Prevalence and Causes of Blindness and Vision Impairment: Magnitude, Temporal Trends, and Projections in South and Central Asia

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43   study can be found by accessing this site: http://www.anglia.ac.uk/epidemiology%20/

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50   DISCLAIMER STATEMENT: While the work that is reported here was performed by the Vision Loss Expert

51   Group as part of the Global Burden of Disease, Risk Factors and Injuries Study 2015, the results prepared here

52   by the authors in this paper are prepared independently of the final estimates of the Global Burden of Disease

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54   Competing Interests Statement:

55   Jost B. Jonas: Patent holder with Biocompatibles UK Ltd. (Farnham, Surrey, UK) (Title: Treatment of eye dis-

56   eases using encapsulated cells encoding and secreting neuroprotective factor and / or anti-angiogenic factor;

57   Patent number: 20120263794), and Patent application with University of Heidelberg (Heidelberg, Germany) (Ti-

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Background: To assess prevalence and causes of vision loss in Central and South Asia.

Methods: A systematic review of medical literature assessed the prevalence of blindness (presenting visual acuity<3/60 in the better eye), moderate and severe vision impairment (MSVI; presenting visual acuity <6/18 but ≥3/60) and mild vision impairment (MVI; presenting visual acuity <6/12 and ≥6/18) in Central and South Asia for 1990, 2010, 2015, and 2020.

Results: In Central and South Asia combined, age-standardized prevalences of blindness, MSVI and MVI in 2015 were for men and women 2.80% (80%uncertainty interval (UI):1.14-4.91) and 3.47% (80%UI:1.45-5.99), 16.75% (80%UI:5.60-30.84) and 20.06% (80%UI:7.15-36.12), 11.49% (80%UI:3.43-21.44) and 12.77% (80%UI:4.04-23.48), respectively, with a significant decrease in the study period for both gender. In South Asia in 2015, 11.76 million individuals (32.65% of the global blindness figure) were blind and 61.19 million individuals (28.3% of the global total) had MSVI. From 1990 to 2015, cataract (accounting for 36.58% of all cases with blindness in 2015) was the most common cause of blindness, followed by undercorrected refractive error (36.43%), glaucoma (5.81%), age-related macular degeneration (2.44%), corneal diseases (2.43%), diabetic retinopathy (0.16%) and trachoma (0.04%). For MSVI in South Asia 2015, most common causes were under-corrected refractive error (accounting for 66.39% of all cases with MSVI), followed by cataract (23.62%), age-related macular degeneration (1.31%) and glaucoma (1.09%).

Conclusions: One third of the global blind resided in South Asia in 2015, although the age-standardized preva-lence of blindness and MSVI decreased significantly between 1990 and 2015.

Précis

Age-standardized prevalence of blindness in South Asia was more than twice the global prevalence with one third of the global blind residing in South Asia and undercorrected refractive error and cataract as most common causes.

Introduction

93   The Global Burden of Disease Study (GBD) 2016 revealed that vision impairment and hearing impairment to-
94   gether with other sense organ deficits were worldwide one of the most common causes for YLDs (Years Lived
95   with Disability) in the population aged 65+ years.[1] Particularly in South Asia, the prevalence of blindness (de-
96   fined as presenting visual acuity <3/60 in the better eye) and of moderate to severe visual impairment (MSVI;
97   defined as presenting visual acuity <6/18 but ≥3/60 in the better eye) was among the highest as compared to
98   other world regions.[2, 3] Since South Asia has become one of the economically fastest growing regions world-
99   wide and in view of the heavy weight South Asia has on the prevalence of worldwide blindness and MSVI, the
100   Vision Loss Expert Group of the Global Burden of Disease study conducted this study to re-assess the preva-
101   lence of vision impairment in the world regions of South Asia and Central Asia and to compare the data with
102   findings obtained in other world regions as well as previously in the same regions.

Methods

107   The methodology used for the preparation of prevalence estimates for vision impairment and blindness including
108   a PRISMA checklist and a flowsheet has been published in full elsewhere.[2, 4, 5] The study was approved by
109   the ethics committee II of the Medical Faculty Mannheim of the University of Heidelberg, Germany. Using data
110   in the Global Vision Database, we estimated 1990-2015 trends in vision impairment prevalence and their uncer-
111   tainties, by age and gender, for 188 countries in the 21 GBD regions.[2, 4, 5] The Central Asia and South Asia
112   super-region consisted of 9 countries in Central Asia and 6 countries in South Asia (Table 1). The method of
113   data identification, access, and extraction has been described in detail previously.[2, 4, 5] Mild vision impairment
114   was defined as presenting visual acuity of less than 6/12 but better or equal to 6/18. We included vision impair-
115   ment data from population-based studies identified through a systematic review which included investigations
116   published between 1980 and 2014 as well as unpublished data identified by members of the Vision Loss Expert
117   Group convened for the 2010 Global Burden of Disease Study. In total, 10 new studies were added to the Glob-
118   al Vision Database for the Central and South Asia region (Table 1). Data on both presenting and best-corrected
119   visual acuity were extracted.

120   For the statistical analysis, we fitted two hierarchical Bayesian logistic regressions to estimate vision
121   impairment prevalence over time - by age group, gender and country - one model each for each vision impair-
122   ment group.[6] We modeled hierarchical linear trends over time, allowing for region-specific trends in prevalence
123   of vision impairment in the seven world regions. Prevalence estimates were reported as posterior means along
124   with 80% posterior uncertainty intervals (UI).[5] We calculated trends, with uncertainty intervals, of age-
125   standardized vision impairment by calculating the difference between the 1990 and 2015 age-standardized
126   prevalences.

