Rapid Assessments of Avoidable Blindness in Sargodha, Nowshera, Rawalpindi and Quetta Districts in Pakistan

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Executive summary

The World Health Organisation (WHO) estimated that globally in 2020, 43.3 million people were blind, 295 million had moderate to severe visual impairment and 258 million had mild visual impairment (1). About 80% of all visual impairment (VI) is considered avoidable, with the main causes being cataract and uncorrected refractive errors. If not recognised and treated in a timely manner, these impairments can lead to blindness. The vast majority of people with VI live in low- and middle-income countries (LMICs) and are aged 50 years and over (2).

A major constraint in the implementation of national plans and policies to reduce avoidable blindness has been the absence of country-specific epidemiological data. In order to resolve this issue, the WHO recommends conducting periodic population-based studies such as Rapid Assessments of Avoidable Blindness (RAABs) to provide data for decision-making and programme planning. RAAB is a standard methodology for obtaining reliable results for people in the age group with the highest prevalence of VI, i.e. aged 50 and over (3).

This report describes the results of four RAABs which assessed the magnitude and causes of VI in the districts of Sargodha, Nowshera, Rawalpindi and Quetta. In all four districts, the RAAB survey was supplemented by a disability and wealth survey. We also examined the interaction between the two components to understand how individual characteristics of people aged 50 years and above - specifically disability and wealth - may drive their eye health and eye-health seeking behaviour.

In each of the four districts, we recruited 2,800 individuals aged 50 years and over, with response rates ranging from 95.5% in Nowshera to 97.4% in Rawalpindi. After adjusting for age and sex, the prevalence of blindness (measured as presenting visual acuity in the better eye) among people aged 50 and over ranged from 0.3% in Quetta and 1.3% in Rawalpindi to 2.3% in Sargodha and 2.9% in Nowshera. Significant differences between males and females were only observed in Rawalpindi, where males were observed to have a higher prevalence of blindness than females: 1.8% (95%CI 1.3-2.3%) compared with 0.8% (95%CI 0.3-1.2%) respectively. Cataract surgical coverage is high in all districts: 83.9% in Nowshera, 89.1% in Sargodha, 98.1% in Rawalpindi and 99.6% in Quetta.

The prevalence of diabetes among those in this age group was estimated to range from 9.1% in Quetta, 14.6% in Rawalpindi, 17.4% in Sargodha and up to 21.1% in Nowshera. The prevalence of disability among over-50s was observed to be lowest in Rawalpindi at 2.6%, then 5.5% in Quetta, 10.1% in Nowshera and 12.7% in Sargodha.

RAABs provide valuable information for decision-makers and health service managers. They show that overall, these districts are making significant progress in eliminating avoidable blindness and achieving universal eye-health coverage. However, progress has been more substantial in urban districts with a broad range of eye-care services. In addition, our findings suggest that there are socio-demographic inequalities and vulnerable population groups, such as people with disabilities, for whom access to eye-care services needs to be maximised. Finally, despite diabetes being a rapidly growing problem in Pakistan, not many patients are aware of their condition. There is therefore an urgent need to roll out diabetes awareness services and public health interventions, which aim to control the disease's progress and prevent its visual and non-visual complications.

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Abbreviations

ARMD	Age-related macular degeneration
BCVA	Best corrected visual acuity
CSC	Cataract surgical coverage
DHS	Demographic and Health Survey
DM	Diabetes mellitus
DR	Diabetic retinopathy
EMR	Eastern Mediterranean Region
ET	Equity Tool
EVI	Early visual impairment
FCDO	Foreign, Commonwealth and Development Office
GDP	Gross Domestic Product
GNI	Gross National Income
HDI	Human Development Index
IOV	Inter-observer variation
LMIC	Low- and middle-income country
LP	Light perception
MVI	Moderate visual impairment
PPS	Probability proportionate to size
PVA	Presenting visual acuity
RAAB	Rapid Assessment of Avoidable Blindness
SVI	Severe visual impairment
STDR	Sight threatening diabetic retinopathy
VA	Visual acuity
VI	Visual impairment
WGSS	Washington Group Short Set of questions
WHO	World Health Organisation

Introduction

The World Health Organisation (WHO) estimated that globally in 2020, 43.3 million people were blind, 295 million had moderate to severe visual impairment and 258 million had mild visual impairment (1). About 80% of all visual impairment (VI) is considered avoidable, with the main causes being cataract and uncorrected refractive errors. If not recognised and treated in a timely manner, these impairments can lead to blindness. The vast majority of people with VI live in low- and middle-income countries (LMICs) and are aged 50 years and over (2).

The prevalence of blindness in South Asia, including Pakistan, is estimated to be 8.95 per 1,000 people – among the highest prevalence globally (1). Despite a decrease in age-standardised prevalence over recent years, estimates suggest that the absolute number of people living with blindness and VI will increase over the coming years due to population growth and ageing (1, 2).

In 2016-2017, a Rapid Assessment of Avoidable Blindness (RAAB) conducted in the Pakistani districts of Swabi and Mansehra reported a prevalence of blindness among people aged 50 and over of 4.5% and 1.8% respectively (4). Cataract and refractive error were the most common causes of blindness and VI in both districts. Findings also showed that functional low vision was above 4% in both districts, and that poor post-surgical visual outcome in both districts was approximately 30%.

This RAAB included the diabetes and diabetic retinopathy (DR) component, with the prevalence of diabetes among those aged 50 and over being 8-10% in both districts. Findings also showed that 33% of diabetics had eye complications and 5-11% had sight-threatening complications due to poor glycaemic control and unawareness of diabetes-related complications. After the RAAB has been conducted, eye-health experts identified a need to:

- Implement control strategies through strengthening primary eye-care services, creating awareness amongst the population and improving the provision of cataract surgeries and vitreo-retinal services.
- Support public eye-health awareness programmes to address avoidable blindness and diabetes complications, with a strong emphasis on female education.
- Develop strong referral chains from primary to secondary and tertiary levels to monitor and control blinding diabetic retinopathy with services to be integrated in the eye-care delivery.

Survey results in the Swabi and Mansehra districts are not representative of other parts of the country, and more RAAB surveys from other districts are needed to build a more comprehensive picture.

This report describes the results of four RAABs which assessed the magnitude and causes of visual impairment in the districts of Sargodha, Nowshera, Rawalpindi and Quetta. In all four districts, the RAAB survey (Result 1) was supplemented by a disability and wealth survey (Result 2).

We also examined the interaction between the two components to understand how individual characteristics of people aged 50 years and over – and specifically disability and wealth – may drive their eye health and eye-health seeking behaviour.

Methodology

1. Survey setting

Pakistan is a lower middle-income country located in South Asia. It is the sixth most populous country in the world with a population of 220.89 million people in 2020. The country's Gross Domestic Product (GDP) was estimated at US$300.31 billion in 2020 and the Gross National Income (GNI) per capita was US$1,460.

2. Study design

RAAB is a cross-sectional descriptive quantitative survey.

This study reports on four RAABs conducted in Sargodha district in central Punjab province; Nowshera district in Peshawar division of Khyber Pakhtunkhwa province; Rawalpindi city in the northern part of Punjab province; and Quetta district in the north-west of Baluchistan province.

These four RAABs contributed to the National Blindness Survey, which consisted of 16 individual RAABs in randomly-selected districts representing all provinces, and which were selected proportional to size of their populations.

3. Study objectives

1. To estimate the prevalence of blindness and severe and moderate visual impairment and low vision among people aged 50 years and over.
2. To identify the main causes of blindness and severe and moderate visual impairment in the same population.
3. To estimate cataract surgical coverage and the quality of visual outcomes after cataract surgery in this population.
4. To identify barriers to the uptake of cataract surgery in this population.
5. To estimate the prevalence of diabetes and diabetic retinopathy amongst people aged 50 years and above.
6. To estimate the prevalence of disability in the same population.

4. Study areas and sample selection

The study population included people aged 50 years and over, who were ordinarily residents in the four study districts. Ordinarily, a 'resident' was defined as someone living in a selected household for six or more months over the past year and sharing meals from the same kitchen. Participants who were not residents, were unable to provide meaningful consent or who refused to participate were excluded from the study.

District 1: Sargodha

Sargodha is a district of central Punjab with Sargodha city its capital. The district has an area of 5,864 km² with a population of 1,537,866 (5), and is divided into seven tehsils or sub-districts. Its health service infrastructure consists of one tertiary care hospital, one secondary care hospital, two civil hospitals, 14 rural health centres and 131 basic health units.

District 2: Nowshera

Nowshera is located in the Peshawar division of Khyber Pakhtunkhwa province, with Nowshera city its capital and district headquarters. According to the 2017 census, its total population was 1,518,540 within an area of 1,748 km² (5). Administratively, Nowshera is divided into three tehsils. Healthcare facilities in the district include one tertiary care hospital, one secondary care hospital, 13 rural health centres and 28 basic health units.

District 3: Rawalpindi

Rawalpindi is located in the northern part of Punjab province and is amongst the districts with the highest Human Development Index (HDI), ranked third in the country in 2015 (6). The district has an area of 5,286 km² and a population of 5.4 million, with 46.8% living in rural areas (5). Its capital – Rawalpindi city – is the fourth largest city in Pakistan, and has a large catchment area as it is adjacent to many districts of Khyber Pakhtunkhwa province and Azad Jammu and Kashmir states. Rawalpindi has a good network of primary, secondary and tertiary health facilities, most of which are located in urban areas. There are over 100 primary health facilities in the public sector and 30 secondary or tertiary health facilities in the public and private sectors, including two teaching hospitals.

District 4: Quetta

Quetta is located in the north-west of Baluchistan province, bordering Afghanistan's Kandahar province. The district is famous for its agricultural produce, most notably fruit orchards bearing apples and grapes. It is 2,653 km² in size with a population of 2,275,699 (5) and administratively is divided into three tehsils and 67 union councils (the smallest administrative unit). Baluchistan is the most underdeveloped province of Pakistan and all of its districts (except Quetta) fall into the low HDI category (6). Quetta itself is in the medium HDI category. The district has two tertiary care hospitals and two rural health centres supported by 32 basic health units. Quetta also hosts three million Afghan refugees.

Sample size and sampling methodology

The estimated sample size for each district was 2,800 for an expected prevalence of 5% with 20% precision, design effect of 1.4 and an additional 10% for non-responders. The sample was recruited from a total of 80 clusters (35 subjects per cluster).

We used a multi-stage cluster sampling approach as per the RAAB instructional manual. Firstly, all villages/locations were listed with their respective populations. A cumulative list was uploaded in the RAAB V6 software and clusters were selected automatically using population proportionate to size (PPS). This process was repeated for each district individually. At the second stage, 50 eligible people were selected in each cluster via compact segment sampling. Maps of locations were obtained from the local municipal corporation/basic health unit/district health unit and then divided into equal segments that would include 35 people aged 50 years and above.

Where maps were not available on the day of the survey, areas were mapped manually and divided into segments of approximately equal population size and with well-demarcated boundaries (using the map), so that each segment included the desired cluster size of 35 people aged 50 years and over. All people in the segment were enrolled and examined.

5. Data collection and management

Three separate validated survey tools were used in this study: the Rapid Assessment of Avoidable Blindness and Diabetic Retinopathy (RAAB + DR) tool, the Equity Tool (ET) and the Washington Group Short Set of questions on disability (WGSS).

Survey tools were administered using mobile data collection app Commcare, which allowed data to be collected on tablets and synced daily to an online server. Unique identification codes were automatically generated, which meant no personal data beyond individual age and sex was captured or stored. Data was downloaded and stored in Excel format and uploaded to the RAAB 6 software for basic analysis (RAAB data only) and Stata version 15 for further analyses (all data).

Rapid Assessment of Avoidable Blindness and Diabetic Retinopathy

The study used the standard RAAB + DR (V.6) survey methodology as outlined in the RAAB 6 manual (7)

Relative wealth

We used the Equity Tool (ET) to measure the relative wealth of participants i.e. how an individual and their household compares to other individuals/households in the country in their wealth. This tool, maintained by Metrics for Management, is an internationally recognised tool designed to evaluate economic differences between social groups. Economic status of participants is determined by categorising them into one of five asset-based wealth quintiles ranging from quintile one (the poorest) to quintile five (the wealthiest). The tool is based on the standard asset-based tool used in Demographic and Health Surveys (DHS) adapted for specific countries. The ET was administered to the heads of households, who provided information on behalf of the entire household.

Over the course of administering the survey, in 2020 Metrics for Management updated their ET for Pakistan, changing the questions slightly and updating the cut-off points based on a 2016/17 DHS (a full description of the changes can be found on their website) (8). Although this survey captured the ‘old’ ET questions, we updated the cut-off points for each quintile using the publicly available DHS 2017/18 data to ensure our participants were placed in the most correct quintiles according to their situation.

Disability

The Washington Group Short Set (WGSS) of questions was developed by the United Nations Statistical Commission to measure the prevalence of disability in censuses and surveys. The WGSS includes six questions, which ask about difficulties in performing certain universal basic tasks: seeing, hearing, walking, communication, self-care and remembering or concentrating. It was designed to be applied and understood in all cultural settings following translation to the local language.

The tool does not use the word ‘disability’, thereby avoiding stigma and subsequent potentially biased responses. The responses are given on a four-point scale ranging from “no difficulty” to “cannot do at all”. Participants who respond with “a lot of difficulty” or “cannot do at all” to at least one of the six domains are considered to have a disability.

6. Subject examination protocol

The purpose of the study and examination procedure was explained to the participants, and written informed consent was obtained before examination. If an eligible person was absent, the survey team returned at least twice to the household on the same day to examine them before leaving the area. If after repeated visits they could not be examined, information about their visual status was collected from relatives or neighbours. All eligible people underwent a standardised ophthalmic examination in their households. Before measuring visual acuity (VA), the ophthalmic assistant explained the procedure very clearly to all the participants in local language and obtained written consent.

Visual acuity (VA) was measured with a Snellen tumbling E chart, using optotype size 18 on one side and size 60 on the other side, at a six- or three-metre distance. Eyes were classified on the basis of VA as below.

