Causes of blindness and visual impairment in Pakistan. The Pakistan National Blindness and Visual impairment Survey

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'On behalf of the Pakistan National Eye Survey Study Group.'

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ABSTRACT

Purpose:
To determine the causes of blindness and visual impairment in adults (≥30 years old) in Pakistan, and to explore socio-demographic variations in cause.
Methods:
Multi-stage, stratified, cluster random sampling survey was used to select a nationally representative sample of adults. Each subject was interviewed, had their visual acuity measured, underwent autorefraction and fundus/optic disc examination. Those that saw < 6/12 in either eye underwent a more detailed ophthalmic examination. Causes of visual impairment were classified according to the accepted WHO methodology. An exploration of demographic variables was conducted using regression modeling.
Results:
A sample of 16,507 adults (95.5% of those enumerated) was examined. Cataract was the most common cause of blindness (51.5%; defined as <3/60 in the better eye on presentation) followed by corneal opacity (11.8%), uncorrected aphakia (8.6%) and glaucoma (7.1%). Posterior capsular opacification accounted for 3.6% of blindness. Among the moderately visually impaired (<6/18 to ≥6/60), refractive error was the most common cause (43%), followed by cataract (42%).

Refractive error as a cause of SVI/BL was significantly higher in rural dwellers than in urban dwellers (OR 3.5, 95%CI: 1.1, 11.7). Significant provincial differences were also identified. Overall we estimate that 85.5% of causes were avoidable and that 904,000 adults in Pakistan have cataract (<6/60) requiring surgical intervention.

Conclusions:

This comprehensive survey provides the reliable estimates of the causes of blindness and visual impairment in Pakistan. Despite expanded surgical services, cataract still accounts for over half of the blindness in Pakistan. One in eight blind adults has visual loss from sequelae of cataract surgery. Services for refractive errors need to be further expanded and integrated into eyecare services, particularly those serving rural populations.

INTRODUCTION

Pakistan, the sixth most populous country in the world, [1] is a developing country situated in the World Health Organization's (WHO) Eastern Mediterranean Region. The country ranks 135 in the United Nations Human Development Index [2], and a recent report has suggested that the country is facing significant hardship; a declining GDP growth and a near doubling of the proportion of the population living below the poverty line between 1987 and 2003. [3] The geography and climate of Pakistan are extremely diverse; the eastern and southern parts are dominated by the Indus River and its tributaries, the northern parts by the snow-covered Himalayan mountain range. The country's four provinces are Punjab, Sindh, North West Frontier Province (NWFP) and Balochistan.

The evidence base on national blindness and visual impairment in Pakistan prior to this survey is extremely limited. One study, estimating the main cause of blindness to be cataract (66.7%), [4] led the National Committee for the Prevention of Blindness (NCPB) to develop a Five Year National Plan for the Prevention of Blindness (1994-1999) with a particular focus on large scale expansion of cataract surgical services.

The aim of this second national survey (conducted between 2002 and 2004) was to apply more rigorous survey methodologies to produce accurate data. The prevalence of blindness among adults (aged ≥30 years) has been published [5] and we now report on the causes of blindness and visual impairment, providing estimates of the magnitude of the major causes and exploring their demographic associations.

MATERIAL AND METHODS

A detailed description of the methods used in the survey for sampling, training, ocular examination protocols has already been published. [6] A brief summary of the key methodological details is provided below.

Sample size

Based on an assumed prevalence of blindness of 1.8%, a random sampling error precision of 0.3%, a design effect of 2.0, and a 10% increase for non response, the total sample size was calculated as 16,600.

Sampling strategy

Multi-stage stratified cluster random sampling, with probability proportional-to-size (PPS) procedures, was used. Enumeration, using the random walk method, was undertaken until the target number of adults was attained in each cluster. All enumerated individuals were asked to attend the survey station, set up in their community, for ophthalmic examination in the following days. Enumerated individuals who were unable to attend were examined in their home whenever possible. Three visits were made to homes before marking the subject as a non responder.

Ethical and Official Government Approval for the study

Ethical approval was provided by the Pakistan Medical Research Council (PMRC) in March 2002. This study followed the tenets of the Declaration of Helsinki.