127   For forecasting the prevalence of blindness and vision impairment to 2020 and 2050, we applied our
128   model to forecast prevalence of blindness and MSVI into the future. Our model relies on health status and edu-

129 cation as covariates. Since it is impossible to predict how these will evolve decades into the future, we extrapo-

130 lated these covariates to the year 2020 and then held them constant to 2050. As our model gives estimates of

131 crude prevalence for country-years we relied on the United Nations Population Division's (UNPOP) forecasts to

132 2050 to derive crude numbers affected and age-standardized prevalence figures.[7]

133 Finally, for estimating the causal attribution to the blindness and vision impairment burden, we estimated

134 the proportions of overall vision impairment attributable to cataract, glaucoma, age-related macular degenera-

135 tion, diabetic retinopathy, corneal opacity, trachoma, uncorrected refractive error, and non-cause specific in

136 1990–2015 by geographical region and year.[3, 5, 8]

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138

139 **Results**

140 Our investigation included 49 studies performed in South Asia and 3 studies carried out in Central Asia (Table

141 1). Within the South Asian studies, 22 investigations were performed in urban areas and in rural areas, 25 stud-

142 ies were carried out only in rural communities, and 2 studies were performed only in urban communities; 32

143 studies from South Asia included communities aged 40+ years, while the remaining 17 South Asian studies also

144 included younger individuals. All three studies carried out in Central Asia were conducted in rural and urban

145 regions for populations aged 40+ years. The visual acuity data were ascertained through clinical examination.

146 In the study region of Central Asia in 2015, the crude prevalence of blindness for all ages was 0.29%

147 (80% uncertainty interval [UI]: 0.09 -0.53), with a prevalence of 1.83% (80%UI:0.67-3.33%) for MSVI and 1.69%

148 (80%UI:0.48-3.33) for mild vision impairment. In the study region of South Asia in 2015, the crude prevalence of

149 blindness for all ages was 0.70% (80%UI:0.24-1.29), with a prevalence of 3.62% (80%UI:1.75-5.83%) for MSVI

150 and 2.98% (80%UI:1.05-5.46) for mild vision impairment.

151 The age-standardized prevalence of blindness in 2015 in the super region of Central Asia and South

152 Asia combined was higher for women (3.47%; 80%UI:1.45-5.99) than for men (2.80%; 80%UI:1.14-4.91) (Table

153 2) (Fig. 1). The corresponding figures for MSVI were 20.06% (80%UI:7.15-36.12) for women and 16.75%

154 (80%UI:5.60-30.84) for men, and for mild vision impairment it was 12.77% (80%UI:4.04-23.48) for women and

155 11.49% (80%UI:3.43-21.44) for men (Table 2a, 2b) (Fig. 2).

156 There was a significant reduction in the age-standardized prevalences of blindness, MSVI and mild vi-

157 sion impairment in the period from 1990 to 2015 for men and women (Table 2, 3). For females the age-

158 standardized values for blindness in 1990 and 2015 were 1.81% (0.76-3.09) and 0.85% (0.33 -1.53), for MSVI

159 they were 8.43% (2.87-15.34) and 5.62% (1.80-10.50), and for mild vision impairment the rates were 5.36%

160 (1.45-10.58) and 4.08% (1.09-7.94), respectively, demonstrating that females, as also did men, benefitted from a

161 significant reduction in the rates of blindness and vision impairment.

162 In South Asia, 11.76 million individuals were blind in 2015, a little less than 1/3 (32.65%) of the global

163 blindness figures of 36.02 million (Table 4). A similar ratio has been estimated in the projection to 2020 with an

164 increase in the number of people blind both in South Asia (12.94 million (UI: 4.37-24.20) and in the world (38.50

165 million (UI: 13.18-70.95)). In a similar manner, 61.19 million individuals in South Asia had MSVI in 2015, repre-

166 senting 28.25 of the global total of 216.60 million individuals affected with MSVI. This proportion remains largely

167 unchanged in 2020 with 68.27 million with MSVI in South Asia and 237.08 million individuals affected globally.

168 Figures for mild VI also show similar trends. For Central Asia, the prevalence figures of blindness, MSVI and

169 mild VI in 2015 (in millions) were 0.25, 1.60 and 1.47, respectively, and for 2020 the figures were 0.25, 1.69 and

170 1.56, respectively (Table 4).   The number of individuals affected by of blindness, MSVI and mild VI increased

171 from 2015 to 2020 (as projected) for both regions, except for the number of individuals with blindness in Central

172 Asia where number were projected to remain constant in the period from 2015 to 2020 (Table 4).

173   In 1990 cataract was in South Asia as well as worldwide the most common cause of blindness, followed

174 by undercorrected refractive error, glaucoma, age-related macular degeneration, corneal disease, trachoma and

175 diabetic retinopathy (Table 5a). This pattern was mostly maintained in 2015 and also in the projection up to

176 2020, with the only difference of diabetic retinopathy taking the second-last position from trachoma in exchange

177 for the last position (Tables 5b, 5c, 5d). In Central Asia in 2015, undercorrected refractive error (12.85%) ranked

178 only fourth after cataract, glaucoma and age-related-macular degeneration as more frequent causes of blind-

179 ness (Table 5).