Visual acuity (VA) level	WHO category
Can see 6/12	Normal vision
Cannot see 6/12, but can see 6/18	Mild (early) visual impairment (EVI)
Cannot see 6/18, but can see 6/60	Moderate visual impairment (MVI)
Cannot see 6/60, but can see 3/60	Severe visual impairment (SVI)
Cannot see 3/60, but can see 1/60	Blind
Light perception (LP+)	Blind
No light perception (LP-)	Blind

If a person was not able to see 6/12 in either eye with available correction, pinhole vision was measured. The lens status of all participants was assessed (using both a torch and distant direct ophthalmoscopy) by the ophthalmologist inside their own houses. All eyes that could not see 6/18 with available correction were examined with a direct ophthalmoscope. Only the primary cause of blindness or visual impairment was recorded for each eye. If there were two or more primary disorders, equally contributing to visual loss, then according to the WHO criteria the cause that is more amenable to treat or to prevent was recorded. All information was recorded using the standardised RAAB form.

People who had vision-impairing cataract were asked why they had not undergone cataract surgery, and up to two responses were marked per person in pre-coded categories. Those who had undergone cataract surgery were asked about the details of their operation (e.g. place, age, type of operation, satisfaction). People with a treatable eye condition were referred for appropriate treatment. The nurse also questioned every subject about their

diabetes status and examined the random blood glucose of every subject using glucometers. In addition, all eligible subjects were asked questions regarding wealth assessment and disability.

Equipment used

- Snellen's tumbling E Chart
- Measuring tape and rope
- Torch
- Direct ophthalmoscope
- Indirect ophthalmoscope
- Glucometer with its consumables

Teams

Five teams were selected for each survey, with each team comprising an ophthalmologist, an ophthalmic assistant, an ophthalmic nurse and a driver.

Training

A certified RAAB trainer trained the teams for seven days: five days for the standard RAAB training and two additional days for diabetic retinopathy. The teams were trained in grading diabetic retinopathy by a vitreo-retinal surgeon. Interobserver variation (IOV) was also conducted and Kappa statistics of more the 0.6 was achieved for quality control purposes.

Data Analysis

Data was downloaded in .csv format and uploaded in Stata v15 software for analysis (9).

Results were tabulated, calculating sample prevalence estimates for each outcome of interest, and 95% confidence intervals surrounding them were estimated. Standard errors were adjusted for clustering using the design effect observed. The age and sex distributions of the sample were reviewed against available census data and a weighting file was developed and used to create age- and sex-adjusted estimates and confidence intervals of each key indicator.

Results

1. Sargodha

Description of the sample

2,801 participants aged 50 years or above were recruited in Sargodha, of whom 2,708 were examined (96.6% response rate) (Table 1.1).

Table 1.1 Examination status of enrolled participants

	Male		Female		Total	
	N	%	N	%	n	%
Examined	1,531	97.4	1,177	95.5	2,708	96.6
Not examined	11	0.7	6	0.4	17	0.6
Refused	12	0.8	27	2.3	39	1.5
Unable to communicate	17	1.1	20	1.7	37	1.4
Total	**1,571**	**100**	**1,230**	**100**	**2,801**	**100**

56.5% of the examined individuals were male (n=1,531); and nearly half of the sample were aged 50-59. The age distribution was similar in the male and female subgroups (Table 1.2).

Table 1.2 Age and sex distribution of examined individuals

	Male		Female		Total	
	N	%	N	%	N	%
50-59	812	49.9	679	49.7	1,491	49.8
60-69	417	29.5	307	30.2	724	29.8
70-79	190	13.8	118	13.7	308	13.8
80+	112	6.8	73	6.4	185	6.6
Total	**1,531**	**100**	**1,177**	**100**	**2,708**	**100**

Compared with the population of people aged 50 years and older living in the district, males were slightly over-represented in the study sample (56.5% compared with 53% in the population), while the age distribution of the sample was broadly comparable with the population (Table 1.3). To address the potential bias arising from the sampling, estimates for the prevalence of blindness and visual impairment were adjusted (weighted) for sex and age.

Table 1.3 Comparison of study sample and area population

	Male				Female				Total			
	Study sample		Region		Study sample		Region		Study sample		Region	
	N	%	n	%	N	%	n	%	n	%	N	%
50-59	812	49.9	136,849	49.1	679	49.7	119,890	48.7	1,491	49.8	256,739	48.9
60-69	417	29.5	82,516	29.6	307	30.2	73,980	30.1	724	29.8	156,496	29.8
70-79	190	13.8	38,939	14.0	118	13.7	33,873	13.8	308	13.8	72,812	13.9
80+	112	6.8	20,315	7.3	73	6.4	18,199	7.4	185	6.6	38,514	7.3
Total	1,531	100.0	278,619	100.0	1,177	100.0	245,942	100.0	2,708	100.0	524,561	100.0

Prevalence and causes of visual impairment

The prevalence of blindness in our sample was 2.8% (95% CI 2.00-3.7), while the adjusted prevalence of blindness was 3.2% (95% CI 2.4-4.0) (Tables 1.4 and 1.5). The prevalence of blindness was higher among women (3.6%, 95% CI 2.4-4.8) than men (2.8%, 95% CI 1.9-3.8) but the difference was not statistically significant. The adjusted prevalence of severe visual impairment (SVI) was 3.3% (2.9% for men and 3.7% for women) and the adjusted prevalence of moderate visual impairment (MVI) was 16.7% (17.1% for men and 16.2% for women).

Table 1.4 Sample prevalence of blindness, SVI, MVI, EVI and FLV

	Male			Female			Total		
	N	%	95% CI	N	%	95% CI	n	%	95% CI
Blindness	42	2.7	1.8-3.7	35	3.0	1.8-4.1	77	2.8	2.0-3.7
Severe VI	42	2.7	1.8-3.6	37	3.1	1.7-4.6	79	2.9	2.1-3.8
Moderate VI	248	16.2	14.4-18.0	168	14.3	12.0-16.6	416	15.4	13.7-17.0
Early VI	358	23.4	21.2-25.6	277	23.5	20.6-26.5	635	23.5	21.6-25.3
Functional low vision	49	3.2	2.3-4.1	31	2.6	1.7-3.7	80	3.0	2.3-3.6

Table 1.5 Extrapolated prevalence of blindness, SVI, MVI, EVI and FLV (adjusted)

	Male		Female		Total	

	N	%	95% CI	n	%	95% CI	n	%	95% CI
Blindness	7,909	2.8	1.9-3.8	8,867	3.6	2.4-4.8	16,774	3.2	2.4-4.0
SVI	8,021	2.9	2.0-3.8	9,203	3.7	2.3-5.2	17,223	3.3	2.4-4.1
MVI	47,588	17.1	15.3-18.9	39,856	16.2	13.9-18.5	87.442	16.7	15.0-18.3
EVI	65,915	23.7	21.5-25.9	60,487	24.6	21.7-27.5	126,397	24.1	22.3-25.9
FLV	9,455	3.4	2.5-4.4	7,710	3.1	2.2-4.0	17,166	3.3	2.6-3.9

The principal cause of bilateral blindness (63.6% of cases) was untreated cataract (Table 1.6) with non-trachomatous corneal opacities the second most common cause (13.0%). Glaucoma was responsible for 5.2% of blindness and 5% of SVI, while diabetic retinopathy was responsible for 3.9% of blindness and 5.1% of SVI. Untreated cataract was also the leading cause of severe VI (55.7%) and moderate VI (71.6%).

Table 1.6 Main causes of visual impairment

	Blindness		Severe VI		Moderate VI		Early VI	
	N	%	n	%	n	%	N	%
Refractive error	0	0.0	1	1.3	30	7.2	415	65.4
Aphakia (uncorrected)	2	2.6	4	5.1	7	1.7	0	0.0
Cataract (untreated)	49	63.6	44	55.7	298	71.6	159	25.0
Cataract surgical complications	4	5.2	12	15.2	44	10.6	33	5.2
Trachomatous corneal opacity	2	2.6	0	0.0	0	0.0	0	0.0
Non-trachomatous corneal opacity	10	13.0	3	3.8	6	1.4	9	1.4
Phthisis	0	0.0	1	1.3	0	0.0	0	0.0
Onchocerciasis	0	0.0	0	0.0	0	0.0	0	0.0
Glaucoma	4	5.2	0	0.0	5	1.2	6	0.9
Diabetic retinopathy	3	3.9	4	5.1	16	3.8	7	1.1
ARMD	2	2.6	10	12.7	6	1.4	2	0.3
Other posterior segment disease	1	1.3	0	0.0	3	0.7	4	0.6
All other globe/CNS abnormalities	0	0.0	0	0.0	1	0.2	0	0.0
TOTAL	**77**	**100.0**	**79**	**100.0**	**416**	**100.0**	**635**	**100.0**

The adjusted prevalence of bilateral blindness due to cataract was 1.4% (95% CI 0.9-2.3); and the adjusted prevalence of SVI and MVI due to cataract was 2.5% (95% CI 1.6 -3.7) and 7.5% (95% CI 6.0 – 9.4) respectively. There were no statistically significant sex differences in the prevalence of cataract-related visual impairments at any levels of VA (Table 1.7).

Table 1.7 Prevalence of bilateral cataract with VA<3/60, VA<6/60 and VA<6/18 (adjusted)

	Male			Female			Total		
	N	%	95% CI	n	%	95% CI	n	%	95% CI
Cataract and VA<3/60 in the better eye with available correction or pinhole									
	15	1.0	0.5,1.9	23	2.0	1.2,3.3	38	1.4	0.9,2.3
Cataract and VA<6/60 in the better eye with available correction or pinhole									
	27	1.8	1.1,2.9	40	3.4	2.1,5.5	67	2.5	1.6,3.7
Cataract and VA<6/18 in the better eye with available correction or pinhole									
	107	7.0	5.5,8.7	97	8.3	6.3,10.8	204	7.5	6.0,9.4

Cataract surgery

Cataract surgical coverage (CSC) measures the proportion of cataracts that have been operated on out of all operable cataracts. CSC (persons) in our sample was 89.1% at VA<3/60; the coverage was higher among men than women (91.8% vs 85.7%) (Table 1.8).

Table 1.8 Cataract surgical coverage (persons)

	Males	Females	Total
	%		
VA <3/60	91.8	85.7	89.1
VA <6/60	86.4	78.0	82.7
VA <6/18	65.2	61.6	63.6

Table 1.9 shows that of the 712 eyes operated for cataract, 217 (30.6%) had very good presenting vision (VA ≥ 6/12) increasing to 322 (45.2%) with best correction. Another 26.5% of eyes had good presenting vision (6/12 > VA ≥ 6/18), 25.6% had borderline vision (6/18 > VA ≥ 6/60) and 17.4% of eyes had poor vision (VA<6/60).

Table 1.9 Visual outcomes by type of surgery (eyes)

	Non-IOL		IOL		Couching		Total	
	Eyes	%	Eyes	%	Eyes	%	Eyes	%
VA with available correction								
Very good: can see 6/12	0	0.0	217	32.1	0	0.0	217	30.6
Good: can see 6/18	0	0.0	189	28.0	0	0.0	189	26.5

Borderline: can see 6/60	9	26.5	173	25.6	0	0.0	182	25.6
Poor: cannot see 6/60	25	73.5	96	14.2	3	100.0	124	17.4
Total	34	100.0	675	100.0	3	100.0	712	100.0
VA with best correction								
Very good: can see 6/12	0	0.0	322	47.7	0	0.0	322	45.2
Good: can see 6/18	5	14.7	168	24.9	0	0.0	173	24.3
Borderline: can see 6/60	14	41.2	108	16.0	2	66.7	124	17.4
Poor: cannot see 6/60	15	44.1	77	11.4	1	33.3	93	13.1
Total	34	100.0	675	100.0	3	100.0	712	100.0

Surgical complications were identified as the most common cause of poor visual outcomes in operated eyes (62/124), followed by selection (27/124) and sequelae (21/124). Both surgical complications and selection were important causes of borderline outcomes (Table 1.10).

Table 1.10 Causes of visual outcomes (eyes)

	Selection		Surgery		Spectacles		Sequelae		Total	
	Eyes	**%**	**Eyes**	**%**	**Eyes**	**%**	**Eyes**	**%**	**Eyes**	**%**
Very good: can see 6/12	0	0.0	0	0.0	0	0.0	0	0.0	217	30.5
Good: can see 6/18	19	27.1	62	23.8	96	79.3	12	27.9	189	26.5
Borderline: can see 6/60	24	34.3	137	52.5	11	9.1	10	23.3	182	25.6
Poor: cannot see 6/60	27	38.6	62	23.8	14	11.6	21	48.8	124	17.4
Total	70	100.0	261	100.0	121	100.0	43	100.0	712	100.0

Table 1.11 shows that 51.5% of operated eyes in the last three years had very good vision; reducing to 27.8% for those operated on four to six years ago. More than half of all eyes operated on more than seven years ago had borderline or poor vision.

Table 1.11 Visual outcomes by years after surgery (eyes)

	3 yrs post-op		4-6 yrs post-op		7+ yrs post-op		Total	
	Eyes	**%**	**Eyes**	**%**	**Eyes**	**%**	**Eyes**	**%**
Very good: can see 6/12	104	51.5	60	27.8	53	18.0	217	30.5
Good: can see 6/18	52	25.7	70	32.4	67	22.8	189	26.5
Borderline: can see 6/60	27	13.4	60	27.8	95	32.3	182	25.6
Poor: cannot see 6/60	19	9.4	26	12.0	79	26.9	124	17.4

Total	202	100.0	216	100.0	294	100.0	712	100.0

The majority of cataract operations took place in government hospitals (482 out of 712), with over half achieving very good (27.2%) or good (26.1%) outcomes, and around 19% achieving poor outcomes. Voluntary hospitals were the second most common location: 80% of eyes operated in these hospitals had very good (33.3%) and good (40.7%) outcomes. A similar number of eyes were operated in eye camps (n=80); but the visual outcomes of the eyes operated in eye camps were poorer with just over 40% having very good or good vision and 22.5% having poor vision (Table 1.12).

Table 1.12 Visual outcomes by place of surgery (eyes)

	Gov. hospital		Vol. hospital		Priv. hospital		Eye camp		Total	
	Eyes	%	Eyes	%	Eyes	%	Eyes	%	Eyes	%
Very good: can see 6/12	131	27.2	27	33.3	38	55.1	21	26.3	217	30.5
Good: can see 6/18	126	26.1	33	40.7	18	26.1	12	15.0	189	26.5
Borderline: can see 6/60	134	27.8	12	14.8	7	10.1	29	36.3	182	25.6
Poor: cannot see 6/60	91	18.9	9	11.1	6	8.7	18	22.5	124	17.4
Total	482	100.0	81	100.0	69	100.0	80	100.0	712	100.0

Over 45% of people with untreated bilateral cataracts said that they were unaware of treatment, 20.2% reported not being able to access treatment and 10.5% were afraid to have surgery (Table 1.13). A higher proportion of men were unaware of treatment than women (50.0% vs 41.4% respectively), while substantially more women reported being afraid of surgery than men (15.7% vs 3.7% respectively).