Definitions Used in the Ophthalmic Examination

Visual impairment

The WHO categories of visual impairment were used in this study. [7] Blindness was defined as a presenting visual acuity (i.e. with glasses for distance if normally worn, or unaided) of less than 3/60 (<20/400, logMAR >1.30) in the better eye. Severe visual impairment (SVI), was defined as <6/60 to ≥3/60, moderate visual impairment (MVI), as <6/18 to ≥6/60. A 'near normal' category was also included as <6/12 but ≥6/18. Any person with an acuity of <6/12 in the better eye was regarded as visually

impaired. As visual fields were only assessed on a subset of the sample, constricted visual fields were not included in the definition of blindness. The Snellen notation for visual acuity has been used in this paper for ease of comparison.

Unilateral severe visual impairment and blindness

This was defined as a participant presenting with ≥6/12 in one eye and<6/60 in the fellow eye.

Clinical examination and identification of causes:

Distance visual acuities were measured in all subjects using a reduced logarithm of minimum angle of acuity (logMAR) tumbling "E" chart. [8] All study participants had a basic eye examination and all also underwent autorefraction (Nikon Retinomax K-plus II Nikon, Tokyo, Japan). Individuals with <6/12 presenting visual acuity in one or both eyes ("red card holders") were subject to a more detailed examination. All 'red carders' had their visual acuity retested with the autorefraction result in a trial frame and all had a slit-lamp examination with a dilated posterior segment examination. All 'red carders' presenting with <6/18 with a treatable condition were referred to the nearest eye care facility.

Identification of causes of visual loss

The survey ophthalmologist, epidemiologist and the three clinical ophthalmologists determined the cause(s) of visual loss, following the principles outlined in the WHO Prevention of Blindness Proforma, (Version III). For each eye all pathological findings were recorded at the time of examination. Any degree of improvement in visual acuity when retested with a refractive correction was deemed evidence of refractive error present in that eye. One main cause was then selected for each eye, the WHO recommendations stipulating that a) if any pathology is secondary to another, the primary pathology should be selected (e.g. if the pathology was band keratopathy secondary to uveitis, uveitis should be selected), and/or b) conditions amenable to treatment, or c) which could have been prevented are preferentially selected over and above unavoidable causes. Following this, the main cause in the right eye or the main cause in the left eye was chosen to represent the principal cause for the individual. If the main causes in the right eye and the left eye differed, the principal disorder for the individual was selected as the one most readily treatable or, if not treatable, the one which was more amenable to prevention (e.g. if the main causes were right eye cataract, left eye optic atrophy, cataract was selected as the principal cause). Refractive error was considered more amenable to treatment than cataract. [9] If refractive error and cataract co-existed in the same eye, cataract was given as the main cause if refractive error correction did not improve the visual acuity to 6/18 or better.

Statistical analysis

All data were double entered by two trained data processors. Conditions were sub-grouped as preventable or treatable (i.e. avoidable) or unavoidable. Cause specific proportions of blindness and visual impairment were determined by age group, gender, province, location of household (rural/urban) and level of literacy. Univariate and age/gender adjusted logistic regression modeling was used to explore associations of the major causes (e.g. cataract vs. all other causes) with demographic variables. Generalized estimating equations were used in the models to adjust for dependency in the data due to clustered sampling. Estimation of the cause specific magnitude in Pakistan was calculated from age and gender standardized prevalence data (using the latest population data). [10] Extrapolations for the year 2020 were calculated using projected population estimates derived from the US census bureau. [11]

RESULTS

Study population

A total of 17,314 adults (≥30 years) were enumerated, 16,507 (95.3%) of whom were examined and included in this study. 53.1% of the study sample were women, their mean age being significantly lower than that of males (45.9 years vs. 48.9 years respectively, p<0.001). The demographics of responders and non-responders, and details of the prevalence of visual impairment have been described in detail elsewhere. [5] 4,416 subjects (27%, 95%CI: 26.1, 27.4%) were identified with a presenting visual acuity <6/12. Of these, 561 persons (crude prevalence 3.4%, 95%CI: 3.1, 3.7 %) presented blind.

Causes of bilateral blindness and visual impairment

Initially, all possible pathologies of a reduced visual acuity in eyes that presented with <6/12 vision were recorded by the examining ophthalmologist (total of 14,881 eyes). Refractive error and cataract were recorded as causes in 5,463 (36.7%) and 5,345 (35.9%) eyes, respectively. The next most common cause was central corneal opacity (912 eyes, 6.1%), uncorrected aphakia (430 eyes, 2.9%) and macular degeneration (418 eyes, 2.8%).