180   For global MSVI in 1990, undercorrected refractive error was the most common cause accounting for

181 50.80% of all cases with MSVI, followed by cataract (26.62%), age-related macular degeneration (5.97%), glau-

182 coma (2.14%), corneal disease (1.99%), trachoma (1.75%) and finally diabetic retinopathy (1.03%) (Table 6a).

183 This ranking order remained mostly unchanged till 2015, with the change in the ranking of diabetic retinopathy

184 getting more common, while corneal diseases and trachoma showed a reduced relative prevalence as cause for

185 MSVI in 2015 (Table 6a-d). A similar ranking was prevalent in South Asia in 2015, with the difference that cor-

186 neal disorders as compared to diabetic retinopathy were more the reason for MSVI (Table 6).   Central Asia

187 showed the same ranking order as the global ranking, with major change in the projection to 2020.   For both

188 Central Asia and South Asia there is a minor decline in the proportion of MSVI due to cataract and a small in-

189 crease in the proportion of blindness and MSVI due to undercorrected refractive error from 1990 to 2015 (Tables

190 6a, 6c).

191

192

193 **Discussion**

194 Applying an updated statistical model, refreshing the database by including findings obtained in recent investiga-

195 tions and projecting the number of people affected by vision impairment to the year 2020, our study revealed

196 that South Asia included 32.65%, 28.25% and 26.73% of the World's blind, moderately and severely vision im-

197 paired, and mild vision impaired individuals, respectively (Table 4).   By 2020 this contribution to the World's

198 vision impaired is estimated to change only slightly to 33.61%, 28.80% and 27.15%, respectively. From 1990 to

199 2015, the estimated age-standardized prevalence of blindness and MSVI in both Central and South Asia de-

200 creased significantly although the absolute numbers of people who were blind or who had MSVI increased.   In

2015, approximately 123.35 million people in South Asia had a presenting visual acuity of less than 6/12 in the better eye, and this number is estimated to further increase to 137.06 million individuals by 2020. In 2015, Central Asia was home to 0.69%, 0.74% and 0.78% of the World's blind, moderately and severely vision impaired and mild vision impaired people, respectively (Table 4). As globally, cataract was the most common cause of blindness in 2015 in this super-region of Central and South Asia. South Asia and Central Asia differed in the ranking of undercorrected refractive error which was ranked second in South Asia and fourth in Central Asia.   In both regions, glaucoma followed by age-related macular degeneration and as compared to cataract showed a considerably lower prevalence as cause for blindness. During the study period from 1990 to 2015 and projected further on to 2020, the percentage of cataract, undercorrected refractive error and glaucoma as causes for blindness remained mostly unchanged in South Asia, while the percentages of age-related macular degeneration, corneal diseases and trachoma decreased slightly (Table 5).   In Central Asia, the percentage of glaucoma remained unchanged during the study period, while the percentages of cataract, age-related macular degeneration, and corneal diseases decreased and the percentage of diabetic retinopathy as cause of blindness increased.

The decrease in the percentage of age-related macular degeneration as cause for blindness in Central Asia may be due to the success of previously introduced clinical therapies of exudative age-related macular degeneration, i.e. the intravitreal injection of anti-vascular endothelial growth factor (VEGF) drugs.[9, 10] The increasing importance of diabetic retinopathy as a cause for vision loss in Central Asia likely reflects the increasing prevalence of diabetes mellitus in the general population and the ageing of the population so that individuals with diabetes live to an age at which ocular complications of their systemic disease are experienced.[11-13] Interestingly, that tendency has not been detected yet in South Asia, where, in particular in the countryside, the prevalence of diabetic retinopathy within the group of individuals with diabetes is markedly lower than in Western countries, probably due to a considerably reduced life expectancy of diabetic patients.[13]

Much of the improvement in the blindness rate in South Asia is likely to be attributable to increased cataract surgery coverage and also the recent improvements in cataract surgical outcomes. These improvements in cataract surgical outcomes have been reported in India, Bangladesh, Pakistan and Nepal.[15-17] While the figures for Central Asia were slightly lower than the average global figures, the age-standardized prevalence of blindness and MSVI in South Asia was about double as high as globally (Table 4). It indicates that intensified measures are needed to further reduce the prevalence and burden of blindness and MSVI in South Asia.

As is found globally, women had a markedly higher age-standardized prevalence of blindness and MSVI than men.[4] The general gender difference in the age-standardized prevalence of vision impairment may be due to, among other factors, a disparity between men and women in the access to medical services and to the general increased life expectancy of women. Future public health measures may thus be focused on providing equal opportunity for both sexes in attaining access to the medical system, especially older women.

In contrast to high-income regions in the US/Western Europe, cataract remained the most frequent cause for blindness in Central Asia, and in particular in South Asia. In 2015, there were 4.74 million people blind

237 due to cataract in South Asia. It clearly reflects the importance of further propagating cataract surgery as one of
238 the most cost-effective manners to reduce avoidable blindness in a large group of the population. Care has to
239 be taken that the quality of cataract surgery is sufficiently high to avoid an increase of blindness related to com-
240 plicated cataract surgery.[18] The most frequent cause for MSVI in Central Asia and South Asia, and the sec-
241 ond most common cause for blindness in South Asia was undercorrected refractive error. One of the most effec-
242 tive, cheapest and safest ways to improve vision loss would be to provide adequate glasses to adequately cor-
243 rect refractive errors. This also includes the provision of reading glasses since near vision impairment is a most-
244 ly unaddressed problem. Most health care projects and population-based studies usually only assess distant
245 visual acuity.

