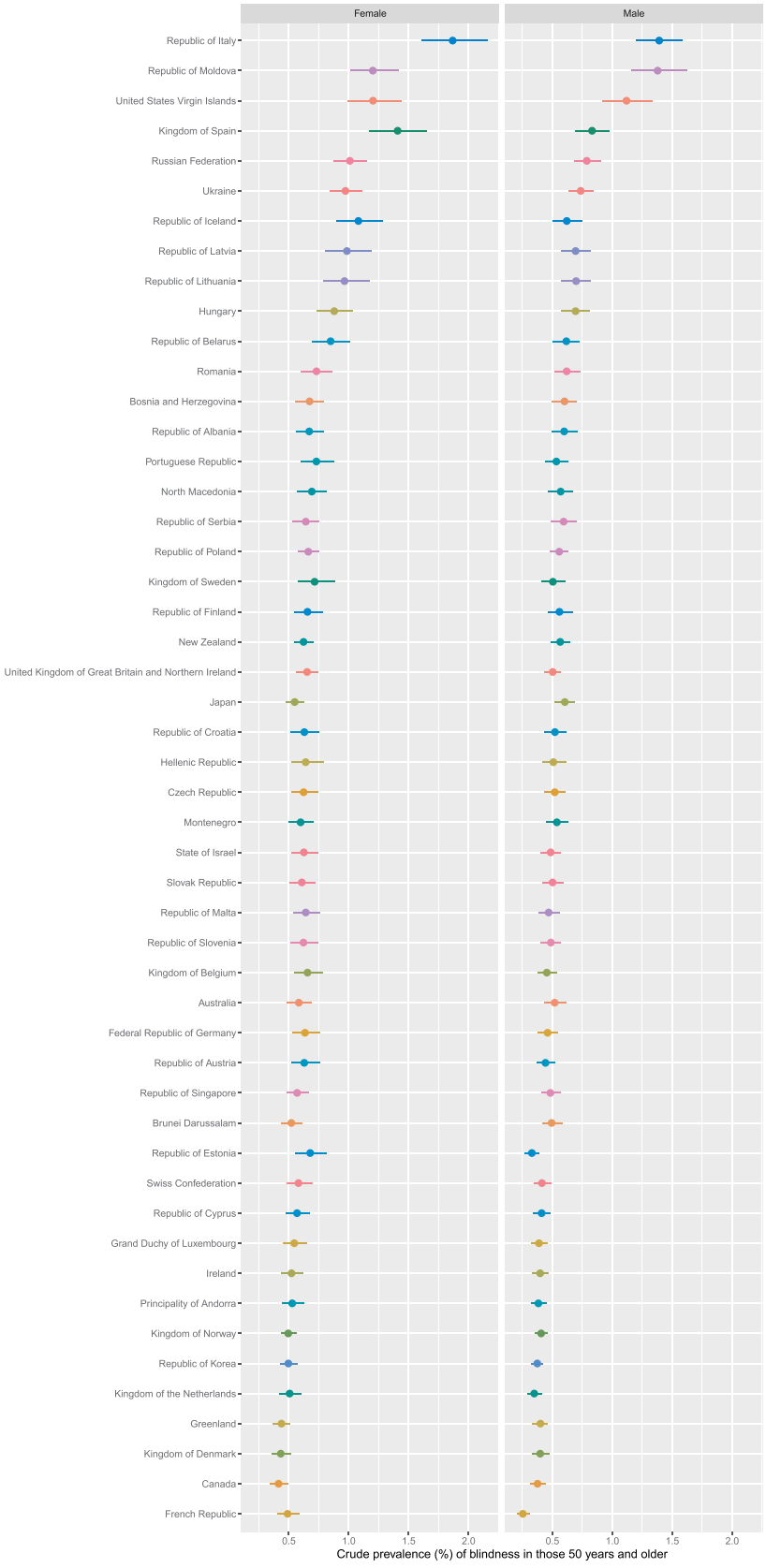


Figure 1. Ladder plot showing the age-standardized prevalence of blindness in men and women aged 50+ years for 2020.



Figure 2. Ladder plot showing the age-standardized prevalence of moderate and severe vision impairment in men and women aged 50+ years for 2020.

Table 3. Estimated number of people affected by blindness and moderate vision impairment (VI).