Data were then analyzed using the principal cause as shown in **Table 1**. Overall an extremely high proportion of all categories of visual loss were due to conditions which could have been treated or prevented. A striking 85.4% of blindness was due to avoidable causes. Unoperated cataract together with uncorrected aphakia and posterior capsule opacification (PCO) accounted for 46.8%, 78.1% and 63.7% of MVI, SVI and blindness respectively. Under/uncorrected refractive errors accounted for 70.2% of visual loss in individuals with <6/12, but only 2.7% of blindness.
Amongst the 47 blind from "other" causes, posterior segment disorders dominated, including retinitis pigmentosa (11 subjects), vitreous haemorrhage (6 subjects) and retinal detachment (2 subjects).

Table 1. Principal cause for persons, by category of visual loss in the better eye (presenting visual acuity).

		<6/12-6/18		<6/18-6/60		<6/60-3/60		<3/60	
		N	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Treatable†	Refractive error	1,047	70.2	905	42.7	17	6.9	15	2.7
	Cataract	287	19.2	883	41.6	166	67.8	289	51.5
	Uncorrected Aphakia	23	1.5	66	3.1	13	5.3	48	8.6
	PCO *	15	1.0	45	2.1	11	4.5	20	3.6
	Glaucoma	10	0.7	36	1.7	6	2.4	40	7.1
	Diabetic retinopathy	4	0.3	10	0.5	1	0.4	1	0.2
Total treatable		**1,386**	**93.0**	**1,945**	**91.7**	**214**	**87.3**	**413**	**73.6**
Preventable†	Central corneal scar	29	1.9	55	2.6	8	3.3	66	11.8
Total avoidable		**1,415**	**94.9%**	**2,000**	**94.3%**	**222**	**90.6%**	**479**	**85.4%**
Unavoidable	Phthisis/absent globe	1	0.1	3	0.1	1	0.4	15	2.7
	Macular degeneration	8	0.5	21	1.0	5	2.0	12	2.1
	Optic atrophy	2	0.1	5	0.2	1	0.4	5	0.9
	Amblyopia	10	0.7	13	0.6	2	0.8	3	0.5
	Other	55	3.7	79	3.7	14	5.7	47	8.4
Total unavoidable		**76**	**5.1**	**121**	**5.7**	**23**	**9.4**	**82**	**14.6**
Grand Total		**1,491**	**100.0**	**2,121**	**100.0**	**245**	**100.0**	**561**	**100.0**

* Posterior Capsule Opacification
† In this analysis a treatable condition was one in which an intervention existed to restore visual function or an intervention existed, if administered early, that prevented the consequences of established disease. A preventable cause was one in which a cost effective intervention existed that prevented the condition from occurring in the first place.

Causes of unilateral severe visual impairment and blindness (SVI/BL)

The main causes of unilateral reduced vision are presented in **Figure 1.** Overall more men were unilaterally blind than women (238 men, 187 women, p<0.001).

Demographic variation

We have previously reported that the prevalence of blindness increased almost exponentially with increasing age. The prevalence was also associated with female gender, rural dwelling, and illiteracy. [5]

Among blind subjects cataract was the main cause in all age groups. There were no persons blind as a result of glaucoma or uncorrected aphakia in the 30-39 year age group, however among those aged 70 years and older, glaucoma and uncorrected aphakia accounted for 9% and 10%, respectively. PCO was not a cause of blindness in the younger age groups (i.e. 30-59 years) but in older subjects it was a prominent treatable cause (6.3% in 60-69 year olds). In contrast amblyopia was a more common cause in younger subjects but was not reported as a cause in subjects ≥60years. The highest proportion of phthsis/absent globe as a cause was found in the youngest age group (7.8%). The distribution in individuals with MVI is demonstrated on **Figure 2**.

The principal causes of MVI stratified by demographic variables are presented in **Table 2**. In men the principal cause was cataract (45.4%), whereas in women it was refractive error (45.4%). Provincial differences suggested that refractive error was a more common problem in NWFP (48.5%). Similarly refractive error was more common in urban settings (47.5%) (whereas in rural settings cataract dominated (45.3%)) and in literate subjects (59.3%). The proportion attributed to corneal opacity was highest in Balochistan (9.9%).

Table 2. Principal cause of visual loss for persons with moderate visual impairment (< 6/18 but ≥6/60 in better eye).