246   There are limitations of our study. First, parts of the survey were based on rapid assessment surveys
247 which often only presented measurements of presenting visual acuity and in some investigations, data on best
248 corrected visual acuity data, usually measured though a pinhole. The findings obtained in these studies were
249 used for the statistical analysis only with respect to cataract and uncorrected refractive error as causes for vision
250 impairment. Second, the causal proportions for 1990 and 2010 in our current study as compared to the esti-
251 mates performed in our previous investigation did not markedly differ.[3] Reasons for differences were due to an
252 improvement of the statistical model, an increase in the number of studies assessed and a better design of the
253 most recent studies included.   Third, despite extensive data seeking, data were not available for many countries
254 and years, were reported using sometimes incomparable definitions of vision impairment, or were representative
255 of a subnational or community area only.   Fourth, a considerable fraction of the causes of blindness and MSVI
256 has remained undetermined and has been designated as "other causes" in the analysis. In the present updated
257 survey, "other causes" accounted for about 20.44% in Central Asia and for 12.42% in South Asia of the causes
258 of blindness, while in the previously published estimate the percentage was 33.0% for Central Asia and 10.9%
259 for South Asia.[3] Fifth, almost all population-based studies underlying the present meta-analysis did not examine
260 individuals living in nursing homes and might have had a higher age-standardized prevalence of vision impair-
261 ment and blindness than the younger individuals who participated in the studies.   Sixth, the basic studies used
262 different definitions of the diseases, in particular for glaucoma. Seventh, eyes with vision loss often had several
263 diseases, so that it might have been difficult to decide which one of the diseases was the factor contributing
264 most to the vision loss. Eighth, caution should be applied in the interpretation of projections to 2020 by cause.
265 Ninth, near vision impairment was only scarcely examined in the preceding investigations, so that it could not
266 reliably be assessed in the present study. Tenth, for many prevalence estimates, the uncertainty intervals (UI)
267 overlap indicating a borderline significance of differences between the prevalence estimates.
268   In conclusion the age-standardized prevalence of blindness and MSVI has decreased significantly be-
269 tween 1990 and 2015. Age-standardized prevalence of blindness and visual impairment continues to be higher
270 in females, indicating greater efforts be directed towards delivery of eye health to them. The age-standardized
271 prevalence of blindness in males and females in South Asia is more than twice the global age-standardized
272 prevalence and for Central Asia it is less than the global age-standardized prevalence. One third of the global

273   blind resided in South Asia in 2015 and the figures do not change when projected to 2020. The projected num-

274   bers of people blind, with MSVI and mild visual impairment show an increasing trend from 2015 to 2020. Under-

275   corrected refractive error and cataract continue to be the two most common causes of blindness and visual im-

276   pairment from 1990 and projected to 2020.

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320

321 Table 1

322 Countries included in the category of Central Asia and South Asia.

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Central Asia (n=3, 0)	Armenia, Azerbaijan, Georgia, Kazakhstan , Kyrgyz-stan, Mongolia(n=2, 0), Tajikistan, Turkmenistan (n=1, 0), Uzbekistan
South Asia (n=49, 10)	Afghanistan (n=1, 1), Bangladesh (n=2, 0), Bhutan (n=1, 1), India (n=21, 5), Nepal (n=19, 3), Pakistan (n=5, 0)

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326 The "n" numbers indicate the number of studies from that country and following the comma, the number of new

327 studies for that country included since the most recent Global Vision Database meta-analysis. A list of all refer-

328 ences used for this analysis can be found in a web appendix at

329 file:///C:/Users/jj2/Desktop/Downloads/Global%20Burden%20of%20Diseases%20Vision%20Loss%20Group%20

330 -%20Web%20Appendix%20(1).pdf.

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333   Table 2a

334   Age-standardized prevalence (mean [80% uncertainty interval]) of blindness and vision impairment stratified by

335   sex and age in Central Asia and South Asia combined in 2015 and projected to 2020

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2015	Age: 50+ years	All Ages	2020	Age: 50+ Years	All Ages
Blindness					
Male	3.72 (1.39 - 6.75)	0.92 (0.34 - 1.67)	Male	3.49 (1.24 - 6.46)	0.86 (0.30 - 1.59)
Female	4.00 (1.41 - 7.39)	0.99 (0.34 - 1.83)	Female	3.78 (1.29 - 7.05)	0.93 (0.31 - 1.74)
Both	3.86 (1.40 - 7.08)	0.95 (0.34 - 1.75)	Both	3.64 (1.26 - 6.77)	0.90 (0.31 - 1.67)
Moderate and Severe Vision Impairment					
Male	16.33 (8.55 - 25.47)	4.42 (2.23 - 7.03)	Male	15.73 (7.84 - 24.99)	4.26 (2.03 - 6.87)
Female	17.65 (9.00 - 27.62)	4.81 (2.35 - 7.69)	Female	17.13 (8.22 - 27.09)	4.67 (2.13 - 7.52)
Both	17.00 (8.78 - 26.56)	4.62 (2.29 - 7.36)	Both	16.45 (8.03 - 26.06)	4.46 (2.08 - 7.19)
Mild Vision Impairment					
Male	11.70 (4.70 - 20.32)	3.48 (1.28 - 6.28)	Male	11.38 (4.37 - 19.94)	3.38 (1.18 - 6.12)
Female	12.25 (4.86 - 21.30)	3.71 (1.33 - 6.73)	Female	11.97 (4.58 - 21.06)	3.61 (1.25 - 6.60)
Both	11.97 (4.78 - 20.80)	3.60 (1.30 - 6.50)	Both	11.67 (4.47 - 20.50)	3.49 (1.21 - 6.35)