The most common barrier to surgery among individuals with unilateral cataracts was feeling that the operation was unnecessary (31.4%).

Table 1.13 Barriers to cataract surgery

	Male		Female		Total	
	n	%	N	%	n	%
Bilateral (BCVA <6/60 due to cataract)						
Need not felt	4	7.4	3	4.3	7	5.6
Fear	2	3.7	11	15.7	13	10.5
Cost	2	3.7	7	10.0	9	7.3
Treatment denied by provider	2	3.7	2	2.9	4	3.2
Unaware treatment is possible	27	50.0	29	41.4	56	45.2

Cannot access treatment	11	20.4	14	20.0	25	20.2
Local reason	6	11.1	4	5.7	10	8.1
Total	54	100.0	70	100.0	124	100.0
Unilateral (BCVA <6/60 due to cataract)						
Need not felt	21	25.9	27	37.5	48	31.4
Fear	15	18.5	7	9.7	22	14.4
Cost	9	11.1	4	5.6	13	8.5
Treatment denied by provider	3	3.7	3	4.2	6	3.9
Unaware treatment is possible	23	28.4	15	20.8	38	24.8
Cannot access treatment	5	6.2	7	9.7	12	7.8
Local reason	5	6.2	9	12.5	14	9.2
Total	81	100.0	72	100.0	153	100.0

Diabetes and diabetic retinopathy

Overall, the sample prevalence of diabetes mellitus was 18.0%, and the prevalence was significantly higher among women compared with men: 21.4% compared with 15.1% (p<0.001) (Table 1.14).

Table 1.14 Sample prevalence of known and newly diagnosed diabetes mellitus by age group and sex

	Male		Female		Total	
	N	**% (95%CI)**	**N**	**% (95%CI)**	**n**	**% (95%CI)**
50-59	104	12.8 (10.2 – 16.0)	126	18.6 (14.5 – 23.4)	230	15.3 (12.4 – 18.8)
60-69	79	18.9 (14.6 – 24.2)	69	22.5 (17.0 – 29.1)	148	20.5 (16.5 – 25.2)
70-79	27	14.2 (9.8 – 20.1)	31	26.3 (17.5 – 37.5)	58	19.4 (14.8 – 25.1)
80+	25	22.3 (14.2 – 33.3)	20	27.4 (18.0 – 39.3)	45	24.5 (17.0 – 33.8)
All ages	**235**	**15.5 (12.7 – 18.7)**	**246**	**21.4 (17.4 – 25.9)**	**481**	**18.0 (15.0 – 21.5)**

More than half (55.5%) of all diabetics did not know about their disease status. Men were less likely to be aware of their diabetes status than women (58.3% compared with 52.9%). Among people who knew about their disease status, only 29.4% had controlled levels of

blood glucose (<200 mg/dl). Women had slightly better glycaemic control than men (33.6% compared with 24.5%) although it was statistically non-significant (p=0.1) (Table 1.15).

Table 1.15 Diabetics and random blood sugar level

		Male		Female		Total	
		N	**%**	**n**	**%**	**n**	**%**
All diabetics	Known diabetes	98	41.7	116	47.2	214	44.5
	Newly diagnosed diabetes	137	58.3	130	52.9	267	55.5
	Total	**235**	**100.0**	**246**	**100.0**	**481**	**100.0**
Known diabetes	Blood sugar <200 mg/dl	24	24.5	39	33.6	63	29.4
	Blood sugar >200 mg/dl	74	75.5	77	66.4	151	70.6
	Total	**98**	**100.0**	**116**	**100.0**	**214**	**100.0**

The majority of people (85.5%) with previously known diabetes had never had an eye examination for diabetic retinopathy; and only 10.7% had had a DR examination in the past 12 months (Table 1.16).

Table 1.16 Last eye examination for diabetic retinopathy among known diabetics

	Male		Female		Total	
	N	%	N	%	n	%
Never had eye examination for DR	81	85.7	102	87.9	183	85.5
0-12 months ago	14	14.3	9	7.8	23	10.7
13-24 months ago	1	1.0	3	2.6	4	1.9
>24 months ago	2	2.0	2	1.7	4	1.9
Total	**98**	**100.0**	**116**	**100.0**	**214**	**100.0**

49.7% of diabetics (239 people) agreed to undergo a DR examination. The prevalence of any retinopathy among the examined diabetics was 46.8% or 4.2% in the overall sample (Table 1.17). About 3.6% of the examined diabetics had sight-threatening DR. Prevalence of any retinopathy among those examined increased with age and was higher among women, particularly older women aged 70 years and over (Table 1.18).

Table 1.17 Prevalence of diabetic retinopathy in examined diabetics

	Among diabetics		Total sample
Retinopathy grade	N	% (95%CI)	% (95%CI)
No retinopathy (R0)	129	53.2 (44.9-61.4)	
Background DR – mild (R1)	76	31.8 (25.0-39.4)	2.9 (2.2 – 3.8)

Background DR – observable (R2)	23	10.3 (6.8-15.4)	0.9 (0.6 – 1.4)
Background DR – referable (R3)	1	0.4 (0.6-3.0)	0.04 (0.005 – 0.3)
Proliferative DR (R4)	4	1.8 (0.7-5.0)	0.2 (0.06 – 0.4)
Ungradable DR (R6)	6	2.4 (1.0-5.7)	0.2 (0.09 – 0.5)
Any retinopathy	110	46.8 (38.6-55.1)	4.2 (3.4 – 5.3)
Maculopathy grade			
No maculopathy (M0)	192	79.5 (71.6-85.7)	
Maculopathy – observable (M1)	34	14.9 (9.9-21.9)	1.4 (0.9 – 2.0)
Maculopathy – referable (M2)	8	3.6 (1.8-7.1)	0.3 (0.2 – 0.6)
Not adequately visualised	5	2.0 (0.7-5.4)	0.2 (0.07 – 0.5)
Any maculopathy	47	20.5 (14.4-28.4)	1.9 (1.3 – 2.6)
Any retinopathy and/or maculopathy	111	47.2 (39.1-55.5)	4.3 (3.4 – 5.4)
Sight-threatening DR (R4 and/or M2)	8	3.6 (1.8-7.1)	0.3 (0.2 – 0.6)
Any laser scars	20	8.8 (4.9-15.2)	0.8 (0.4 – 1.4)

Table 1.18 Prevalence of any retinopathy and/or maculopathy among people with diabetes by age and sex

	Male		Female		Total	
	N	%	n	%	n	%
50-59	23	39.7 (27.9-52.8)	23	42.6 (28.0-58.6)	46	41.0 (31.2-51.5)
60-69	22	53.7 (37.1-69.5)	20	46.5 (31.8-61.8)	42	49.9 (39.1-60.7)
70-79	5	38.5 (16.5-66.4)	11	64.7 (40.3-83.3)	16	54.6 (37.2-71.0)
80+	2	33.3 (8.0-74.2)	5	71.4 (31.4-93.2)	7	54.8 (28.4-78.8)
All ages	52	44.4 (35.2-54.1)	59	49.8 (38.5-61.1)	111	47.2 (39.1-55.5)

Disability and wealth

The prevalence of reported difficulties in at least one of the six domains was 12.7%, with little difference between males and females. The prevalence of non-visual disability (any domain excluding seeing) was 9.8% (Table 1.19).

Table 1.19 Sample prevalence of individuals reporting a lot of difficulties functioning, or cannot do at all, in six domains

	Male		Female		Total	
	n	%	n	%	n	%
Seeing	97	6.2	83	6.8	180	6.4
Hearing	39	2.5	29	2.4	68	2.4
Walking	98	6.2	73	5.9	171	6.1
Self-care (upper body)	80	5.1	47	3.8	127	4.5
Communication	23	1.5	20	1.6	43	1.5
Cognition	36	2.3	23	1.9	59	2.1
Difficulties in at least one domain	191	12.5	152	12.9	343	12.7
Difficulties in at least one of five domains (excluding seeing)	151	9.9	114	9.7	265	9.8

Two-thirds (61.5%) of people who had a disability in at least one domain (excluding seeing) had visual impairment; this is compared with 21.1% in the overall sample. The prevalence of blindness among people with non-visual disability was 20.4%; and the prevalence of SVI was 12.8%. The corresponding figures in the overall sample were 2.8% and 2.9% (Table 1.20).

Table 1.20 Prevalence of visual impairment (PVA) among people with reported functional difficulties

	Difficulties in at least one of six domains		**Difficulties in at least one of five domains (excluding seeing)**	
	n	**%**	**n**	**%**
Good vision: can see 6/12	45	13.1	40	15.1
EVI: can see 6/18	79	23.0	62	23.4
MVI: can see 6/60	111	32.4	75	28.3
SVI: cannot see 6/60	47	13.7	34	12.8

Blind: cannot see 3/60	64	17.8	54	20.4
Total	343	100.0	265	100.0

Overall, the study sample was slightly wealthier than the national population, as only 22.3% belonged to the two poorest quintiles, compared with 51.3% in the two richest quintiles (against the expected 40% in each). However, data on visual impairment and relative wealth suggests that blindness and severe VI affected more people in the poorer socio-economic groups in this district. Among people who were blind in the sample, 46.8% belonged to the two poorest quintiles, while only 23.4% belonged to the second wealthiest quintile and no one belonged to the top wealthiest quintile. In contrast, among people with good vision (VA>6/12), 54.2% belonged to the two wealthiest quintiles and only 18.8% belonged to the two poorest quintiles (Table 1.21).

Table 1.21 Prevalence of visual impairment (PVA) by relative wealth quintile (national reference)

	Q1		Q2		Q3		Q4		Q5	
	n	%	n	%	n	%	n	%	N	%
Good vision: can see 6/12	36	2.4	246	16.4	406	27.1	650	43.3	163	10.9
EVI: can see 6/18	17	2.7	108	17.0	166	26.1	263	41.4	81	12.8
MVI: can see 6/60	23	5.5	105	25.2	102	24.5	142	34.1	44	10.6
SVI: cannot see 6/60	12	15.2	20	25.3	18	22.8	21	26.6	8	10.1
Blind: cannot see 3/60	9	11.7	27	35.1	23	29.9	18	23.4	0	0.0
Total	**97**	**3.6**	**506**	**18.7**	**715**	**26.4**	**1,094**	**40.4**	**296**	**10.9**

2. Nowshera

Description of sample

2,806 participants aged 50 years or older were recruited in Nowshera, of whom 2,680 were examined (95.5% response rate) (Table 2.1).

Table 2.1 Examination status of enrolled participants

	Male		Female		Total	
	N	%	n	%	n	%
Examined	1,333	95.8	1,347	95.3	2,680	95.5
Not examined	21	1.5	7	0.5	28	1.0
Refused	28	2.0	45	3.2	73	2.6
Unable to communicate	10	0.7	15	1.0	23	0.9
Total	1,392	100.0	1,414	100.0	2,806	100.0

49.7% of the examined individuals were male (n=1,333). Compared with females, a slightly higher proportion of males were aged 80 years or more and the oldest men were slightly older on average than the oldest women (in the oldest age group, the median age was 82.5 years for men and 80 years for women) (Table 2.2).

Table 2.2 Age and sex distribution of examined individuals

	Male		Female		Total	
	N	%	N	%	n	%
50-59	704	52.8	784	58.2	1,488	55.5
60-69	367	27.5	365	27.1	732	27.3
70-79	169	12.7	127	9.4	296	11.0
80+	93	7.0	71	5.3	164	6.1
Total	1,333	100.0	1,347	100.0	2,680	100.0

Compared with the population of people aged 50 years and older in the area, females were slightly over-represented in the study sample (50.3% in the sample compared with 46.5% in the population), although there were more older men in the sample than in the population (Table 2.3).

Table 2.3 Comparison of study sample and area population

	Male	Female	Total

	Study sample		Region		Study sample		Region		Study sample		Region	
	N	%	n	%	N	%	n	%	N	%	N	%
50-59	730	52.4	41,688	49.9	806	57.0	37,043	50.8	1,536	54.7	78,731	50.3
60-69	383	27.5	26,862	32.1	386	27.3	22,198	30.5	769	27.4	49,060	31.3
70-79	177	12.7	10,181	12.2	134	9.5	8,867	12.2	311	11.1	19,048	12.2
80+	102	7.3	4,882	5.8	88	6.2	4,780	6.6	190	6.7	9,662	6.2
Total	1,392	100	83,613	100	1,414	100	72,888	100	2,806	100	156,501	100

Prevalence and causes of visual impairment

The age- and sex-adjusted prevalence of all-cause blindness was 2.9% (95% CI 1.9-4.0) (Tables 2.4 and 2.5). The prevalence was higher among men (3.4%, 95% CI 2.6-4.9) than women (2.4%, 95% CI 1.6-3.2) but the difference was not statistically significant. The adjusted prevalence of SVI was 3.9% (3.8% for men and 4.0% for women) and the prevalence of MVI was 15.5% (16.1% for men and 14.8% for women).

Table 2.4 Sample prevalence of blindness, SVI, MVI, EVI and FLV

	Male			Female			Total		
	n	%	95% CI	n	%	95% CI	n	%	95% CI
Blindness	46	3.5	1.8-5.1	28	2.1	1.3-2.9	74	2.8	1.7-3.8
Severe VI	51	3.8	2.7-5.0	46	3.4	2.2-4.6	97	3.6	2.7-4.5
Moderate VI	213	16.0	13.4-18.6	181	13.4	11.5-15.4	394	14.7	13.1-16.3
Early VI	272	20.4	17.7-23.1	300	22.3	19.9-24.7	572	21.3	19.3-23.4
Functional low vision	55	4.1	3.0-5.2	40	3.0	2.1-3.8	95	3.5	2.8-4.3

Table 2.5 Extrapolated prevalence of blindness, SVI, MVI, EVI and FLV (adjusted)

	Male			Female			Total		
	N	%	95% CI	n	%	95% CI	N	%	95% CI
Blindness	2,803	3.4	1.7-5.0	1,766	2.4	1.6-3.2	4,569	2.9	1.9-4.0
Severe VI	3,146	3.8	2.6-4.9	2,878	4.0	2.7-5.2	6,026	3.9	2.9-4.8
Moderate VI	13,498	16.1	13.5-18.8	10,804	14.8	12.9-16.8	24,306	15.5	13.9-17.1
Early VI	17,076	20.4	17.7-23.1	16,366	22.5	20.1-24.8	33,446	21.4	19.3-23.4
FLV	3,362	4.0	2.9-5.1	2,471	3.4	2.5-4.2	5,837	3.7	3.0-4.5

The principal cause of bilateral blindness was untreated cataract (71.6%) followed by non-trachomatous corneal opacity (8.1%). Untreated cataract was also the principal cause of SVI (63.9%) and MVI (73.1%). Diabetic retinopathy was the third leading cause of blindness contributing to 6.8% of blindness, 13% of SVI and 9.9% of MVI. Glaucoma was responsible for 1.4% of blindness and 5.2% of SVI. (Table 2.6).

