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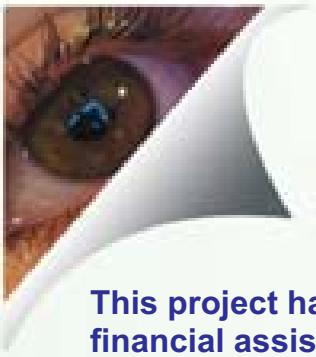

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Date: 8th October 2012.

Message

I am delighted to know that the Epidemiology of Blindness in Nepal 2012 report of surveys is coming up in the shape of a concise book. I hope this report will help Ministry of Health and Population to increase the coverage of eye services in rural and remote areas so that we can achieve the national goal of vision 2020: The right to sight.

Eye health care is one of the sector in which Nepal has now accomplished a substantial achievement. This is an exemplary result of the successful public private partnership in health sector of Nepal.

There has been rapid and extensive development of eye care infrastructure, human resource and service delivery in the country in last three decades and as a result the prevalence of blindness has reduced by more than half.

Integration of eye care into the general health care system at the community level is the main need of eye care system of Nepal at present. At this occasion, I want to mention that Ministry of Health and Population of Government of Nepal has already started the process of integration of eye care into general health care system.

I would like to thank Nepal Netra Jyoti Sangh and all the other NGOs, INGOs involved in providing valuable support to eye care and in implementing the eye care programs in Nepal and look forward to see further commendable progress in eye care sector during coming days. I also like to thank all those involved in preparing this report and hope this report will provide concrete baseline information for planning future eye care service of Nepal.

(Rajendra Mahto)
Minister

Government of Nepal

Ministry of Health & Population

Phone: 4.

Ramshahpath, Kathmandu
Nepal

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Date: .....

Message

I am pleased to know that "The Epidemiology & Blindness in Nepal 2012" Report is being published as a book by Nepal Netra Jyoti Sangh.

There has been a commendable progress in the eye care sector of Nepal in last three decades. Now, we have been successful in developing comprehensive quality eye care services and delivering it to the people. As a result, the prevalence of blindness has now reduced to more than half in comparison to 1981. This is a successful example of successful public private partnership in heath care.

To achieve the national goal of VISION 2020 Global Initiative, the eye care service need to be further expanded to the grassroot level throughout the country to reach the unreached population especially in the remote, rural and mountainous areas. For this purpose, Ministry of Health and Population of Government of Nepal has already started the process of integration of eye care service into general health care service.

This report provides information on present situation of blindness and outcome of the existing eye care service in Nepal and I hope it will be very helpful in planning future eye care service of the country.

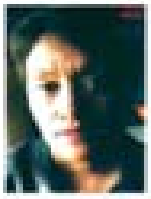
I like to thank all the stakeholders for their contribution in implementing the eye care program in Nepal and providing support for the same and expect further progress during the coming days. Similarly, I also like to thank those involved in preparing this report.

October 2012

Dr Praveen Mishra
Secretary

NEPAL OPHTHALMIC SOCIETY

Kathmandu



Dr Reeta Gurung
President

Message from the President of Nepal Ophthalmic Society

It gives me immense pleasure to be informed that the time has come for this important report to come up in the form of a handbook.

This report provides evidence-based detailed fresh information on the present situation of blindness and eye care service with also a comparison to that of early 1980s, and impart of eye care service of Nepal during the last three decades.

There has been a paradigm shift in the eye care service of Nepal in last three decades from a rudimentary 1000 surgeries per year in 1981 to over 250000 surgeries of high quality and various sub specialties per year in 2011.

In most developing countries, prevalence of blindness has not decreased significantly mainly because of the increase in population and longevity of people. Aging is the most important factor in visual impairment and blindness. However Nepal, in spite of the increase in population and longevity of people, difficult geographical terrain and transportation and long standing political unrest, has been successful in reducing the prevalence of blindness from 0.84% of 1981 to 0.35% at present. This is apparently a great achievement which is the result of tireless concerted efforts of national NGOs involved in implementing eye care program, Government of Nepal and the international NGOs and other stakeholders supporting eye care service of Nepal.

All this has been possible due to the good leadership, effective management, devoted and skilled ophthalmologists with one of the highest productivity in the world in terms of surgeries per surgeon, equally devoted and skilled ophthalmic assistants, optometrists and other supporting staff and community participation.

The eye care service of Nepal need to be further expanded to reach the unreached population especially in the sparsely populated rural, remote and mountainous areas of the country. I hope that the integration of eye care into general health care system of the government of Nepal at the community level, for which the process has already been started, will be very fruitful in achieving it.