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345 Table 2b
346 Crude and age-standardized prevalence (%) of blindness and moderate to severe vision impairment (MSVI) and
347 mild vision impairment (mild VI) in 2015 in Central Asia and South Asia (all ages); 80% uncertainty intervals are
348 given in brackets
349

	Blind	MSVI	Mild VI
Crude prevalence, Central Asia			
Males	0.23 (0.08 – 0.43)	1.58 (0.57 – 2.89)	1.50 (0.42 – 2.97)
Females	0.34 (0.11 – 0.63)	2.08 (0.76 – 3.75)	1.87 (0.54 – 3.68)
All	0.29 (0.09 – 0.53)	1.83 (0.67 – 3.33)	1.69 (0.48 – 3.33)
Crude prevalence, South Asia			
Males	0.63 (0.23 – 1.15)	3.31 (1.62 – 5.33)	2.79 (0.98 – 5.11)
Females	0.77 (0.26 – 1.43)	3.95 (1.89 – 6.36)	3.19 (1.12 – 5.83)
All	0.70 (0.24 – 1.29)	3.62 (1.75 – 5.83)	2.98 (1.05 – 5.46)
Age-standardized prevalence Central Asia			
Males	0.36 (0.12 - 0.66)	2.20 (0.82 - 3.99)	2.00 (0.59 - 3.90)
Females	0.36 (0.12 - 0.68)	2.25 (0.82 - 4.05)	2.02 (0.59 - 3.97)
Age-standardized prevalence South Asia			
Males	0.94 (0.35 - 1.72)	4.53 (2.29 - 7.18)	3.56 (1.31 - 6.40)
Females	1.03 (0.36 - 1.91)	4.98 (2.45 - 7.92)	3.81 (1.38 - 6.89)
Age-standardized prevalence Central Asia and South Asia Combined			
Males	0.92 (0.34 - 1.67)	4.42 (2.23 - 7.03)	3.48 (1.28 - 6.28)
Females	0.99 (0.34 - 1.83)	4.81 (2.35 - 7.69)	3.71 (1.33 - 6.73)
All	0.95 (0.34 - 1.75)	4.62 (2.29 - 7.36)	3.60 (1.30 - 6.50)

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352 Table 3

353 Age-standardized prevalence of blindness and moderate to severe vision impairment (MSVI), and mild vision

354 impairment (VI) by sex and region comparing adults 50 years and older with all ages, for 2015 in Central Asia

355 and South Asia

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Age (Years)	50+						All Ages					
Sex	Men			Women			Men			Women		
Region	Blind	MSVI	Mild VI	Blind	MSVI	Mild VI	Blind	MSVI	Mild VI	Blind	MSVI	Mild VI
Central Asia	1.45 (0.48 - 2.69)	8.27 (3.19 - 14.87)	7.18 (2.28 - 13.81)	1.48 (0.48 - 2.78)	8.47 (3.19 - 15.17)	7.29 (2.27 - 14.07)	0.36 (0.12 - 0.66)	2.20 (0.82- 3.99)	2.00 (0.59 - 3.90)	0.36 (0.12 - 0.68)	2.25 (0.82 - 4.05)	2.02 (0.59 - 3.97)
South Asia	3.83 (1.43 - 6.95)	16.72 (8.82 - 25.99)	11.92 (4.81- 20.64)	4.18 (1.48 - 7.71)	18.26 (9.40 - 28.43)	12.56 (5.01 - 21.75)	0.94 (0.35 - 1.72)	4.53 (2.29 - 7.18)	3.56 (1.31 - 6.40)	1.03 (0.36 - 1.91)	4.98 (2.45 - 7.92)	3.81 (1.38 - 6.89)
World	1.82 (0.67 - 3.28)	10.12 (4.85 - 16.45)	8.33 (3.10 - 15.02)	1.91 (0.68 - 3.49)	10.79 (5.00 - 17.74)	8.77 (3.23 - 15.84)	0.46 (0.17 - 0.84)	2.79 (1.29- 4.61)	2.46 (0.84 - 4.55)	0.49 (0.17 - 0.90)	2.99 (1.33 - 4.99)	2.60 (0.88 - 4.85)

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364   Table 4
365   Estimated number of people (millions) affected by blindness and moderate and severe vision impairment (MSVI)
366   and mild vision impairment (VI) in Central Asia and South Asia by region in 2015 and projections to 2020.
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	Blind		MSVI		Mild VI	
Region	2015	2020	2015	2020	2015	2020
Central Asia	0.25 (0.08 - 0.47)	0.25 (0.08 - 0.48)	1.60 (0.58 - 2.90)	1.69 (0.56 - 3.11)	1.47 (0.42 - 2.90)	1.56 (0.41 - 3.13)
South Asia	11.76 (4.14 - 21.72)	12.94 (4.37 - 24.20)	61.19 (29.65 - 98.57)	68.27 (31.30 - 110.79)	50.40 (17.73 - 92.25)	55.85 (18.90 - 102.48)
World	36.02 (12.86 - 65.44)	38.50 (13.18 - 70.95)	216.60 (98.51 - 359.1)	237.08 (101.5 - 399.0)	188.54 (64.46 - 350.19)	205.73 (67.30 - 385.11)