		Treatable (%)						Preventable (%)	Unavoidable (%)		
	N=	RE	Cataract	PCO	UA	DR	Glaucoma	Corneal opacity	Optic atrophy	MD	Other
Gender											
Male	935	39.1	45.4	2.1	2.9	0.3	2.1	2.9	0.2	1.2	3.8
Female	1186	45.4	39.8	2.1	3.3	0.6	1.3	2.4	0.3	0.8	4.0
Province											
Balochistan	101	38.6	29.7	1.0	3.0	0.0	3.0	9.9	1.0	1.0	12.8
NWFP	342	48.5	36.5	2.3	1.5	0.3	0.9	4.1	0.9	1.2	3.8
Punjab	1159	40.7	43.0	1.2	5.0	0.8	2.1	2.3	0.0	1.0	3.9
Sindh	519	43.9	44.3	4.2	0.0	0.0	1.0	0.8	0.2	0.8	4.8
Location											
Urban	729	47.5	34.6	2.5	2.5	1.2	1.5	2.9	0.1	1.8	5.4
Rural	1392	40.2	45.3	1.9	3.4	0.1	1.8	2.4	0.3	0.6	4.0
Literacy											
Literate	290	59.3	28.6	1.0	1.7	1.4	1.7	1.4	0.3	0.3	4.3
Illiterate	1831	40.0	43.7	2.3	3.3	0.3	1.7	2.8	0.2	1.1	4.6

NWFP= North West Frontier Province

RE: Refractive Error: PCO: Posterior Capsule Opacification; UA: Uncorrected Aphakia; DR: Diabetic Retinopathy; MD: Macular Degeneration.

Association analysis

The age and gender adjusted association analyses of the principal cause in participants with SVI/BL are presented in **Table 3**. The odds of refractive error as a cause compared to any other cause steadily deceased with age (p= 0.025) whereas the odds of cataract and aphakia increased with each decade (p= 0.023 and p=0.025 respectively).

Table 3. Age and gender adjusted association analysis of the principal causes of subjects presenting with severe visual impairment and blindness (<6/60 in the better eye)

		RE	Cataract	PCO	UA	Corneal Opacity	Glaucoma
Age †	30-39	1	1	1	1	1	1
	Decade increase	**0.7 (0.6 ,1.0)**	**1.2 (1.0, 1.3)**	1.33 (0.91, 1.96)	**1.4 (1.0, 1.8)**	0.93 (0.8, 1.1)	1.23 (0.9, 1.7)
Gender ††	Women	1	1	1	1	1	1
	Men	0.8 (0.4, 1.6)	0.8 (0.6, 1.1)	0.5 (0.2, 1.0)	0.8 (0.5, 1.4)	0.9 (0.8, 1.1)	0.9 (0.5, 1.6)
Province	NWFP	1	1	1	1	1	1
	Balochistan	1.0 (0.3, 4.2)	**0.5 (0.3, 0.95)**	0.6 (01, 3.1)	1.5 (0.3, 9.4)	3.61 (0.6, 22.5)	**6.2 (1.2, 32.9)**
	Punjab	0.6 (0.3, 1.6)	0.8 (0.5, 1.2)	0.4 (0.2, 1.1)	**4.3 (1.3, 14.0)**	**7.1 (1.7, 30.0)**	4.1 (1.0, 17.5)
	Sindh	0.6 (0.2, 1.7)	0.91 (0.6, 1.5)	0.9 (0.3, 2.3)	1.78 (0.5, 6.8)	**8.0 (1.8, 34.9)**	2.4 (0.5, 11.5)
Dwelling	Urban	1	1	1	1	1	1
	Rural	**3.5 (1.1, 11.7)**	0.2 (0.7, 1.3)	0.6 (0.3, 1.4)	1.06 (0.6, 1.9)	1.4 (0.8, 2.6)	1.2 (0.6, 2.6)
Literacy	Illiterate	1	1	1	1	1	1
	Literate	1.18 (0.3, 4.5)	1.20 (0.7, 2.2)	NA*	1.0 (0.3, 3.5)	0.38 (0.1, 1.3)	0.8 (0.2, 3.4)

† Gender adjusted

†† Age Adjusted

*No literate subjects were found with PCO as their principal cause of severe visual impairment and blindness.