	Blindness, (number (95% CI))				Moderate VI, (number (95% CI))			
Region	1990	2000	2010	2020	1990	2000	2010	2020
Australasia	40262 (32,660–48527)	45,384 (36,810–54750)	56,407 (45,105–68889)	68,866 (54,913–84527)	385,878 (333,237–442474)	460,756 (398,367–528237)	561,495 (481,545–646440)	677,127 (579,584–782276)
High-income Asia Pacific	373031 (304,985–449695)	403,712 (331,351–485127)	447,363 (366,175–536898)	535,124 (439,912–640330)	2,785,532 (2,406,179–3189545)	3,243,887 (2,784,660–3715228)	3,877,568 (3,327,666–4459053)	4,584,023 (3,912,765–5290085)
High-income North America	416417 (339,210–504434)	447,493 (364,145–543249)	534,343 (432,315–653070)	711,990 (575,977–867402)	4,353,040.00 (3,734,227.22–5008106.99)	4,851,131 (4,157,536–5596243)	5,453,006 (4,665,531–6274674)	6,483,030 (5,548,449–7460112)
Western Europe	1237221 (984,992–1525496)	1,230,702 (984,903–1511835)	1,356,057 (1,086,422–1665597)	1,533,752 (1,218,371–1898343)	9,936,879 (8,509,500–11420417)	10,730,125 (9,170,175–12320090)	12,178,100 (10,428,830–14043272)	13,430,322 (11,497,033–15518095)
Central Europe	283220 (229,670–341974)	285,048 (231,144–344126)	299,467 (240,288–364388)	327,352 (264,513–398083)	2,801,254 (2,378,905–3263721)	3,008,932 (2,543,707–3521567)	3,272,143 (2,764,243–3845094)	3,642,424 (3,061,692–4282576)
Eastern Europe	817263 (681,238–959917)	853,662 (712,915–1004712)	772,146 (642,166–906215)	789,618 (663,130–923121)	8,652,844 (7,427,449–10019994)	9,065,756 (7,758,535–10509282)	9,374,455 (8,048,875–10879217)	10,076,967 (8,649,024–11703244)
World	28727188 (24,330,372–33469590)	33,418,797 (28,343,018–38899428)	37,028,948 (31,339,506–43116119)	43,279,994 (36,422,802–50650530)	136,339,883 (118,314,861–155941648)	167,287,682 (145,440,158–191126407)	205,726,218 (178,917,096–234511710)	260,282,672 (224,738,540–299522456)

Table 4. Estimated number of people affected by moderate and severe vision impairment (MSVI), and severe VI in 1990, 2000, 2010 and 2020.

	MSVI, (number (95% CI))				Severe VI, (number (95% CI))			
Region	1990	2000	2010	2020	1990	2000	2010	2020
Australasia	421522 (367,069–480835)	506,484 (441,219–576160)	620,518 (537,035–708556)	750,156 (647,414–859265)	35,643 (29,221–42737)	45,727 (37,053–55325.88)	59,023 (47,804–72060)	73,028 (59,244–89116)
High-income Asia Pacific	3160394 (2,759,966–3582237)	3,728,910 (3,254,675–4222884)	4,488,625 (3,916,143–5112879.05)	5,343,281 (4,633,738–6107291)	374,862 (312,734–446144),	485,022 (403,519–584684)	611,056 (504,695–745016)	759,257 (625,636–930246)
High-income North America	4950802 (4,305,830–5641291)	5,546,383 (4,817,265–6334331)	6,262,577 (5,443,849–7130222)	7,436,236 (6,452,538–8468539)	597,762 (487,892–728899)	695,252 (565,355–850070)	809,571 (657,550–987037)	953,205 (776,961–1167663)
Western Europe	11301542 (9,808,910–12846744)	12,247,092 (10,617,509–13935965)	13,945,340 (12,077,904–15955138)	15,420,703 (13,369,643–17640463)	1,364,662 (1,129,621–1660827)	1,516,966 (1,250,941–1847643)	1,767,239 (1,454,377–2168081)	1,990,380 (1,638,633–2442337)
Central Europe	3032362 (2,594,031–3512574)	3,254,816 (2,773,084–3777960)	3,545,591 (3,022,142–4137586)	3,950,769 (3,351,897–4616785)	231,108 (188,684–280679)	245,883 (199,417–300310)	273,447 (221,241–336520)	308,345 (249,067–378815)
Eastern Europe	9527040 (8,284,351–10926147)	9,973,837 (8,643,315–11468651)	10,295,419 (8,952,268–11848705)	11,079,063 (9,608,315–12755575)	874,196 (727,691–1050866)	908,081 (753,684–1098457)	920,964 (763,299–1121043)	1,002,095 (832,361–1207574)
World	153901963 (135,001,857–173923155)	189,813,929 (167,055,634–214242930)	233,470,680 (205,563,556–263379141)	295,091,907 (258,246,707–334643230)	17,562,080 (14,827,462–20650711)	22,526,246 (19,044,202–26504955)	27,744,462 (23,420,327–32727634)	34,809,234 (29,225,747–41302412)

from 2000 to 2022, most marked in Eastern Europe (−23.59%).