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372   Table 5

373   Table 5a: Proportion of blindness by cause for all ages in 1990

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Region, Year: 1990	Under-corrected Refractive Error	Cataract	Glau-coma	Age-related Macular Degene-ration	Diabet-ic Reti-no-pathy	Corneal Disease	Tra-choma	Other
Central Asia	12.52 (10.62 - 14.37)	29.77 (22.36 - 37.73)	13.40 (4.00 - 26.55)	16.44 (4.21 - 32.89)	2.23 (0.26 - 5.04)	5.21 (0.47 - 12.28)	0.00 (0.00 - 0.00)	20.44 (4.83 - 40.56)
South Asia	35.54 (32.29 - 38.41)	38.79 (32.99 - 44.43)	5.93 (2.20 - 10.85)	3.10 (0.83 - 6.32)	0.10 (0.02 - 0.21)	3.91 (0.73 - 8.47)	0.20 (0.18 - 0.23)	12.42 (4.42 - 22.80)
World	19.58 (17.29 - 21.72)	36.67 (30.11 - 43.22)	8.66 (3.25 - 15.72)	7.93 (2.32 - 15.54)	0.85 (0.15 - 1.83)	4.75 (0.80 - 10.47)	2.78 (2.66 - 2.90)	18.78 (7.12 - 32.87)

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380   Table 5b: Proportion of blindness by cause for all ages in 2010

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Region, Year: 2010	Under-cor-rected Refrac-tive Error	Cataract	Glau-coma	Macular Degene-ration	Diabet-ic Reti-no-pathy	Corneal Disease	Tra-choma	Other
Central Asia	12.82 (11.03 - 14.57)	27.06 (18.96 - 35.75)	14.10 (3.73 - 29.18)	14.68 (3.08 - 31.18)	3.59 (0.39 - 8.38)	3.73 (0.29 - 8.31)	0.00 (0.00 - 0.00)	24.01 (5.57 - 48.05)
South Asia	36.29 (33.63 - 38.73)	37.39 (30.16 - 44.61)	5.77 (2.27 - 10.26)	2.51 (0.76 - 4.88)	0.14 (0.03 - 0.29)	2.58 (0.53 - 5.54)	0.09 (0.06 - 0.12)	15.24 (5.41 - 28.01)
World	20.23 (18.16 - 22.20)	35.67 (27.74 - 43.66)	8.48 (3.17 - 15.38)	6.28 (1.68 - 12.64)	0.99 (0.16 - 2.19)	3.37 (0.58 - 7.39)	1.54 (1.38 - 1.71)	23.43 (8.98 - 40.83)

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387   Table 5c: Proportion of blindness by cause for all ages in 2015

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Region, Year: 2015	Under-cor-rected Refrac-tive Error	Cataract	Glau-coma	Age-related Macular Degene-ration	Diabet-ic Reti-no-pathy	Corneal Dis-eases	Tra-choma	Other
Central Asia	12.85 (11.07 - 14.60)	25.94 (17.43 - 35.02)	14.17 (3.50 - 29.80)	14.01 (2.64 - 30.57)	3.60 (0.34 - 8.59)	3.58 (0.25 - 8.02)	0.00 (0.00 - 0.00)	25.86 (6.09 - 51.43)
South Asia	36.43 (33.81 - 38.83)	36.58 (28.55 - 44.67)	5.81 (2.18 - 10.51)	2.44 (0.71 - 4.83)	0.16 (0.03 - 0.35)	2.43 (0.45 - 5.34)	0.04 (0.01 - 0.07)	16.10 (5.71 - 29.58)
World	20.28 (18.23 - 22.24)	35.15 (26.40 - 44.03)	8.49 (2.99 - 15.66)	5.93 (1.46 - 12.18)	1.06 (0.15 - 2.38)	3.21 (0.50 - 7.19)	0.97 (0.80 - 1.15)	24.92 (9.58 - 43.36)

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393   Table 5d: Proportion of blindness by cause for all ages in 2020

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Region, Year: 2020	Under-corrected Refractive Error	Cataract	Glau-coma	Age-related Macular Degene-ration	Diabet-ic Reti-no-pathy	Corneal Dis-ease	Tra-choma	Other
Central Asia	12.88 (11.10 - 14.63)	25.59 (16.52 - 35.34)	13.86 (3.09 - 29.95)	13.31 (2.22 - 29.72)	4.44 (0.39 - 10.80)	3.50 (0.21 - 7.96)	0.00 (0.00 - 0.00)	26.41 (6.10 - 52.86)
South Asia	36.50 (33.89 - 38.90)	36.17 (27.11 - 45.30)	5.76 (2.02 - 10.64)	2.21 (0.58 - 4.41)	0.16 (0.02 - 0.36)	2.32 (0.38 - 5.25)	0.00 (0.00 - 0.00)	16.88 (5.97 - 31.02)
World	20.58 (18.52 - 22.54)	34.73 (25.04 - 44.63)	8.43 (2.75 - 15.96)	5.57 (1.23 - 11.72)	1.20 (0.16 - 2.75)	3.09 (0.42 - 7.09)	0.40 (0.30 - 0.58)	25.99 (9.96 - 45.27)