Statistically significant associations indicated in bold print. ($p<0.05$)

RE: Refractive Error; PCO: Posterior Capsule Opacification; UA: Uncorrected Aphakia

Estimate of the number of adults presenting with visual impairment in Pakistan by cause

If the acuity level of <6/60 is used to denote 'operable cataract' there are 904,000 (95%CI: 736,000 to 1,107,000) adults requiring surgery. A further 173,000 individuals have uncorrected aphakia or PCO. A total of 1,390,000 adults have a presenting visual acuity of <6/60 in the better eye due to avoidable causes (Table 4). Assuming the prevalence and patterns of causes remain unchanged, the figures for the year 2020 show that a total of 2,560,000 adults will have avoidable causes of SVI. The estimate for 'operable cataract' is predicted to increase to almost 2 million by the year 2020.
Projections for the year 2020 are shown on **Table 4**. Regarding adults with MVI (<6/18 to ≥6/60, better eye) 2,140,000 would benefit from having their refractive error corrected this number increasing to 4,320,000 adults in 2020.

Table 4. Estimated number of adults (≥30 years) in Pakistan with severe visual impairment and blindness (presenting vision <6/60 in the better eye) by cause. (Age/gender standardized figures)

	2003 (139 million)*	2020 (213 million)**
Cause		
Treatable		
Cataract	904,000	1,860,000
Uncorrected aphakia	116,000	238,000
Glaucoma	89,000	185,000
Refractive Error	72,000	147,000
Posterior Capsule Opacification	57,000	119,000
Diabetic retinopathy	3,200	6,900
Preventable		
Central Corneal Opacity	150,000	308,000
Other		
Macular Degeneration	35,000	72,000
Optic atrophy	15,000	32,000
Total †	**1,620,000**	**3,320,000**

* Total Pakistan population
** Estimated Total Pakistan population [11]
† Including other causes

DISCUSSION

The survey reported in this paper used a diagnostically rigorous methodology, similar to that in the recent surveys in Bangladesh and India.[12, 13] The response rate was very high (95.3%) minimizing potential non response bias. The use of the WHO criteria for coding causes of visual loss allows comparisons with other similarly coded surveys.

The refractive status of every individual was assessed by autorefraction, and furthermore subjects with a visual acuity of <6/12 in either eye had trial lens corrected visual acuities measured. This allowed an accurate evaluation of refractive error as a cause of visual impairment, these data being important for planning refractive error services (a priority of the global initiative to eliminate avoidable blindness, VISION2020: the Right to Sight. [14]) The examination process also involved a dilated examination of all eyes with a visual acuity <6/12, allowing the detection of posterior segment disease, which has often been overlooked in the presence of cataract. [15]

Visual fields were only performed on a subset of the sample, which is a limitation of the survey, and individuals with extensive visual field loss (e.g. in glaucoma, retinitis pigmentosa) but who had good visual acuity might have been missed. As fields were not performed on all subjects, constricted fields were not included in our definition of blindness. As the primary cause of a phthisical/absent globe could not always be determined it is possible that some 'unavoidable' cases could have been treatable or preventable (misclassification bias).

We found 14,881 eyes with visual acuity <6/12. When all pathological findings in each eye were analyzed together refractive error caused as much visual loss as cataract (36.7% and 35.6% respectively).

Almost 75% of individuals who were blind had treatable causes, and over 90% of subjects had treatable causes of visual impairment. The two most important treatable causes of blindness were unoperated cataract (or uncorrected aphakia, 8.6% and PCO, 3.6%) and glaucoma (7.1%), others being refractive error (2.7%) and diabetic retinopathy (0.2%). In the 1990 study [4], cataract accounted for 66.7% of blindness, whereas the current survey found unoperated cataract accounting for 51.5%. It is not possible to directly compare data for cataract between these studies, as different age groups were used, but the observed reduction almost certainly represents a real reduction, given the large scale increase in cataract surgical service delivery in Pakistan. However, the finding that despite this increase nearly one in ten adults in Pakistan were visually impaired (<6/12) due to unoperated cataract highlights the importance of continued support of the NCPB for extending cataract surgical services in Pakistan.