In 2020, the super-region of HIC/Central/Eastern Europe is home to 2.8 million (or 6.5%) out of 43.3 million blind individuals globally, and home to 29.0 million (9.8%) out of 295.1 million individuals with MSVI globally. These figures of the share of the HIC/Central/Eastern Europe population on the global population with respect to blindness and MSVI decreased from 1990 to 2020 from 7.3% (2.1 million/28.7 million) to 6.5% in the case of blindness and from 12.9% (19.8 million/153.9 million) to 9.8% in the case of MSVI. Although this study did not assess the causes for blindness and MSVI, one may discuss that the success of the anti-VEGF (vascular endothelial growth factor)-based therapy of intraocular neovascular and edematous diseases such as neovascular age-related macular degeneration and diabetic retinopathy were involved in the reduction of the age-standardized prevalence of blindness and MSVI and, since the therapy is more available in the HICs than in other world regions, the decrease in the proportion of the blind and visually impaired individuals was more marked in the HICs as compared to the global population.[12–15]

The figures for the prevalence of blindness and MSVI in Central/Eastern Europe were higher than those for the HICs (Tables 2 and supplementary Table 1a). As compensation, the decrease in the age-standardized prevalence of blindness and MSVI was higher in Central/Eastern Europe than in the HICs, with no marked differences between the sexes. Although an improvement is easier starting from a worse situation at baseline, the higher rate of improvement in Central/Eastern Europe as compared to the HICs shows the commitment of the countries in Central/Eastern Europe to decrease the number of their inhabitants being blind or visually impaired. It may be noteworthy, that in high-income North America, the age-standardized prevalence of blindness, MSVI and moderate VI increased for both sexes.

Although the age-standardized prevalence of blindness and MSVI decreased in the last years, the total number of people blind or visually moderately to severely impaired increased from 1990 to 2020 from 2.1 million to 2.8 million blind people and from 19.8 million to 29.0 million people with MSVI in the HICs (Tables 3 and 4). As a corollary, the number of blind individuals and individuals with MSVI increased in Eastern/Central Europe from 1990 to 2020 from 1.10 million to 1.12 million, and from 12.6 million to 15.0 million, respectively (Tables 3 and 4). The discrepancy between a decrease in the age-standardized prevalence and an increase in the total number of individuals affected is typical for many age-related diseases, is found globally, and is caused mainly by the ageing of the population in countries with a relatively high socio-economic index. It shows that although the previous and recent actions in public health were successful in reducing the age-standardized figures, additional efforts are needed to address the increase in the number of elderly individuals in the societies. It may be of particular interest that the standardized prevalence rate of vision loss increased in high-income North America while it decreased in all other regions between 2000 to 2020. It goes along with changes in other burden of disease-related parameters including life expectancy, most of which showed a deterioration for high-income North America during the study period.[1,16]

When the results of our study are discussed, its limitations should be taken into account. First, the meta-analysis also included rapid assessment surveys, which contributed data on presenting visual acuity and in some cases, data on best-corrected visual acuity data, usually measured though a pinhole. Second, despite extensive data seeking, data were not available for some countries and years. Third, definitions of vision impairment could vary between the studies. Fourth, some study populations were not nationally representative but represented only a subnational or community area. Fifth, most population-based studies of eye disease did not include individuals living in nursing homes whereas there were reports in high-income countries of double the prevalence of vision loss.

In conclusion, the age-standardized prevalence of blindness and MSVI have further decreased in HICs and Eastern/Central Europe, while the number of people affected increased due to ageing of the population.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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Author contributions

Please see Supplementary material Text for more detailed information about individual author contributions to the research, divided into the following categories: managing the overall research enterprise; writing the first draft of the manuscript; primary responsibility for applying analytical methods to produce estimates; primary responsibility for seeking, cataloguing, extracting, or cleaning data; designing or coding figures and tables; providing data or critical feedback on data sources; developing methods or computational machinery; providing critical feedback on methods or results; drafting the manuscript or revising it critically for important intellectual content; and managing the estimation or publications process.

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Vision Loss Expert Group of the Global Burden of Disease Study

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