Table 2.6 Main causes of visual impairment

	Blindness		Severe VI		Moderate VI		Early VI	
	n	%	N	%	N	%	n	%
Refractive error	0	0.0	0	0.0	40	10.2	372	65.0
Aphakia (uncorrected)	0	0.0	0	0.0	0	0.0	0	0.0
Cataract (untreated)	53	71.6	62	63.9	288	73.1	160	28.0
Cataract surgical complications	4	5.4	6	6.2	8	2.0	16	2.8
Trachomatous corneal opacity	0	0.0	1	1.0	0	0.0	0	0.0
Non-trachomatous corneal opacity	6	8.1	0	0.0	1	0.3	1	0.2
Phthisis	0	0.0	0	0.0	0	0.0	0	0.0
Onchocerciasis	0	0.0	0	0.0	0	0.0	0	0.0
Glaucoma	1	1.4	5	5.2	10	2.5	2	0.3
Diabetic retinopathy	5	6.8	13	13.4	39	9.9	19	3.3
ARMD	4	5.4	5	5.2	2	0.5	1	0.2
Other posterior segment disease	0	0.0	3	3.1	6	1.5	0	0.0
All other globe/CNS abnormalities	1	1.4	2	2.1	0	0.0	1	0.2
TOTAL	**74**	**100.0**	**97**	**100.0**	**394**	**100.0**	**572**	**100.0**

The adjusted prevalence of blindness due to cataract was 1.3% (95% CI 0.8-2.1). Cumulatively, unoperated cataract was responsible for 12.5% (95% CI 10.7 – 14.6) of visual impairment (VA<6/18), including 3.1% (95% CI 2.2-4.4) of SVI or worse (VA<6/60). Prevalence of VI and unoperated cataract was higher among men at all levels of VA (Table 2.7).

Table 2.7 Prevalence of cataract-related visual impairment at VA<3/60, VA<6/60 and VA<6/18 (adjusted)

	Male			Female			Total		
	N	%	95% CI	N	%	95% CI	n	%	95% CI
Cataract and VA<3/60 in the better eye with available correction or pinhole									
	23	1.7	0.9,3.1	12	0.9	0.5,1.6	35	1.3	0.8,2.1
Cataract and VA<6/60 in the better eye with available correction or pinhole									

	44	3.3	2.2,5.0	39	2.9	2.0,4.3	83	3.1	2.2,4.4
Cataract and VA<6/18 in the better eye with available correction or pinhole									
	182	13.7	10.9,17.0	152	11.3	9.3,13.6	334	12.5	10.7,14.6

Cataract surgery

Cataract surgical coverage (CSC) for persons was 83.9% at VA<3/60, with the coverage lower among men compared with women (79.5% vs 89.0%) (Table 2.8).

Table 2.8 Cataract surgical coverage (persons)

	Males	Females	Total
	%	%	%
VA <3/60	79.5	89.0	83.9
VA <6/60	68.8	72.7	70.6
VA <6/18	40.1	44.6	42.1

Table 2.9 shows that out of the 445 eyes operated for cataract, 176 (39.6%) had very good presenting vision (VA ≥ 6/12) and 111 (24.9%) had good presenting vision with available correction. With best correction, the proportion of eyes with very good vision increased to 52.4% and the proportion of eyes with good or very good vision (VA ≥ 6/18) to 67.7%. Over 14% of eyes had borderline vision (6/18 > VA ≥ 6/60) and 21.1 % had poor vision (VA<6/60) reducing to 18.0% with best correction (Table 2.9).

Table 2.9 Visual outcomes by type of surgery (eyes)

	Non-IOL		IOL		Couching		Total	
	Eyes	%	Eyes	%	Eyes	%	Eyes	%
VA with available correction								
Very good: can see 6/12	0	0.0	176	40.1	0	0.0	176	39.6
Good: can see 6/18	0	0.0	111	25.3	0	0.0	111	24.9
Borderline: can see 6/60	1	16.7	63	14.4	0	0.0	64	14.4
Poor: cannot see 6/60	5	83.3	89	20.3	0	0.0	94	21.1
Total	6	100.0	439	100.0	0	100.0	445	100.0
VA with best correction								
Very good: can see 6/12	0	0.0	233	53.1	0	0.0	233	52.4
Good: can see 6/18	0	0.0	68	15.5	0	0.0	68	15.3

Borderline: can see 6/60	1	16.7	63	14.4	0	0.0	64	14.4
Poor: cannot see 6/60	5	83.3	75	17.1	0	0.0	80	18.0
Total	6	100.0	439	100.0	0	100.0	445	100.0

Selection was identified as the most common cause of poor visual outcomes in operated eyes (55/94), followed by surgical complications (42/94), and sequelae (19/94) (Table 2.10).

Table 2.10 Causes of visual outcomes (eyes)

	Selection		Surgery		Spectacles		Sequelae		Total	
	Eyes	**%**	**Eyes**	**%**	**Eyes**	**%**	**Eyes**	**%**	**Eyes**	**%**
Very good: can see 6/12	0	0.0	0	0.0	0	0.0	0	0.0	176	39.6
Good: can see 6/18	10	10.0	12	28.6	53	93.0	36	51.4	111	24.9
Borderline: can see 6/60	35	35.0	10	23.8	4	7.0	15	21.4	64	14.4
Poor: cannot see 6/60	55	55.0	20	47.6	0	0.0	19	27.1	94	21.1
Total	100	100.0	42	100.0	57	100.0	70	100.0	445	100.0

Table 2.11 shows that 86.7% of eyes operated in the last three years had good or very good visual outcomes; this reduces to 78.2% for the eyes operated four to six years ago and 61.5% for the eyes operated seven or more years ago. With regards to poor vision outcomes (VA<6/60), these were particularly common in people operated four and more years ago. Among people operated in the past three years only 8% of eyes had poor vision.

Table 2.11 Visual outcomes by years after surgery (eyes)

	3 yrs postop.		4-6 yrs postop.		7+ yrs postop.		Total	
	Eyes	**%**	**Eyes**	**%**	**Eyes**	**%**	**Eyes**	**%**
Very good: can see 6/12	66	58.4	46	43.0	64	28.4	176	39.6
Good: can see 6/18	32	28.3	27	25.2	52	23.1	111	24.9
Borderline: can see 6/60	6	5.3	15	14.0	43	19.1	64	14.4
Poor: cannot see 6/60	9	8.0	19	17.8	66	29.3	94	21.1
Total	113	100.0	107	100.0	225	100.0	445	100.0

Most operations took place in government hospitals (258/445), with more than two-thirds (68.3%) achieving good or very good outcomes, and 17.8 % achieving poor outcomes. Voluntary hospitals were the second most common location (135/445): 61.4% of eyes operated on in these hospitals had good or very good outcomes and 27.4% had poor outcomes. Out of 51 eyes operated on in private facilities, 52.9% had good or very good

outcomes and 21.6% had poor outcomes. Almost no eyes were operated on in eye camps (n=1) (Table 2.12).

Table 2.12 Visual outcomes by place of surgery (eyes)

	Gov. hospital		Vol. hospital		Priv. hospital		Eye camp		Total	
	Eyes	%	Eyes	%	Eyes	%	Eyes	%	Eyes	%
Very good: can see 6/12	100	38.8	55	40.7	20	39.2	1	100.0	176	39.6
Good: can see 6/18	76	29.5	28	20.7	7	13.7	0	0.0	111	24.9
Borderline: can see 6/60	36	14.0	15	11.1	13	25.5	0	0.0	64	14.4
Poor: cannot see 6/60	46	17.8	37	27.4	11	21.6	0	0.0	94	21.1
Total	258	100.0	135	100.0	51	100.0	1	100.0	445	100.0

37.5% of people with untreated bilateral cataracts said that they were afraid to have surgery, 23.1% cited cost as the biggest barrier and 20.6% felt no need to have surgery (Table 2.13). There was little difference in the barriers reported by men and women. The most common barrier to surgery among people with unilateral cataract was fear (32.9%).

Table 2.13 Barriers to cataract surgery

	Male		Female		Total	
	n	%	N	%	N	%
Bilateral (BCVA <6/60 due to cataract)						
Need not felt	17	18.9	16	22.9	33	20.6
Fear	33	36.7	27	38.6	60	37.5
Cost	22	24.4	15	21.4	37	23.1
Treatment denied by provider	1	1.1	2	2.9	3	1.9
Unaware treatment is possible	9	10.0	5	7.1	14	8.8
Cannot access treatment	3	33	1	1.4	4	2.5
Local reason	5	5.6	4	5.7	9	5.6
Total	90	100.0	70	100.0	160	100.0
Unilateral (BCVA <6/60 due to cataract)						
Need not felt	46	25.9	32	23.0	78	27.3
Fear	48	18.5	46	33.1	94	32.9
Cost	19	11.1	29	20.9	48	16.8
Treatment denied by provider	3	3.7	1	0.7	4	1.4

Unaware treatment is possible	7	28.4	16	11.5	23	8.0
Cannot access treatment	3	6.2	5	3.6	8	2.8
Local reason	21	6.2	10	7.2	31	10.8
Total	147	100.0	139	100.0	286	100.0

Diabetes and diabetic retinopathy

Overall, the sample prevalence of diabetes mellitus was 21.9%, and the prevalence was significantly higher among women (25.0%, 95% CI 21.4-29.0) than men (18.7%, 95% CI 15.5-22.4) (p<0.001) (Table 2.14).

Table 2.14 Sample prevalence of known and newly diagnosed diabetes mellitus by age group and sex

	Male		Female		Total	
	N	**% (95%CI)**	**N**	**% (95%CI)**	**n**	**% (95%CI)**
50-59	110	15.6(12.1-19.9)	173	22.1 (18.4-26.3)	283	18.9 (15.8-22.5)
60-69	72	19.6 (15.4-24.7)	91	24.9 (19.4-31.4)	163	22.2 (18.0-27.1)
70-79	45	26.6 (19.8-24.8)	47	37.0 (28.4-46.5)	92	31.8 (26.6-37.6)
80+	22	23.7 (15.2-34.8)	19	26.8 (19.0-36.2)	41	25.2 (19.3-32.3)
All ages	**249**	**18.7 (15.5-22.4)**	**330**	**25.0 (21.4-29.0)**	**579**	**21.9 (18.9-25.2)**

Over half (50.4%) of all diabetics did not know about their disease status at the time of the study. Men were less likely to be aware of the disease than women (53.4% compared with 48.2%). Among people who knew about their disease status, only 26.5% had controlled levels of blood glucose (<200 mg/dl) (Table 2.15).

Table 2.15 Diabetics and random blood sugar level

		Male		Female		Total	
		n	**%**	**N**	**%**	**n**	**%**
All diabetics	Known diabetes	116	46.6	171	51.8	287	49.6
	Newly diagnosed diabetes	133	53.4	159	48.2	292	50.4
	Total	**249**	**100.0**	**330**	**100.0**	**579**	**100.0**
Known diabetes	Blood sugar <200 mg/dl	31	26.7	45	26.3	76	26.5
	Blood sugar ≥200 mg/dl	85	73.3	126	73.7	211	73.5

	Total	116	100.0	171	100.0	287	100.0

The majority of people (69.0%) with previously known diabetes had never had an eye examination for diabetic retinopathy; and only just over a quarter (26.7%) of diabetics who were aware of their disease status had had a DR eye examination in the past 12 months (Table 2.16).

Table 2.16 Last eye examination for diabetic retinopathy among known diabetics

	Male		Female		Total	
	N	%	n	%	n	%
Never had eye examination for DR	75	64.7	126	73.7	201	70.0
0-12 months ago	31	26.7	29	17.0	60	20.9
13-24 months ago	8	6.9	9	5.3	17	5.9
>24 months ago	2	1.7	7	4.1	9	3.1
Total	**116**	**100.0**	**171**	**100.0**	**287**	**100.0**

348 people (60.1%) with diabetes agreed to undergo a DR examination. The prevalence of any retinopathy among examined diabetics was 51.7% or 6.8% in the overall sample, and 10% of examined diabetics had sight-threatening DR (Table 2.17). Prevalence of any retinopathy increased with age and was slightly higher among men than women overall, particularly in the age groups 50-59 years and 70-79 years (Table 2.18).