In this survey over 12% of blindness was due to the sequelae of cataract surgery (i.e. uncorrected aphakia 8.6% and PCO 3.6%). A survey conducted in rural NWFP identified uncorrected aphakia as the second most common cause of blindness. [16] A hospital based study in Lahore, Pakistan showed that only 50% of eyes among individuals returning for follow up after cataract surgery had had IOL implantation. [17] As low cost, high quality IOLs are now readily available, IOL surgery should be routine. Visual loss from PCO is certain to increase as cataract surgical rates increase, and YAG lasers need to be made available for hospitals delivering high volume cataract surgery, with training in their use, upkeep and repair made a priority.

After cataract and the sequelae of cataract surgery, glaucoma was the next most important cause of treatable blindness, accounting for 7.1%. This is lower than the 11% quoted for the WHO Eastern Mediterranean region, subregion D, which includes Pakistan [19], but much higher than in a similarly designed survey in Bangladesh (1.2%). A survey in India of adults aged ≥50 years, which used a blindness definition of <6/60, showed 5.8% of blindness was due to glaucoma. [20] The earlier study in Pakistan estimated the number of people blind from glaucoma to be 80,000 [4] which is similar to the estimate from the current survey (89,000). Due to logistical constraints the type of glaucoma could not be determined, but other studies on the Indian subcontinent suggest that primary angle closure glaucoma is as common, if not more so, than primary open angle glaucoma [21] further highlighting the requirement for YAG lasers to be made more widely available. As cataract is becoming increasingly controlled in developing countries, strategies for the detection and treatment of glaucoma will need to increase in profile. In this survey, glaucoma blindness was highest in Balochistan, the most deprived province (89% of the rural population live in high deprivation districts) [22] with limited access to eye care services.

Diabetic retinopathy accounted for 0.2% of blindness. However, this is likely to underestimate the true burden of retinopathy in the population as diabetic patients are more likely to have cataract, which would be preferentially recorded as the cause of their visual loss, and vitreous hemorrhage (possibly from diabetic neovascularization) was classified in the 'other' category. It is predicted that with rapid urbanization Pakistan will be among the five countries with the highest prevalence of diabetes by the year 2025 [23]. This is likely to alter the existing pattern of blindness and in order to prevent a public health problem preventive strategies need to be established.

In the 1990 Pakistan study refractive error (including uncorrected aphakia) accounted for 11.4% of blindness,[4] which is identical to the figure in the current survey, indicating that there has been minimal progress in addressing this highly treatable condition. Refractive error was the leading cause of moderate visual impairment particularly among the economically active working age group. Targeting this group, particularly with ready made spectacles, should be made a priority as this would prove to be extremely cost effective. It must be recognized, however, that barriers exist e.g. the social implications of spectacle wear. In addition many individuals have mild myopia and as they have adequate near vision they may not feel impaired.

Corneal pathology, the main preventable cause, was the second largest cause of blindness overall (11.8%), again similar to that found in the 1990 survey.[4] There are many causes of corneal scarring, trachoma being one. Trachoma is still endemic in parts of the country, and a recent rapid assessment found that of 233 villages surveyed, 151 (64.8%) had individuals requiring trichiasis surgery. [24] Pakistan has set up a dedicated national task force for trachoma control and is part of the GET 2020 alliance. [25]

Phthisis/absent globe was most important cause of unavoidable blindness and the third most important cause of unilateral SVI/BL. This highlights the importance of ocular trauma in Pakistan. A previous study on ocular trauma in NWFP found that

57.7% of cases had a perforating injury and that men outnumbered women by 5:1. [26] A similar gender difference in unilateral blindness was noted in our survey.

A comparison of the findings of this survey with others in the region shows that Pakistan has the lowest proportion of SVI/BL (57%) due to cataract (India 62.4%, [20] Bangladesh 82% [12].) Refractive error (including uncorrected aphakia) was lowest in Bangladesh (7.5%) followed by Pakistan (12%) and India (19.7%). Corneal opacity, responsible for nearly one in ten cases of SVI/BL, was particularly prevalent in Pakistan but accounted for less than 1% of SVI/BL in India [20] and Bangladesh. [12] The reason for this high disparity is unclear but warrants further investigation. In subjects <6/12, cataract and refractive error were of similar importance in Pakistan however this contrasts with Bangladesh where the main cause remained cataract (73.4%) with refractive error only accounting for 18.9%. [12]

Our findings are markedly different from the findings in high income countries where the primary causes of blindness are age-related macular degeneration, diabetic retinopathy, and myopic degeneration, one survey in the USA indicating that these causes accounted for 63% of blindness. [27]

Based on the findings from this survey and future population dynamics, eye care service delivery needs to continue to expand in Pakistan, focusing principally on high quality cataract surgery and aftercare, and on increased capacity for the correction of refractive errors. This recommendation is consistent with the prioritized areas of action for the region as outlined by the WHO South-East Asia policy 'Vision 2020 – The Right to Sight'. The more challenging conditions to control, namely glaucoma, macular degeneration and diabetic retinopathy, are also emerging as priorities. [28, 29]

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Figure 1. Main causes of unilateral reduced vision in 427 subjects (<6/60 presenting vision in one eye and 6/12 or better in the fellow eye). The ten most common causes are presented.