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401   Table 6: Proportion of moderate to severe vision impairment by cause for all ages in 1990 (Table 6a), 2010 (Ta-

402   ble 6b), 2015 (Table 6) and 2020 (Table 6d)

403

404   Table 6a:

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Region, Year: 1990	Under-cor-rected Refrac-tive Error	Cataract	Glau-coma	Age-related Macular Degene-ration	Diabet-ic Reti-no-pathy	Corneal Dis-ease	Tra-choma	Other
Central Asia	46.51 (41.54 - 50.29)	22.02 (16.11 - 28.52)	3.94 (0.87 - 8.43)	11.63 (2.58 - 24.12)	2.44 (0.35 - 5.67)	2.20 (0.16 - 4.79)	0.00 (0.00 - 0.00)	11.26 (1.87 - 25.14)
South Asia	64.59 (58.92 - 69.42)	25.80 (21.67 - 29.77)	1.12 (0.37 - 2.09)	1.76 (0.41 - 3.70)	0.10 (0.02 - 0.20)	1.28 (0.21 - 2.75)	0.14 (0.12 - 0.16)	5.21 (1.57 - 10.32)
World	50.80 (46.12 - 54.74)	26.62 (21.53 - 31.78)	2.14 (0.69 - 4.11)	5.97 (1.63 - 11.87)	1.03 (0.20 - 2.22)	1.99 (1.88 - 2.09)	1.75 (0.25 - 3.81)	9.71 (3.03 - 18.50)

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411   Table 6b: Proportion of moderate to severe vision impairment by cause for all ages in 2010

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GBD Region 2010	Under-cor-rected Refrac-tive Error	Cataract	Glau-coma	Age-related Macular Degene-ration	Diabet-ic Reti-no-pathy	Corneal Disease	Tra-choma	Other
Central Asia	47.92 (44.30 - 50.76)	18.96 (12.80 - 25.90)	3.99 (0.78 - 8.97)	10.65 (2.04 - 23.38)	4.01 (0.52 - 9.44)	1.49 (0.10 - 3.10)	0.00 (0.00 - 0.00)	12.99 (2.14 - 29.08)
South Asia	66.08 (61.82 - 69.66)	24.22 (19.54 - 28.83)	1.07 (0.38 - 1.97)	1.35 (0.39 - 2.67)	0.13 (0.03 - 0.26)	0.79 (0.16 - 1.63)	0.06 (0.04 - 0.08)	6.30 (1.89 - 12.50)
World	52.12 (48.44 - 55.23)	25.55 (19.80 - 31.54)	2.04 (0.66 - 3.93)	4.65 (1.21 - 9.53)	1.21 (0.21 - 2.68)	1.19 (0.19 - 2.55)	1.07 (0.93 - 1.21)	12.17 (3.87 - 23.03)

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418
419 Table 6c: Proportion of moderate to severe vision impairment by cause for all ages in 2015

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| Region, Year: 2015	Under-cor-rected Refrac-tive Error	Cataract	Glau-coma	Age-related Macular Degene-ration	Diabet-ic Reti-no-pathy	Corneal Disease	Tra-choma	Other
Central Asia	48.26 (44.85 - 50.98)	18.11 (11.70 - 25.35)	4.05 (0.73 - 9.28)	10.05 (1.74 - 22.69)	4.06 (0.45 - 9.75)	1.41 (0.09 - 2.98)	0.00 (0.00 - 0.00)	14.06 (2.34 - 31.39)
South Asia	66.39 (62.16 - 69.95)	23.62 (18.43 - 28.79)	1.09 (0.37 - 2.03)	1.31 (0.37 - 2.62)	0.15 (0.03 - 0.32)	0.74 (0.14 - 1.56)	0.03 (0.00 - 0.05)	6.67 (2.00 - 13.24)
World	52.34 (48.66 - 55.45)	25.15 (18.83 - 31.76)	2.05 (0.62 - 4.03)	4.38 (1.05 - 9.15)	1.30 (0.20 - 2.93)	1.14 (0.17 - 2.48)	0.64 (0.50 - 0.79)	13.00 (4.14 - 24.57)

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424
425   Table 6d: Proportion of moderate to severe vision impairment by cause for all ages in 2020