Table 2.17 Prevalence of diabetic retinopathy in the examined diabetics

	Among examined diabetics		Total sample
Retinopathy grade	N	% (95%CI)	% (95%CI)
No retinopathy (R0)	171	48.3 (41.2-55.6)	6.4 (5.2-7.8)
Background DR – mild (R1)	78	22.3 (17.5-28.1)	3.0 (2.2-4.0)
Background DR – observable (R2)	27	8.1 (5.4-12.0)	1.1 (0.7-1.6)
Background DR – referable (R3)	39	11.2 (8.0-15.4)	1.5 (1.1-2.0)
Proliferative DR (R4)	12	3.5 (1.7-7.1)	0.5 (0.2-1.0)
Ungradable DR (R6)	21	6.6 (3.7-11.5)	0.9 (0.5-1.6)
Any retinopathy	177	51.7 (44.4-58.8)	6.8 (5.5-8.4)
Maculopathy grade			
No maculopathy (M0)	254	72.4 (64.2-79.3)	9.6 (8.0-11.4)
Maculopathy – observable (M1)	40	11.6 (7.8-16.8)	1.5 (1.0-2.3)
Maculopathy – referable (M2)	33	9.4 (6.5-13.5)	1.2 (0.8 – 1.9)
Not adequately visualised	21	6.6 (3.7-11.5)	0.9 (0.5-1.6)

Any maculopathy	94	27.6 (20.7-35.8)	3.6 (2.7-5.0)
Any retinopathy and/or maculopathy	178	52.0 (44.8-59.1)	6.9 (5.6-8.4)
Sight-threatening DR (R4 and/or M2)	35	10.0 (6.8-14.6)	1.3 (0.9-2.0)
Any laser scars	10	2.9 (1.3-6.6)	0.4 (0.2-0.9)

Table 2.18 Prevalence of any retinopathy and/or maculopathy among people with diabetes by age and gender

	Male		Female		Total	
	N	%	N	%	N	%
50-59	24	41.4 (29.1-54.9)	33	34.0 (23.8-46.0)	57	36.9 (28.0-46.8)
60-69	23	54.8 (39.3-69.3)	35	60.3 (48.9-70.8)	58	57.9 (47.6-67.6)
70-79	22	68.8 (48.2-83.9)	20	60.6 (41.9-76.7)	42	64.0 (47.8-77.5)
80+	12	75.0 (48.4-90.6)	9	75.0 (44.0-92.0)	21	75.0 (55.6-87.8)
All ages	81	54.4 (45.5-63.0)	97	50.3 (41.9-58.6)	178	52.0 (44.8-59.1)

Disability and wealth

The prevalence of reported difficulties in at least one of the six domains assessed by the WGSS was 10.1%, with little difference between men and women. The prevalence of non-visual disability (five domains excluding seeing) was 6.6% (6% among men and 7.1% among women) (Table 2.19).

Table 2.19 Sample prevalence of individuals reporting a lot of difficulties functioning, or cannot do at all, in six domains

	Male		Female		Total	
	n	%	N	%	n	%
Seeing	82	5.9	71	5.0	153	5.5
Hearing	33	2.4	28	2.0	61	2.2
Walking	57	4.1	75	5.3	132	4.7

Self-care (upper body)	27	1.9	26	1.8	53	1.9
Communication	11	0.8	4	0.3	15	0.5
Cognition	23	1.7	22	1.6	45	1.6
Difficulties in at least one domain	130	9.8	140	10.4	270	10.1
Difficulties in at least one of five domains (excluding seeing)	80	6.0	96	7.1	176	6.6

Among people with non-visual disabilities, nearly 62% had VI; this is compared with 21.1% in the overall sample. 11.4% of people with reported non-visual difficulties were blind, 17.1% had SVI and 33.5% had MVI (Tables 2.20 and 2.21). The corresponding figures in the overall sample were 2.8%, 3.6% and 14.7%.

Table 2.20 Visual impairment (PVA) and reported functional difficulties (excluding seeing)

	Difficulties in at least one of six domains		Difficulties in at least one of five domains (excluding seeing)	
	n	**%**	**n**	**%**
Good vision: can see 6/12	45	16.7	35	19.9
EVI: can see 6/18	39	14.4	32	18.2
MVI: can see 6/60	107	39.6	59	33.5
SVI: cannot see 6/60	48	17.8	30	17.1
Blind: cannot see 3/60	31	11.5	20	11.4
Total	270	100.0	176	100.0

Overall, the study sample was wealthier than the national population, as only 10.7% belonged to the two poorest quintiles, compared with 65.4% in the two richest quintiles (against the expected 40% in each). The relationship between visual and relative wealth in this district is mixed, with no clear indication of which groups are worst affected. Among people who were blind in the sample, 71.2% belonged to the two richest quintiles, while only 18.2% belonged to the bottom two quintiles. Good vision (VA>6/12) appears to be distributed

proportionally between quintiles: 65.8% belong to the two wealthiest quintiles and 9.5% belong to the two poorest quintiles (Table 2.21).

Table 2.21 Prevalence of visual impairment (PVA) by relative wealth quintile (national reference)

	Q1		Q2		Q3		Q4		Q5	
	n	%	n	%	n	%	n	%	n	%
Good vision: can see 6/12	22	1.6	113	7.9	351	24.7	558	39.2	379	26.6
EVI: can see 6/18	14	2.6	50	9.1	123	22.5	222	40.5	139	25.4
MVI: can see 6/60	10	2.7	38	10.3	91	24.7	128	34.7	102	27.6
SVI: cannot see 6/60	2	2.4	5	6.0	22	26.5	31	37.4	23	27.7
Blind: cannot see 3/60	1	1.5	11	16.7	7	10.6	22	33.3	25	37.9
Total	**49**	**2.0**	**217**	**8.7**	**594**	**23.9**	**961**	**38.6**	**668**	**26.8**

3. Rawalpindi

Description of sample

2,800 participants aged 50 years and older were recruited in Rawalpindi, of whom 2,726 were examined (97.4% response rate) (Table 3.1).

Table 3.1 Examination status of enrolled participants

	Male		Female		Total	
	N	%	n	%	n	%
Examined	1,427	98.4	1,229	96.1	2,726	97.4
Not examined	3	0.2	2	0.2	5	0.2
Refused	14	1.0	42	3.1	56	2.0
Unable to communicate	5	0.4	8	0.6	13	0.4
Total	1,449	100.0	1,351	100.0	2,800	100.0

52.4% of the examined individuals were male (n=1,427), while the age distribution of males and females in the sample was broadly comparable (Table 3.2).

Table 3.2 Age and sex distribution of examined individuals

	Male		Female		Total	
	N	%	N	%	n	%
50-59	895	62.7	889	68.4	1,784	65.4
60-69	396	27.7	310	23.9	706	25.9
70-79	91	6.4	69	5.3	160	5.8
80+	45	3.2	31	2.4	76	2.8
Total	1,427	100.0	1,299	100.0	2,726	100.0

The sex distribution of the study sample was also similar to the local population of people aged 50 years and over (men comprised 52.3% of the sample, and 52.1% in the population), although both male and female groups in the sample were noticeably younger than the population (Table 3.3).

Table 3.3 Comparison of study sample and area population

	Male				Female				Total			
	Study sample		Region		Study sample		Region		Study sample		Region	
	N	%	n	%	N	%	n	%	N	%	n	%

50-59	904	62.4	202,000	49.9	909	67.3	187,338	50.2	1,813	64.8	389,338	50.0
60-69	401	27.7	126,612	31.3	322	23.8	113,470	30.4	723	25.8	240,082	30.9
70-79	92	6.4	51,238	12.7	80	5.9	47,467	12.7	172	6.1	98,705	12.7
80+	52	3.6	25,153	6.2	40	3.0	24,847	6.7	92	3.3	50,000	6.4
Total	1,449	100	405,003	100	1,351	100	373,122	100	2,800	100	778,125	100

Prevalence and causes of visual impairment

The adjusted prevalence of all-cause blindness was 1.3% (95% CI 1.0-1.7) (Tables 3.4 and 3.5). The prevalence was higher among men (1.8%, 95% CI 1.3-2.3) compared with women (0.8%, 95% CI 0.3-1.2). The adjusted prevalence of SVI was 0.9% (0.5% for men and 1.4% for women) and MVI was 6.2% (5.2% for men and 7.2% for women).

Table 3.4. Sample prevalence of blindness, SVI, MVI, EVI and FLV

	Male			Female			Total		
	n	**%**	**95% CI**	**n**	**%**	**95% CI**	**N**	**%**	**95% CI**
Blindness	16	1.1	0.6-1.7	7	0.5	0.1-1.0	23	0.8	0.5-1.2
Severe VI	6	0.4	0.0-0.8	9	0.7	0.3-1.1	15	0.6	0.2-0.9
Moderate VI	55	3.9	2.7-5.0	56	4.3	3.0-5.6	111	4.1	3.1-5.0
Early VI	324	22.7	19.4-26.0	315	24.3	21.1-27.4	639	23.4	20.8-26.1
Functional low vision	10	0.7	0.3-1.1	12	0.9	0.4-1.4	22	0.8	0.5-1.1

Table 3.5 Extrapolated prevalence of blindness, SVI, MVI, EVI and FLV (adjusted)

	Male			Female			Total		
	N	**%**	**95% CI**	**n**	**%**	**95% CI**	**N**	**%**	**95% CI**
Blindness	7,330	1.8	1.3-2.3	2,855	0.8	0.3-1.2	10,185	1.3	1.0-1.7
Severe VI	2,116	0.5	0.1-0.9	5,144	1.4	0.9-1.8	7,259	0.9	0.6-1.2
Moderate VI	21,005	5.2	4.1-6.3	26,908	7.2	5.9-8.5	47,909	6.2	5.2-7.1
Early VI	103,186	25.5	22.2-28.7	106,025	28.4	25.3-31.3	209,207	26.9	24.2-29.6
Functional low vision	4,211	1.0	0.6-1.4	5,932	1.6	1.1-2.1	10,142	1.3	1.0-1.6

Untreated cataract was responsible for just over a third (34.8%) of blindness (Table 3.6) but was the principal cause of severe VI (80.0%), and moderate VI (70.3%). The second principal cause of blindness was evenly split between glaucoma (17.4%) and non-trachomatous corneal opacity (17.4%). The third principal cause was split between diabetic retinopathy (8.7%) and other posterior segment disease (8.7%).

Table 3.6 Main causes of visual impairment

	Blindness		Severe VI		Moderate VI		Early VI	
	N	%	n	%	N	%	n	%
Refractive error	0	0.0	0	0.0	5	4.5	506	79.2
Aphakia (uncorrected)	0	0.0	0	0.0	3	2.7	0	0.0
Cataract (untreated)	8	34.8	12	80.0	78	70.3	107	16.7
Cataract surgical complications	1	4.3	0	0.0	14	12.6	18	2.8
Trachomatous corneal opacity	1	4.3	0	0.0	1	0.9	1	0.2
Non-trachomatous corneal opacity	4	17.4	0	0.0	0	0.0	2	0.3
Phthisis	0	0.0	0	0.0	0	0.0	0	0.0
Onchocerciasis	0	0.0	0	0.0	0	0.0	0	0.0
Glaucoma	4	17.4	0	0.0	1	0.9	1	0.2
Diabetic retinopathy	2	8.7	2	13.3	6	5.4	3	0.5
ARMD	0	0.0	0	0.0	0	0.0	0	0.0
Other posterior segment disease	2	8.7	1	6.7	3	2.7	1	0.2
All other globe/ CNS abnormalities	1	4.3	0	0.0	0	0.0	0	0.0
TOTAL	**23**	**100.0**	**15**	**100.0**	**111**	**10.0**	**639**	**100.0**

The adjusted prevalence of bilateral blindness due to cataract was just 0.5% (95% CI 0.2-1.0). Cumulatively, unoperated cataract was also estimated to cause 0.8% of SVI or worse (VA<6/60) (95% CI 0.5; 1.3) and 3.2% of MVI or worse (VA<6/18) (95% CI 2.2; 4.6). No statistically significant differences in the distribution of visual impairment and bilateral blindness due to cataract were observed between men and women (Table 3.7).

Table 3.7 Prevalence of bilateral cataract with VA<3/60, VA<6/60, and VA<6/18 (adjusted)

	Male			Female			Total		
	N	%	95% CI	N	%	95% CI	N	%	95% CI
Cataract and VA<3/60 in the better eye with available correction or pinhole									
	9	0.6	0.3,1.4	0	0.0	-	9	0.5	0.2,1.0
Cataract and VA<6/60 in the better eye with available correction or pinhole									

	13	0.9	0.5,1.7	9	0.7	0.3,1.8	22	0.8	0.5,1.3
Cataract and VA<6/18 in the better eye with available correction or pinhole									
	42	3.0	1.8,4.8	43	3.4	2.0,5.6	85	3.2	2.2,4.6

Cataract surgery

Cataract surgical coverage for persons was 98.1% at VA,3/60 and 95.7% at VA< 6/60. CSC was marginally lower among men compared with women at both VA levels (Table 3.8).

Table 3.8 Cataract surgical coverage (persons)

	Males	Females	Total
	%		
VA <3/60	96.4	100.0	98.1
VA <6/60	94.3	97.4	95.7
VA <6/18	85.7	85.6	85.8

Table 3.9 shows that of the 720 eyes operated for cataract, 308 (42.8%) had very good presenting vision (VA ≥ 6/12) increasing to 567 (78.8%) with best correction and another 42.4% of eyes had good presenting vision. Around 10.8% of eyes had borderline vision (6/18 > VA ≥ 6/60) and just 4.0% had poor vision (VA<6/60).

Table 3.9 Visual outcomes by type of surgery (eyes)

	Non-IOL		IOL		Couching		Total	
	Eyes	%	Eyes	%	Eyes	%	Eyes	%
VA with available correction								
Very good: can see 6/12	0	0.0	308	43.4	0	0.0	308	42.8
Good: can see 6/18	0	0.0	305	43.0	0	0.0	305	42.4
Borderline: can see 6/60	5	50.0	73	10.3	0	0.0	78	10.8
Poor: cannot see 6/60	5	50.0	24	3.4	0	0.0	29	4.0
Total	10	100.0	710	100.0	0	100.0	720	100.0
VA with best correction								
Very good: can see 6/12	0	0.0	567	79.9	0	0.0	567	78.8
Good: can see 6/18	4	40.0	104	14.6	0	0.0	108	15.0
Borderline: can see 6/60	3	30.0	18	2.5	0	0.0	21	2.9
Poor: cannot see 6/60	3	30.0	21	3.0	0	0.0	24	3.3

Total	10	100.0	710	100.0	0	100.0	720	100.0

Selection was identified as the most common cause of poor visual outcomes in operated eyes (13/29), followed by sequelae (8/29), and surgical complications (6/19) (Table 3.10).

Table 3.10 Causes of visual outcomes (eyes)

	Selection		Surgery		Spectacles		Sequelae		Total	
	Eyes	%	Eyes	%	Eyes	%	Eyes	%	Eyes	%
Very good: can see 6/12	0	0.0	0	0.0	0	0.0	0	0.0	308	42.8
Good: can see 6/18	3	14.3	40	37.4	257	97.0	5	26.3	305	42.4
Borderline: can see 6/60	5	23.8	61	57.0	6	2.3	6	31.6	78	10.8
Poor: cannot see 6/60	13	61.9	6	5.6	2	0.8	8	42.1	29	4.0
Total	21	100.0	107	100.0	265	100.0	19	100.0	710	100.0

Table 3.11 shows that 73.5% of operations in the last three years had very good visual outcomes. This falls to 45.4% for those eyes operated on four to six years ago, although over 90% of eyes operated on at that time had good visual outcomes (VA>6/18). For eyes operated on seven or more years ago, 79.3% had good vision.