Figure 2. The relative contribution of the most common ocular pathologies for the moderately visually impaired (presenting <6/18 to 6/60) subjects according to age group

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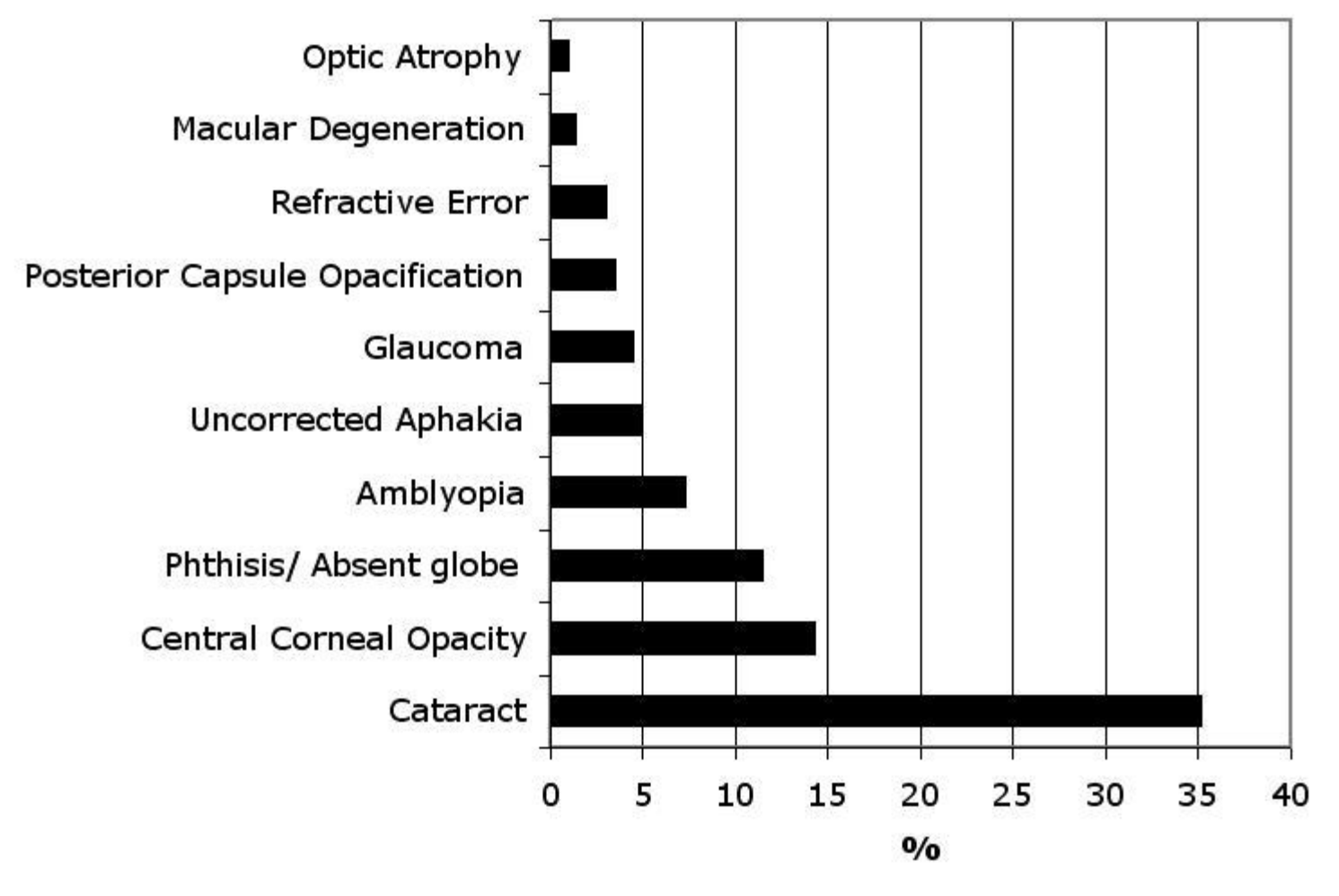
Optic Atrophy