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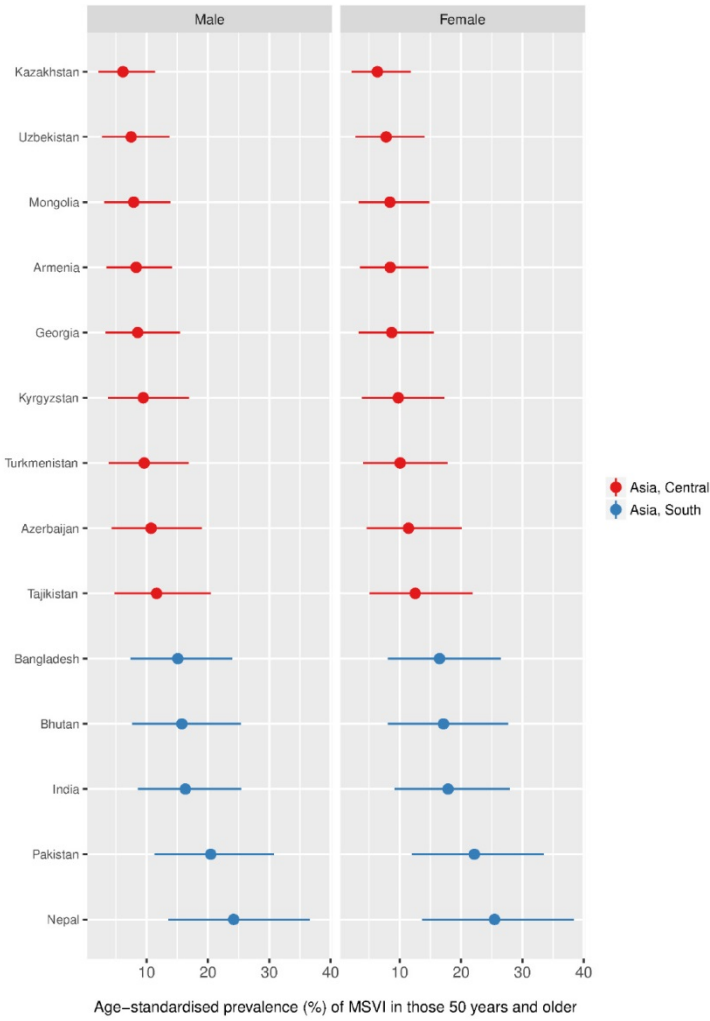| GBD Region 2020	Under-cor-rected Refrac-tive Error	Cataract	Glau-coma	Age-related Macular Degene-ration	Diabet-ic Reti-no-pathy	Corneal Disease	Tra-choma	Other
Central Asia	48.58 (45.32 - 51.20)	17.46 (10.76 - 25.04)	3.94 (0.64 - 9.27)	9.58 (1.46 - 22.26)	5.01 (0.51 - 12.20)	1.34 (0.08 - 2.85)	0.00 (0.00 - 0.00)	14.11 (2.31 - 31.61)
South Asia	66.50 (62.19 - 70.14)	23.37 (17.50 - 29.26)	1.09 (0.34 - 2.09)	1.18 (0.30 - 2.40)	0.15 (0.03 - 0.33)	0.71 (0.11 - 1.53)	0.00 (0.00 - 0.00)	7.00 (2.09 - 13.90)
World	52.61 (48.86 - 55.76)	24.75 (17.77 - 32.12)	2.05 (0.57 - 4.15)	4.16 (0.89 - 8.94)	1.49 (0.20 - 3.43)	1.10 (0.14 - 2.45)	0.22 (0.16 - 0.37)	13.61 (4.34 - 25.73)

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431 Fig. 1

432 Ladder plot showing the age-standardized prevalence of blindness in women (A) and men (B) aged 50+ years

433 for 2015. These are modelled estimates using prevalence figures applied to the individual populations of coun-

434 tries.

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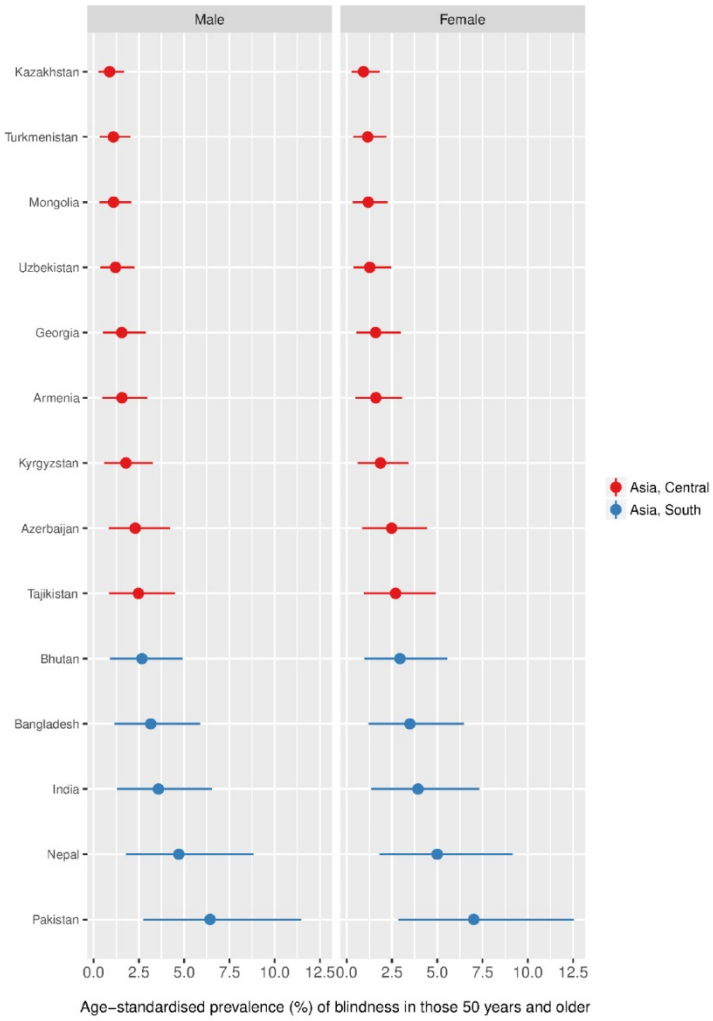
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438   Fig. 2

439   Ladder plot showing the age-standardized prevalence of moderate/severe vision impairment (MSVI) in women

440   (A) and men (B) aged 50+ years for 2015. These are modelled estimates using prevalence figures applied to the

441   individual populations of countries.

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