Table 3.11 Visual outcomes by years after surgery (eyes)

	3 yrs post-op		4-6 yrs post-op		7+ yrs post-op		Total	
	Eyes	%	Eyes	%	Eyes	%	Eyes	%
Very good: can see 6/12	133	73.5	89	45.4	86	25.1	308	42.8
Good: can see 6/18	30	16.6	89	45.4	186	54.2	305	42.4
Borderline: can see 6/60	10	5.5	11	5.6	57	16.6	78	10.8
Poor: cannot see 6/60	8	4.4	7	3.6	14	4.1	29	4.0
Total	181	100.0	196	100.0	343	100.0	710	100.0

Most operations took place in government hospitals (537/710), with more than two-thirds achieving very good or good outcomes, and just 4.1% achieving poor outcomes. Private hospitals were the second most common location: a very high proportion of eyes operated on in private hospitals (61.1%) had very good visual outcomes and only 2.4% had poor visual outcomes. Voluntary hospitals were the third most common location, which also had a very high proportion of eyes with very good vision post-operatively. Almost no eyes were operated on in eye camps (n=4) (Table 3.12).

Table 3.12 Visual outcomes by place of surgery (eyes)

	Gov. hospital		Vol. hospital		Priv. hospital		Eye camp		Total	
	Eyes	%	Eyes	%	Eyes	%	Eyes	%	Eyes	%
Very good: can see 6/12	192	35.8	35	66.0	77	61.1	4	100.0	308	42.8
Good: can see 6/18	253	47.1	14	26.4	38	30.2	0	0.0	305	42.4
Borderline: can see 6/60	70	13.0	0	0.0	8	6.3	0	0.0	78	10.8
Poor: cannot see 6/60	22	4.1	4	7.5	3	2.4	0	0.0	29	4.0
Total	537	100.0	53	100.0	126	100.0	4	100.0	710	100.0

Around 32.1% of people with untreated bilateral cataracts reported feeling surgery was unnecessary for them, and 17.9% were unaware treatment was available (Table 3.13). The most common barrier to surgery among individuals with unilateral cataracts was also the feeling that treatment was not needed (51.3%).

Table 3.13 Barriers to cataract surgery

	Male		Female		Total	
	N	%	N	%	N	%
Bilateral (BCVA <6/60 due to cataract)						
Need not felt	6	30.0	3	37.5	9	32.1
Fear	3	15.0	1	12.5	4	14.3
Cost	4	20.0	0	0.0	4	14.3
Treatment denied by provider	1	5.0	3	37.5	4	14.3
Unaware treatment is possible	4	20.0	1	12.5	5	17.9
Cannot access treatment	2	10.0	0	0.0	2	7.1
Local reason	0	0.0	0	0.0	0	0.0
Total	20	100.0	8	100.0	28	100.0
Unilateral (BCVA <6/60 due to cataract)						
Need not felt	20	55.6	20	47.6	40	51.3
Fear	4	11.1	7	16.7	11	14.1
Cost	2	5.6	4	9.5	6	7.7
Treatment denied by provider	2	5.6	2	4.8	4	5.1

Unaware treatment is possible	4	11.1	3	7.1	7	9.0
Cannot access treatment	1	2.8	2	4.8	3	3.8
Local reason	3	8.3	3	9.5	7	9.0
Total	36	100.0	42	100.0	78	100.0

Diabetes and diabetic retinopathy

Overall, the sample prevalence of diabetes mellitus was 14.6%, with prevalence higher among women than men (16.0% compared with 13.3%) (Table 3.14).

Table 3.14 Sample prevalence of known and newly diagnosed diabetes mellitus by age group and sex

	Male		Female		Total	
	N	**% (95%CI)**	**N**	**% (95%CI)**	**n**	**% (95%CI)**
50-59	87	9.7 (7.2-13.1)	115	12.9 (9.9-16.7)	202	11.3 (8.8-14.3)
60-69	62	15.7 (11.8-20.5)	59	19.0 (14.7-24.3)	121	17.2 (13.9-21.2)
70-79	18	19.8 (13.3-28.4)	15	21.7 (13.5-33.1)	33	20.7 (14.9-28.0)
80+	8	17.8 (9.1-31.8)	5	16.1 (6.8-33.8)	13	17.0 (10.0-27.3)
All ages	**175**	**13.3 (10.7-16.5)**	**194**	**16.0 (13.1-19.4)**	**369**	**14.6 (12.1-17.5)**

Slightly less than half of all diabetics (45.3%) did not know about their disease status and men were less aware of the disease than women (49.7% compared with 41.2%). Among people who knew about their diabetes status, only 34.2% had controlled levels of blood glucose (<200 mg/dl) (Table 3.15).

Table 3.15 Diabetics and random blood sugar level

		Male		Female		Total	
		n	**%**	**n**	**%**	**n**	**%**
All diabetics	Known diabetes	88	50.3	114	58.8	202	54.7
	Newly diagnosed diabetes	87	49.7	80	41.2	167	45.3
	Total	**175**	**12.3**	**194**	**14.9**	**369**	**13.5**
Previously known diabetes	Blood sugar <200 mg/dl	33	37.5	36	31.6	69	34.2

	Blood sugar ≥200 mg/dl	55	62.5	78	68.4	133	65.8
	Total	**88**	**100.0**	**114**	**100.0**	**202**	**100.0**

The majority of people (82.2%) with previously diagnosed diabetes had never had an examination for diabetic retinopathy (Table 3.16).

Table 3.16 Last eye examination for diabetic retinopathy among diabetics with known status

	Male		Female		Total	
	n	%	n	%	n	%
Never had eye examination for DR	73	83.0	93	81.6	166	82.2
0-12 months ago	6	6.8	11	9.6	17	8.4
13-24 months ago	4	4.5	6	6.3	10	5.0
>24 months ago	5	5.7	4	3.5	9	4.5
Total	**88**	**100.0**	**114**	**100.0**	**202**	**100.0**

194 people (52.6%) with diabetes agreed to undergo a DR examination. The prevalence of any retinopathy among examined diabetics was 26.6%, or 2.1% of the overall sample. 2.9% of examined diabetics had sight-threatening DR (Table 3.17). Similarly to Sargodha, prevalence of any retinopathy in this district was higher among women (Table 3.18).

Table 3.17 Prevalence of diabetic retinopathy in diabetics and in entire sample

	Among examined diabetics		Total sample
Retinopathy grade	N	% (95%CI)	% (95%CI)
No retinopathy (R0)	145	73.4 (65.3-80.2)	-
Background DR – mild (R1)	25	13.7 (8.9-20.4)	1.1 (0.7-1.6)
Background DR – observable (R2)	8	4.1 (1.8-8.7)	0.3 (0.1-0.7)
Background DR – referable (R3)	2	0.9 (0.2-3.8)	0.07 (0.02-0.3)
Proliferative DR (R4)	4	2.2 (0.8-5.6)	0.2 (0.06-0.5)
Ungradable DR (R6)	10	5.8 (2.7-12.2)	0.5 (0.2-1.1)
Any retinopathy	49	26.6 (19.8-34.7)	2.1 (1.5-2.9)
Maculopathy grade			
No maculopathy (M0)	166	84.8 (77.1-90.2)	-
Maculopathy – observable (M1)	11	6.0 (2.7-12.8)	0.5 (0.2-1.0)
Maculopathy – referable (M2)	6	2.9 (1.3-6.3)	0.2 (0.1-0.5)

Not adequately visualised	11	6.4 (3.1-12.6)	0.5 (0.2-1.1)
Any maculopathy	28	15.2 (9.8-22.9)	1.2 (0.7-2.0)
Any retinopathy and/or maculopathy	49	26.6 (19.8-34.7)	2.1 (1.5-2.9)
Sight-threatening DR (R4 and/or M2)	6	2.9 (1.3-6.3)	0.2 (0.1-0.5)
Any laser scars	5	3.7 (1.5-8.9)	0.3 (0.1-0.7)

Table 3.18 Prevalence of any retinopathy and/or maculopathy among people with diabetes examined in the study by age and gender

	Male		Female		Total	
	n	%	n	%	N	%
50-59	8	19.1 (9.9-33.4)	17	28.8 (17.0-44.5)	25	24.6 (15.3-37.0)
60-69	7	21.9 (9.9-41.7)	8	22.9 (12.1-39.0)	15	22.4 (13.8-34.3)
70-79	1	10.0 (1.3-49.4)	4	50.0 (22.4-77.6)	5	28.5 (11.1-56.1)
80+	1	25.0 (2.6-80.9)	3	75.0 (22.3-96.9)	4	53.3 (19.0-84.7)
All ages	17	18.7 (11.5-28.9)	32	33.3 (23.7-44.5)	49	26.6 (19.8-34.8)

Disability and wealth

The prevalence of reported difficulties in at least one of the six domains was 2.6%, with little difference between men and women. Taking into account five domains only (excluding seeing) the prevalence was 1.9% (Table 3.19).

Table 3.19 Sample prevalence of individuals reporting a lot of difficulties functioning, or cannot do at all, in six domains

	Male		Female		Total	
	n	%	N	%	n	%
Seeing	25	1.7	18	1.3	43	1.5
Hearing	8	0.6	11	0.8	19	0.7
Walking	23	1.6	18	1.3	41	1.5

Self-care (upper body)	12	0.8	5	0.4	17	0.6
Communication	6	0.4	5	0.4	11	0.4
Cognition	12	0.8	11	0.8	23	0.8
Difficulties in at least one domain	37	2.6	33	2.5	70	2.6
Difficulties in at least one of five domains (excluding seeing)	26	1.8	25	1.9	51	1.9

Among 51 people with difficulties in at least one of five domains (excluding seeing), 12 (23.5%) were blind, three (5.6%) had SVI and another 12 (23.5%) had MVI. This is much higher than the corresponding figures for the overall sample of 0.8%, 0.6% and 4.1%, respectively (Table 3.20).

Table 3.20 Visual impairment (PVA) and reported functional difficulties (excluding seeing)

	Difficulties in at least one of six domains		Difficulties in at least one of five domains (excluding seeing)	
	n	**%**	**n**	**%**
Good vision: can see 6/12	7	10.0	5	9.8
EVI: can see 6/18	23	32.9	19	37.3
MVI: can see 6/60	14	20.0	12	23.5
SVI: cannot see 6/60	8	11.4	3	5.6
Blind: cannot see 3/60	18	25.7	12	23.5
Total	70	100.0	51	100.0

Overall, the study sample was considerably wealthier than the population of Pakistan, as only 2.6% belonged to the two poorest quintiles, compared with 88.7% in the two richest quintiles (against the expected 40% in each) (Table 3.21). This is to be expected as Rawalpindi is known to be a wealthy location. With such a high proportion of the study population concentrated in just two quintiles, it is not possible to explore the relationship between relative wealth and visual impairment.

Table 3.21 Prevalence of visual impairment (PVA) by relative wealth quintile (national reference)

	Q1		Q2		Q3		Q4		Q5	
	n	%	n	%	n	%	n	%	n	%
Good vision: can see 6/12	0	0.0	57	2.9	190	9.8	872	45.0	819	42.3
EVI: can see 6/18	0	0.0	10	1.6	39	6.1	337	52.7	253	39.6
MVI: can see 6/60	0	0.0	2	1.8	3	2.7	51	46.0	55	49.6
SVI: cannot see 6/60	0	0.0	0	0.0	3	20.0	5	33.3	7	46.7
Blind: cannot see 3/60	0	0.0	3	13.0	3	13.0	10	43.5	7	30.4
Total	0	0.0	**72**	**2.6**	**238**	**8.7**	**1,275**	**46.8**	**1,141**	**41.9**

4. Quetta

Description of sample

2,800 participants aged 50 years or older were surveyed in Quetta, of whom 2,704 were examined (96.6% response rate) (Table 4.1).

Table 4.1 Examination status of enrolled participants

	Male		Female		Total	
	n	%	n	%	n	%
Examined	1,351	96.6	1,353	96.5	2,704	96.6
Not examined	0	0.0	2	0.1	2	0.1
Refused	32	2.3	42	3.0	74	2.6
Unable to communicate	15	1.1	5	0.4	20	0.7
Total	1,398	100.0	1,402	100.0	2,800	100.0

50.0% of examined individuals were male (n=1,351). The age distribution of male and female participants was broadly comparable (Tables 4.1 and 4.2).

Table 4.2 Age and sex distribution of examined individuals

	Male		Female		Total	
	n	%	N	%	n	%
50-59	718	53.2	766	56.6	1,484	54.9
60-69	384	28.4	375	27.7	759	28.1
70-79	158	11.7	142	10.5	300	11.1
80+	91	6.7	70	5.2	161	5.9
Total	1,351	100.0	1,353	100.0	2,704	100.0

Compared with the population of people aged 50 years or older in the Quetta district, women were slightly over-represented in the study sample (women made up 50.0% of the sample, compared with 45.5% of the population), although there were more older men in the study sample than in the population (Table 4.3).

Table 4.3 Comparison of study sample and area population

	Male				Female				Total			
	Study sample		Region		Study sample		Region		Study sample		Region	
	N	%	n	%	n	%	N	%	N	%	n	%
50-59	739	52.9	54,559	51.6	784	55.9	45,916	51.9	1,523	54.4	100,475	51.7
60-69	393	28.1	32,856	31.1	385	27.5	27,390	31.0	778	27.8	60,246	31.0
70-79	164	11.7	12,416	11.7	144	10.3	9,839	11.1	308	11.0	22,256	11.5
80+	102	7.3	5,983	5.7	89	6.3	5,250	5.9	191	6.8	11,232	5.8
Total	1,398	100.0	105,814	100.0	1,402	100.0	88,395	100.0	2,800	100.0	194,209	100.0

Prevalence and causes of visual impairment

Adjusted for age and sex, the prevalence of all-cause bilateral blindness was 0.3% (95% CI 0.1-0.6) (Tables 4.4 and 4.5) with little difference between men and women. The adjusted prevalence of SVI was 0.5% (0.6% for men and 0.4% for women) and of MVI 5.0% (5.3% for men and 4.8% for women).