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Refractive Error
Posterior Capsule Opacification
Glaucoma
Uncorrected Aphakia
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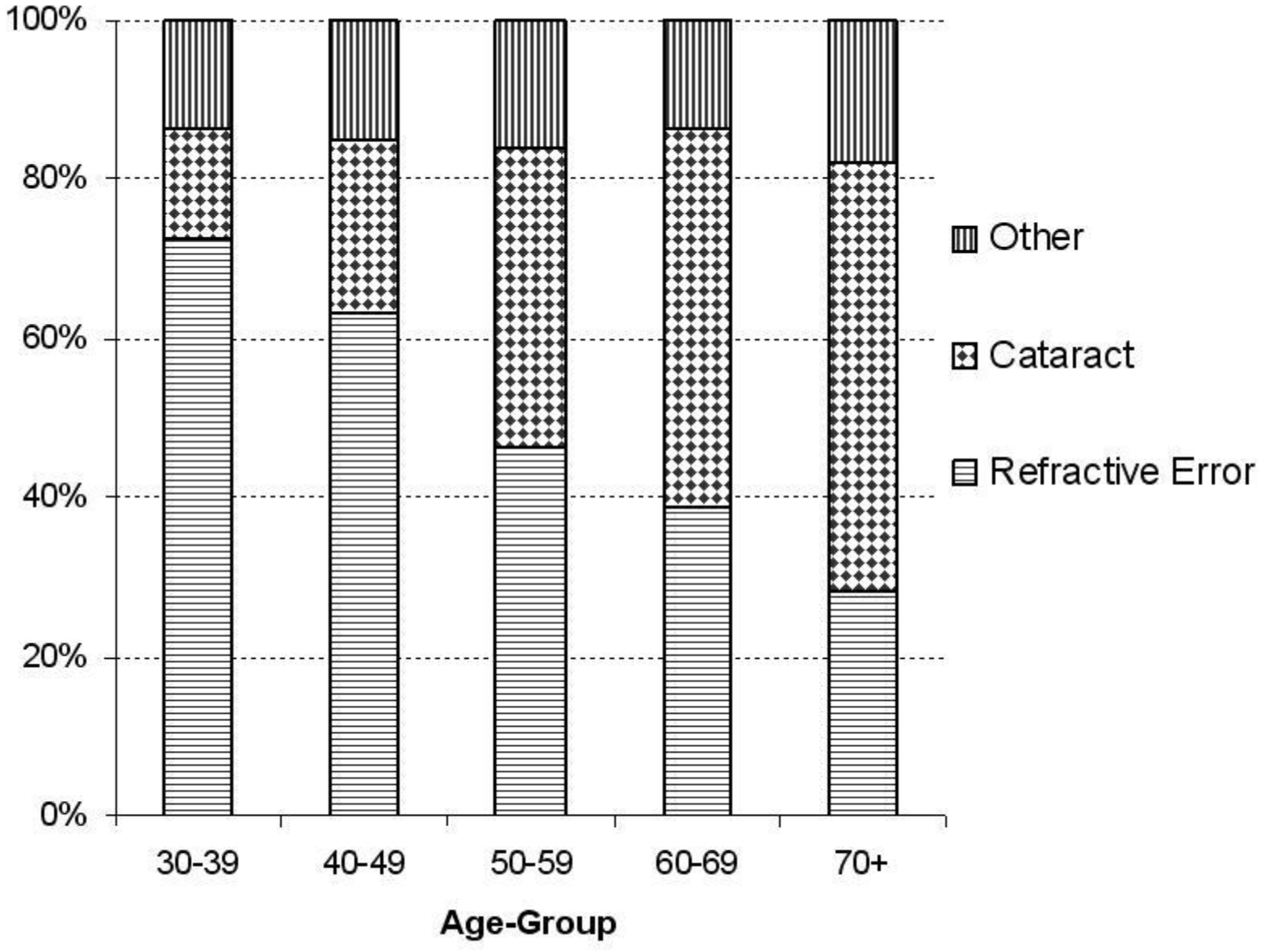
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