Table 4.4 Sample prevalence of blindness, SVI, MVI, EVI and FLV

	Male			Female			Total		
	n	%	95% CI	n	%	95% CI	n	%	95% CI
Blindness	4	0.3	0.0-0.6	5	0.4	0.0-0.7	9	0.3	0.1-0.6
Severe VI	9	0.7	0.3-1.1	5	0.4	0.0-0.7	14	0.5	0.2-0.8
Moderate VI	72	5.3	4.3-6.4	60	4.4	3.3-5.6	132	4.9	4.0-5.8
Early VI	312	23.1	19.8-26.4	320	23.7	20.4-26.9	632	23.4	20.4-26.3
Functional low vision	4	0.3	0.0-0.6	5	0.4	0.1-0.7	9	0.3	0.1-0.5

Table 4.5 Extrapolated prevalence of blindness, SVI, MVI, EVI and FLV (adjusted)

	Male			Female			Total		
	n	%	95% CI	n	%	95% CI	N	%	95% CI
Blindness	290	0.3	0.0-0.6	340	0.4	0.0-0.8	630	0.3	0.1-0.6

Severe VI	659	0.6	0.2-1.0	349	0.4	0.0-0.8	1,008	0.5	0.2-0.8
Moderate VI	5,576	5.3	4.2-6.3	4,197	4.8	3.6-5.9	9,774	5.0	4.2-5.9
Early VI	24,485	23.1	19.8-26.4	22,038	24.9	21.7-28.2	46,525	24.0	21.0-26.9
Functional low vision	317	0.3	0.0-0.6	331	0.4	0.1-0.7	648	0.3	0.1-0.5

Among nine people with bilateral blindness, untreated cataract was the principal cause in three cases (33.3%). Another three cases were due to non-trachomatous corneal opacity, two cases were due to uncorrected aphakia and one case due other posterior segment disease (Table 4.6). The majority of cases of SVI and MVI was due to cataract (85.7% and 89.4%). The majority of cases of early VI was due to refractive error (70.4%).

Table 4.6 Main causes of visual impairment

	Blindness		Severe VI		Moderate VI		Early VI	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Refractive error	0	0.0	0	0.0	7	5.3	445	70.4
Aphakia (uncorrected)	2	22.2	1	7.1	0	0.0	0	0.0
Cataract (untreated)	3	33.3	12	85.7	118	89.4	171	27.1
Cataract surgical complications	0	0.0	0	0.0	2	1.5	10	1.6
Trachomatous corneal opacity	0	0.0	0	0.0	0	0.0	0	0.0
Non-trachomatous corneal opacity	3	33.3	1	7.1	2	1.5	0	0.0
Phthisis	0	0.0	0	0.0	0	0.0	0	0.0
Onchocerciasis	0	0.0	0	0.0	0	0.0	0	0.0
Glaucoma	0	0.0	0	0.0	0	0.0	1	0.2
Diabetic retinopathy	0	0.0	0	0.0	2	1.5	2	0.3
ARMD	0	0.0	0	0.0	0	0.0	1	0.2
Other posterior segment disease	1	11.1	0	0.0	1	0.8	1	0.2
All other globe/CNS abnormalities	0	0.0	0	0.0	0	0.0	1	0.2
TOTAL	**9**	**100.0**	**14**	**100.0**	**132**	**100.0**	**632**	**100.0**

The adjusted prevalence of bilateral blindness due to cataract was negligible (0.0% (95% CI 0.0-0.2)). Cumulatively, unoperated cataracts caused 0.1% (95%CI 0.0; 0.3) of SVI (VA<6/60) and 3.1% (95% CI 2.4; 4.0) of MVI (VA<6/18). No statistically significant differences in the distribution of visual impairment and bilateral blindness due to cataract was observed between men and women (Table 4.7).

Table 4.7 Prevalence of bilateral cataracts with VA<3/60, VA<6/60, and VA<6/18 (adjusted)

	Male			Female			Total		
	N	%	95% CI	N	%	95% CI	n	%	95% CI
Cataract and VA<3/60 in the better eye with available correction or pinhole									
	1	0.1	0.0,0.4	0	0.0	-	1	0.0	0.0,0.2
Cataract and VA<6/60 in the better eye with available correction or pinhole									
	2	0.2	0.1,0.5	1	0.1	0.0,0.6	3	0.1	0.0,0.3
Cataract and VA<6/18 in the better eye with available correction or pinhole									
	46	3.4	2.5,4.5	39	2.9	2.0,4.0	84	3.1	2.4,4.0

Cataract surgery

Cataract surgical coverage (CSC) was 99.6% at VA <3/60 and 98.6% at VA<6/60 with no differences between men and women (Table 4.8)

Table 4.8 Cataract surgical coverage (persons)

	Males	Females	Total
	%		
VA <3/60	99.3	100	99.6
VA <6/60	98.1	99.3	98.6
VA <6/18	78.9	80.4	79.6

Table 4.9 shows that of the 751 eyes operated on for cataract, 497 (66.2%) had very good presenting vision (VA ≥ 6/12) increasing to 661 (88.0%) with best correction. 28.4% of eyes had good presenting vision, 3.9% had borderline vision (6/18 > VA ≥6/60) and just 1.6% had poor vision (VA<6/60) (Table 4.9).

Table 4.9 Visual outcomes by type of surgery (eyes)

	Non-IOL		IOL		Couching		Total	
	Eyes	%	Eyes	%	Eyes	%	Eyes	%
VA with available correction								
Very good: can see 6/12	0	0.0	497	66.6	0	0.0	497	66.2
Good: can see 6/18	0	0.0	213	28.6	0	0.0	213	28.4
Borderline: can see 6/60	0	0.0	29	3.9	0	0.0	29	3.9
Poor: cannot see 6/60	5	100.0	7	0.9	0	0.0	12	1.6

Total	5	100.0	746	100.0	0	100.0	751	100.0
VA with best correction								
Very good: can see 6/12	0	0.0	661	88.6	0	0.0	661	88.0
Good: can see 6/18	0	0.0	50	6.7	0	0.0	50	6.7
Borderline: can see 6/60	5	100.0	29	3.9	0	0.0	34	4.5
Poor: cannot see 6/60	0	0.0	6	0.8	0	0.0	6	0.8
Total	5	100.0	746	100.0	0	100.0	751	100.0

The causes of poor vision in a few eyes with poor visual outcomes were sequelae (5/12), spectacles (5/12) and selection (2/12) (Table 4.10).

Table 4.10 Causes of visual outcomes (eyes)

	Selection		Surgery		Spectacles		Sequelae		Total	
	Eyes	**%**	**Eyes**	**%**	**Eyes**	**%**	**Eyes**	**%**	**Eyes**	**%**
Very good: can see 6/12	0	0.0	0	0.0	0	0.0	0	0.0	497	100.0
Good: can see 6/18	5	62.5	15	93.8	164	97.0	29	47.5	213	0.0
Borderline: can see 6/60	1	12.5	1	6.3	0	0.0	27	44.3	29	0.0
Poor: cannot see 6/60	2	25.0	0	0.0	5	3.0	5	8.2	12	0.0
Total	8	100.0	16	100.0	169	100.0	61	100.0	751	100.0

Table 4.11 shows that almost all eyes operated on in the last three years had either very good (67.8%) and good (31.9%) visual outcomes. Among the eyes operated on four to six years ago, the proportion of eyes with very good and good vision was only marginally lower (71.3% and 24.4% respectively). Even among eyes operated on seven or more years ago, 94.6% had very good or good vision.

Table 4.11 Visual outcomes by years after surgery (eyes)

	3 yrs post-op		4-6 yrs post-op		7+ yrs post-op		Total	
	Eyes	**%**	**Eyes**	**%**	**Eyes**	**%**	**Eyes**	**%**
Very good: can see 6/12	286	67.8	117	71.3	91	56.5	497	66.2
Good: can see 6/18	136	31.9	40	24.4	37	23.0	213	28.4
Borderline: can see 6/60	0	0.0	5	3.0	24	14.9	29	3.9
Poor: cannot see 6/60	1	0.2	2	1.2	9	5.6	12	1.6
Total	426	100.0	164	100.0	161	100.0	751	100.0

Most operations took place in government hospitals (347/751), with more than 90% achieving very good or good outcomes and just 1.4% achievieng poor outcomes. Private hospitals were the second most common location, where all operated eyes had either very good or good vision. Among the eyes operated on in voluntary hospitals, 89.5% had very good or good vision and 7.9% had poor vision. In 13 cases, participant reported being operated by eye camps. (Table 4.12).

Table 4.12 Visual outcomes by place of surgery (eyes)

	Gov. hospital		Vol. hospital		Priv. hospital		Eye camp		Total	
	Eyes	%	Eyes	%	Eyes	%	Eyes	%	Eyes	%
Very good: can see 6/12	347	60.7	26	68.4	120	93.8	4	30.8	497	66.2
Good: can see 6/18	190	33.2	8	21.1	8	6.3	7	53.8	213	28.4
Borderline: can see 6/60	27	4.7	1	2.6	0	0.0	1	7.7	29	3.9
Poor: cannot see 6/60	8	1.4	3	7.9	0	0.0	1	7.7	12	1.6
Total	572	100.0	38	100.0	128	100.0	13	100.0	751	100.0

Among eight people who were bilaterally blind due to cataract, half (n=4) reported feeling surgery was unnecessary for them (all four were male). In two cases (both also male), patients said their treatment was denied by the healthcare provider, while two female participants were unaware that treatment was available (Table 4.13). The most common barrier to surgery among individuals with unilateral cataract was also the feeling that treatment was not needed (63.2%). Men were more likely to say that they did not need surgery (72.5% vs 52.8%).

Table 4.13 Barriers to cataract surgery

	Male		Female		Total	
	n	%	N	%	n	%
Bilateral (BCVA <6/60 due to cataract)						
Need not felt	4	66.7	0	0.0	4	50.0
Fear	0	0.0	0	0.0	0	0.0
Cost	0	0.0	0	0.0	0	0.0
Treatment denied by provider	2	33.0	0	0.0	2	25.0
Unaware treatment is possible	0	0.0	2	100.0	2	25.0

Cannot access treatment	0	0.0	0	0.0	0	0.0
Local reason	0	0.0	0	0.0	0	0.0
Total	6	100.0	2	100.0	8	100.0
Unilateral (BCVA <6/60 due to cataract)						
Need not felt	29	72.5	19	52.8	48	63.2
Fear	0	0.0	7	11.1	4	5.3
Cost	3	7.5	4	19.4	10	13.2
Treatment denied by provider	2	5.0	2	5.6	4	5.5
Unaware treatment is possible	4	10.0	3	5.6	6	7.9
Cannot access treatment	2	5.0	2	5.6	4	5.3
Local reason	0	0.0	3	0.0	0	0.0
Total	40	100.0	36	100.0	76	100.0

Diabetes and diabetic retinopathy

Overall, the sample prevalence of diabetes mellitus was 9.1% and prevalence was higher among women compared with men (10.1% compared with 8.1%) (Table 4.14).

Table 4.14 Sample prevalence of known and newly diagnosed diabetes mellitus by age group and sex

	Male		Female		Total	
	n	**% (95%CI)**	**N**	**% (95%CI)**	**N**	**% (95%CI)**
50-59	56	7.8 (5.6-10.9)	81	10.6 (8.0-13.9)	137	9.2 (7.1-11.8)
60-69	40	10.4 (7.7-14.0)	44	11.7 (8.1-16.7)	84	11.1 (8.4-14.4)
70-79	7	4.4 (2.2-8.8)	7	4.9 (2.4-9.7)	14	4.7 (2.7-8.0)
80+	5	5.5 (2.6-11.4)	5	7.1 (3.1-15.5)	10	6.3 (3.3-11.6)
All ages	**108**	**8.1 (6.3-10.4)**	**137**	**10.1 (8.1-12.6)**	**245**	**9.1 (7.4-11.1)**

Nearly 45% of all diabetics did not know about their disease status, and men were more likely to be aware of their disease status than women (51.8% compared with 39.4%). Among people who knew about their disease status, only 28.2% had controlled levels of blood glucose (<200 mg/dl) (Table 4.15).

Table 4.15 Diabetics and random blood sugar level

		Male		Female		Total	
		n	%	N	%	n	%
All diabetics	Known diabetes	52	48.2	83	60.6	135	55.1
	Newly diagnosed diabetes	56	51.8	54	39.4	110	44.9
	Total	**108**	**100.0**	**137**	**100.0**	**245**	**100.0**
Known diabetes	Blood sugar <200 mg/dl	15	28.9	23	27.7	38	28.2
	Blood sugar ≥200 mg/dl	37	71.2	60	72.3	97	71.9
	Total	**52**	**100.0**	**83**	**100.0**	**135**	**100.0**

The majority of people (88.9%) with diagnosed diabetes had never previously had an examination for diabetic retinopathy (Table 4.16).

Table 4.16 Last eye examination for diabetic retinopathy among known diabetics

	Male		Female		Total	
	n	%	n	%	n	%
Never had eye examination for DR	46	88.5	74	89.2	120	88.9
0-12 months ago	3	5.8	5	6.0	8	5.9
13-24 months ago	0	0.0	1	1.2	1	0.7
>24 months ago	3	5.8	3	3.6	6	4.4
Total	**52**	**100.0**	**83**	**100.0**	**135**	**100.0**

158 people (64.5%) with diabetes agreed to undergo a DR examination. The prevalence of any retinopathy among examined diabetics was 31.9% or 1.9% among the overall sample; and 0.7% of the examined diabetics had sight threatening DR (Table 4.17). Prevalence of any retinopathy was higher among women but mainly due to the sex differences among people with diabetes aged 60-69 years (Table 4.18).

Table 4.17 Prevalence of diabetic retinopathy in diabetics and in entire sample

	Among examined diabetics		Total sample
Retinopathy grade	N	% (95%CI)	% (95%CI)
No retinopathy (R0)	108	68.1 (59.0-75.9)	-
Background DR – mild (R1)	35	22.3 (16.1-30.1)	1.3 (1.0-1.8)
Background DR – observable (R2)	11	7.0 (3.8-12.5)	0.4 (0.2-0.7)
Background DR – referable (R3)	1	0.6 (0.1-4.2)	0.03 (0.005-0.3)
Proliferative DR (R4)	1	0.7 (0.1-4.9)	0.04 (0.006-0.3)

Ungradable DR (R6)	2	1.3 (0.3-5.4)	0.08 (0.02-0.3)
Any retinopathy	50	31.9 (24.1-41.0)	1.9 (1.5-2.4)
Maculopathy grade			
No maculopathy (M0)	148	93.2 (87.2-96.5)	-
Maculopathy – observable (M1)	7	4.8 (2.1-10.7)	0.3 (0.1-0.6)
Maculopathy – referable (M2)	1	0.7 (0.1-4.9)	0.04 (0.006-0.3)
Not adequately visualised	2	1.3 (0.3-5.4)	0.08 (0.02-0.3)
Any maculopathy	10	6.8 (3.6-12.8)	0.4 (0.2-0.8)
Any retinopathy and/or maculopathy	50	31.9 (24.1-41.0)	1.9 (1.5-2.4)
Sight-threatening DR (R4 and/or M2)	1	0.7 (0.1-4.9)	0.4 (0.006-0.3)
Any laser scars	5	3.4 (1.4-7.9)	0.2 (0.08-0.5)

Table 4.18 Prevalence of any retinopathy and/or maculopathy among people with diabetes by age and gender

	Male		Female		Total	
	n	%	N	%	n	%
50-59	5	16.1 (6.7-34.0)	9	16.4 (8.1-30.2)	14	16.3 (9.3-26.8)
60-69	7	29.2 (13.5-52.2)	13	46.4 (28.2-65.6)	20	38.6 (25.3-53.8)
70-79	4	66.7 (25.6-92.1)	3	60.0 (19.2-90.5)	7	63.5 (31.3-86.9)
80+	4	100.0	5	100.0	9	100.0
All ages	20	29.9	30	33.4	50	31.94

Disability and wealth

The prevalence of reported difficulties in at least one of the six domains was 5.5%, with little reported difference between males and females. Among five domains (excluding seeing) the prevalence was 5.0%.

Table 4.19 Sample prevalence of individuals reporting a lot of difficulties functioning, or cannot do at all, in six domains

	Male		Female		Total	
	N	%	n	%	n	%
Seeing	25	1.8	20	1.4	45	1.6
Hearing	15	1.1	16	1.1	31	1.1
Walking	64	4.6	46	3.3	110	3.9
Self-care (upper body)	5	0.4	4	0.3	9	0.3
Communication	2	0.1	1	0.1	3	0.1
Cognition	11	0.8	10	0.7	21	0.8
Difficulties in at least one domain	81	6.0	67	5.0	148	5.5
Difficulties in at least one of five domains (excluding seeing)	75	5.6	61	4.5	1336	5.0

Among people with difficulties in at least one of five domains (excluding seeing), 1.5% were blind, 2.9% had SVI and 9.6% had MVI. This is higher than in the overall sample (0.3%, 0.5% and 5.0%, respectively) (Table 4.20).

Table 4.20 Visual impairment (PVA) and reported functional difficulties

	Difficulties in at least one of six domains		**Difficulties in at least one of five domains (excluding seeing)**	
	n	**%**	**n**	**%**
Good vision: can see 6/12	62	41.9	62	45.6
EVI: can see 6/18	59	39.9	55	40.4
MVI: can see 6/60	16	10.8	13	9.6
SVI: cannot see 6/60	5	3.4	4	2.9
Blind: cannot see 3/60	6	4.1	2	1.5
Total	148	100.0	136	100.0

Overall, this district was relatively wealthier than the average national population in Pakistan; 75.5% of the sample belonged to the two wealthiest quintiles and only 6.6% belonged to the

two poorest quintiles (compared with an expected 40% in each). Data on the relationship of visual impairment and wealth was difficult to interpret due to small numbers of people who were blind or had SVI in this district, and a relatively high concentration of people in the wealthiest two quintiles. Overall, we did not see any particular pattern in the unequal distribution of blindness or VI by wealth (Table 4.21).

Table 4.21 Prevalence of visual impairment (PVA) by relative wealth quintile (national reference)

	Q1		Q2		Q3		Q4		Q5	
	n	%	n	%	n	%	n	%	n	%
Good vision: can see 6/12	6	0.3	110	5.7	354	18.5	938	48.9	509	26.6
EVI: can see 6/18	0	0.0	41	6.5	88	13.9	335	53.0	168	26.6
MVI: can see 6/60	1	0.8	14	10.6	36	27.3	60	45.5	21	15.9
SVI: cannot see 6/60	0	0.0	4	28.6	5	35.7	2	14.3	3	21.4
Blind: cannot see 3/60	0	0.0	2	22.2	4	44.4	2	22.2	1	11.1
Total	**7**	**0.3**	**171**	**6.3**	**487**	**18.0**	**1,337**	**49.5**	**702**	**26.0**

NB – here is the data referenced against urban standards

Discussion

Table 5.1 shows the results of the main indicators measured in this survey across all four districts.

Table 5.1 Selected survey indicators for four study districts

Indicator	Sargodha	Nowshera	Rawalpindi	Quetta
Number examined (response rate)	2,708 (96.6%)	2,680 (95.5%)	2,726 (97.4%)	2,704 (96.6%)
Visual impairment prevalence				
Blindness % (95% CI) **(PVA<3/60)**	3.2 (2.4-4.0) Male 2.8 (1.9-3.8) Female 3.6 (2.4-4.8)	2.9 (1.9-4.0) Male 3.4 (1.7-5.0) Female 2.4 (1.6-3.2)	1.3 (1.0-1.7) Male 1.8 (1.3-2.3) Female 0.8 (0.3-1.2)	0.3 (0.1-0.6) Male 0.3 (0.0-0.6) Female 0.4 (0.0-0.8)
SVI % (95% CI) **(3/60<PVA<6/50)**	3.3 (2.4-4.1)	3.9 (2.9-4.8)	0.9 (0.6-1.2)	0.5 (0.2-0.8)
MVI %, (95% CI) **(3/60<PVA<6/50)**	16.7 (15.0-18.0)	15.5 (13.9-17.1)	6.2 (5.2-7.1)	5.0 (4.2-5.9)
Cataract surgical coverage and post-surgery outcomes				
CSC (person)	VA 3/60 89.1 Male 91.8 Female 85.7 VA 6/60 82.7 Male 86.4 Female 78.0	VA 3/60 83.9 Male 79.5 Female 89.0 VA 6/60 70.6 Male 68.8 Female 72.7	VA 3/60 98.1 Male 96.4 Female 100 VA 6/60 95.7 Male 94.3 Female 97.4	VA 3/60 99.6 Male 99.3 Female 100 VA 6/60 98.6 Male 98.1 Female 99.3
Very good and good outcomes % **(VA>6/18)**	71.7	64.5	85.2	94.6
Poor vision **outcomes** % **(VA<6/60)**	17.4	21.1	4.0	1.6

Diabetes and diabetic retinopathy				
Diabetes prevalence % (sample)	18.0 Male 15.1 Female 21.4	21.9 Male 18.7 Female 25.0	14.6 Male 13.3 Female 16.0	9.1 Male 8.1 Female 10.1
Unaware of diabetes status %	55.5	50.4	45.3	44.9
% controlled glucose level (<200 mg/dl) (known diabetics)	29.4	26.5	34.2	28.2
No eye examination previously (known diabetics)	85.5	69.0	82.2	88.9
Eye examination in the past 12 months (known diabetics)	10.7	26.7	8.4	5.9
Presence of any retinopathy (among examined diabetics)	46.8	51.7	26.6	31.9
Presence of STDR	3.6	10.0	2.9	0.7
Disability				
Any disability % (six domains)	12.7	10.1	2.6	5.5
Non-visual disability % (excluding seeing)	9.8	6.6	1.9	5.0
Blindness % (among people with non-visual disability)	20.4	11.4	23.5	1.5
SVI % (among people with non-visual disability)	12.8	17.1	5.6	2.9

Visual impairment prevalence The study found a difference in the prevalence of visual impairment between the four districts, with the prevalence of blindness being the highest in Sargodha (3.8%), followed by Nowshera (2.9%), Rawalpindi (1.3%) and Quetta (0.3%). The prevalence of SVI was highest in Nowshera (3.9%), followed by Sargodha (3.3%), Rawalpindi (0.9%) and Quetta (0.5%). The prevalence of MVI was highest in Sargodha (16.7%), followed by Nowshera (15.5%), Rawalpindi (6.2%) and Quetta (5%). Rural and peripheral districts (Sargodha and Nowshera) appear to have comparatively higher

prevalence of VI than more urbanised districts of Rawalpindi and Quetta, with well-established eye-health services in both public and private sectors. In addition, Rawalpindi is amongst the districts with the highest human development index (HDI), highest cataract surgical rate (as per the 2019 cataract surgical study report) and a high literacy rate, which suggests that higher levels of socio-economic development inversely correlate with levels of blindness and visual impairment (6, 10). There were no statistically significant sex differences in the prevalence of visual impairment in any of the districts.

Cataract surgical coverage In all four districts, CSC was high with variations from 83.9% in Nowshera to 99.6% in Quetta. The majority of patients (60% in Nowshera, 67.7% in Sargodha, 75.6% in Rawalpindi and 76.2% in Quetta) said that their surgery was performed in a government hospital. This finding is different from the results of the cataract surgical rate (CSR) mapping study conducted in Pakistan in 2019, which showed that between 70% and 95% of the cataract surgeries in these districts were contributed by private/charity sector providers. It is possible that in these RAABs, some patients misclassified their charity hospital provider as a government provider. We also do not know how comparable these two studies are and therefore cannot comment further on this discrepancy. Further investigation of the CSR alongside CSC data may be necessary.

Post-surgical visual outcomes All four districts had a high proportion of eyes with good or very good post-surgery visual outcomes. However, there were some variations ranging from 64.5% in Nowshera to 94.6% in Quetta. The proportion of eyes with poor visual outcomes was higher in rural districts (17.4% in Sargodha and 21.1% in Nowshera) compared with the two urban districts (4% and 1.6% in Rawalpindi and Quetta respectively). Surgical complications, selection for the surgery, sequelae and unavailable spectacles were the major causes of poor visual outcomes. There were also some district differences in the visual outcomes by place of surgery. In Sargodha district, there was a substantial proportion of eyes (11%) operated on in eye-care camps and nearly 59% of these eyes had borderline or poor visual outcomes.

In other districts, the proportion of eyes operated on in camps was very small. In Nowshera, over 47% of eyes operated on in private facilities had borderline or poor outcomes. This is higher than the proportion of such eyes operated on in government (31.8%) or charity (38.5%) facilities. In Rawalpindi, the highest proportion of eyes with borderline or poor outcomes was from government facilities (17.1%), while in Quetta these were from charity facilities (10.5%). In this district, there were no borderline or poor visual outcomes among the eyes operated on in private sector facilities.

There were also some district differences in the reasons for not having surgery among patients with bilateral cataract. In the two rural districts with lower CSC (Sarghoda and Nowshera), patients cited fear, unawareness of treatment or difficulty in accessing treatment among the main reasons for not having surgery. In Sargodha, over 45% of patients with unoperated bilateral cataract said they were unaware of treatment, and another 20% said that they could not access it. In Nowshera, however, over one-third of patients with bilateral cataract (37.5%) feared the surgery, 23% experienced difficulties with costs and another 20.6% felt no need to have surgery. In the districts with higher CSC (Rawalpindi and Quetta), the majority of patients with unoperated bilateral cataract said they did not feel they needed surgery. Men were more likely than women to say that they were unaware of treatment; and in Sargodha women were likely to say that fear and costs of surgery were barriers to them

accessing treatment. Similar findings were reported earlier in another study in Khyber Pakhtunkhwa province (11).

Diabetes and diabetic retinopathy (DR) The prevalence of diabetes varied from 9.1% in Quetta (lowest) to 21.9% in Nowshera (highest). Women were more affected by diabetes than men in all districts. The findings are lower than the data presented in the Diabetes Atlas 10th Edition 2021, which estimates the prevalence of diabetes among 20-79 year olds in Pakistan at 30.8%, while the National Diabetes Survey of Pakistan conducted in 2016-2017 estimated prevalence of diabetes at 26.3% (12, 13).

Around one-half of people with diabetes in our study were unaware of their condition. In every district, the proportion of males unaware of their status (from 49.7% in Rawalpindi to 58.3% in Sargodha) was higher than females (from 39.4% in Quetta to 52.9% in Sargodha). The proportion was slightly higher in the two rural districts (50-55%) than in the two urban districts (45%). Among diabetics who were aware of their disease, only one-third or less had controlled level of glucose. This proportion was slightly higher in Rawalpindi (34.2%) than in the three other districts.

A very significant proportion of patients with known diabetes status had never had an eye examination. This proportion was slightly lower in Nowshera (69%). In the other three districts, this proportion was over 80%. Similarly, only one in eight known diabetics had undergone an eye examination during the past year; this proportion was higher in Nowshera (26.7%). In the other three districts, the proportion ranged from 5.9% to 10.7%. The prevalence of any retinopathy among people with diabetes varied from 26.6% to 51.7% and the prevalence of sight-threatening retinopathy varied from 0.7% to 10%. The prevalence of both any retinopathy and sight-threatening retinopathy was higher in the two rural districts and the prevalence was highest in Nowshera.

Disability The prevalence of disability measured by WGSS varied between districts from 2.6% in Rawalpindi to 12.7% in Sargodha; and the prevalence of non-visual disability followed the same pattern ranging from 1.9% in Rawalpindi to 9.8% in Sargodha. The prevalence of both all and non-visual disabilities was higher in rural districts, where it was also similar to the results of the Pakistan Social and Living Standards Measurement (PSLM) survey 2019-2020 (14). Our study also shows that people with non-visual disabilities are more likely to be blind or severely visually impaired than people without disabilities, suggesting that people with functional limitations experience difficulties in accessing eye-care services. The findings are consistent with similar studies in other locations (15) .

In conclusion The RAABs conducted in four districts with funding from the FCDO provide valuable information for decision-makers and health service managers. They show that overall, these districts are making significant progress in eliminating avoidable blindness and achieving universal eye-health coverage. However, the progress has been more substantial in urban districts with a broad range of eye-care services. Further investments should be made in rural districts to close the geographical inequalities highlighted in this study. In addition, our findings suggest that there are socio-demographic inequalities and vulnerable population groups, such as people with disabilities, who need to be given particular attention-maximising opportunities for their access to eye-care services. Finally, diabetes is a rapidly growing problem in Pakistan, but many patients are not aware of their condition. Those who are aware of their diabetes status do not pay attention to their glucose levels or attend regular eye check-ups. There is an urgent need to roll out diabetes awareness services and

public health interventions with an aim to controlling the progress of diabetes and prevent its visual and non-visual complications.

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