I thank all those involved in the important task of prevention and control of blindness in Nepal averting huge socio- economic burden to the nation and contributing to quality of life of the needy individuals by providing them with vision, hope, self respect, economic independence and social acceptance.

I also thank those involved in bringing out this report and hope this report will prove a milestone in the history of eye care like the Nepal Blindness Survey of 1981, by providing concrete evidence-based fresh baseline information which will be very helpful in planning future eye care service of Nepal.

.....

Dr Reeta Gurung
President

Date. 12 DEC. 2012

तमसोमा ज्योतिर्गमय

नेपाल नेत्रज्योति संघ

NEPAL NETRA JYOTI SANGH

(National Society for Comprehensive Eye Care)

CENTRAL OFFICE

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Foreword and acknowledgements

The Nepal Blindness survey (NBS) conducted in 1981 was the major millestone in the history of eye care service of Nepal for the first time which showed that the magnitude of blindness was of public health significance and requires utmost priority for the intervention. The human resource and service infrastructure at that time was not capable enough to deal with the magnitude of the problem. Considering the situation the Public Private Partnership in eye care was adopted and many INGOs and NGOs were involved in this battle against the blindness in Nepal. The result of NBS 1981 was the evidence which motivated to develop master plan for eye care service in Nepal. Advocacy in the basis of survey result brought many international INGOs forward to support Nepal's Eye Care Programme. As a result rapid extensive development of eye care infrastructure and technology, human resource and delivery of service took place based on the need of country identified in 1981.

It was felt necessary to reassess the situation of blindness and impact of services after three decade of eye care service delivery and one decade of launching of Vision 2020 in Nepal. Nepal Netra Jyoti Sangh took the initiation in partnership with Tilganga Institute of Opthalmology for reassessing the situation of blindness adopting the Rapid Assessment of Avoidable Blindness (RAAB) method for blindness survey in the country.

This report is the result of an ambitious project to document achievements of the eye care programme in Nepal since its inception in 1981. Starting in 2006, population-based surveys were conducted in every zone of Nepal to assess the actual situation on blindness and visual impairment. The last zones were completed by the end of 2010.

The report of these surveys shows that the overall prevalence of blindness has reduced to 0.35% compared to that of 0.84% in 1981. This is a commendable achievement made by the eye care programmes of Nepal.

We thank Dr Hans Limburg, MD, PhD, DCEH who conceptualised the methodology of RAAB survey and is the main architect of this kind of survey, who also trained the survey team in Nepal and provided consistent

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support from survey designing to report writing including compilation of different survey reports making it the national data and carried out the enormous work.

We are greatly indebted to all the ophthalmologists, optometrists and ophthalmic assistants (listed in Annex 3) who travelled to all the corners of the country to interview and examine people for this study. Without their commitment, dedication and perseverance, this enormous task could not have been accomplished. Together they covered nearly all districts of Nepal and examined 39,908 persons of age 50 years and older.

We also thank the survey supervisors Mr. Y.D. Sapkota and Mr Bimal Poudyal from NNJS and Mr. Mohan Krishna Shrestha from Tilganga Institute of Ophthalmology. Their work ensured that the quality of the field work was outstanding and the coverage very high. We are also grateful to Dr Tirtha Mishra, Secretary General, Dr G P Pokharel, Member of NNJS Central Executive Board, Mr. Sailesh Mishra, Programme Director, NNJS for their support in resource mobilization and Mr. Bhabani Prasad Pant, Ophthalmic Officer NNJS for his support in preparation and write-up of the report and all NNJS staff and NNJS board for their persistent support from survey designing to report writing.

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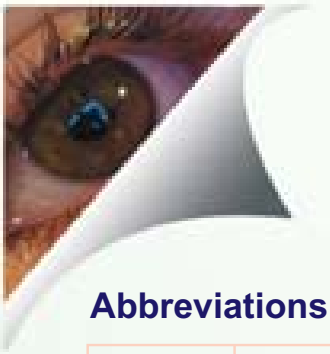
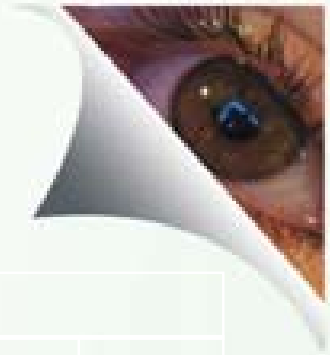


Abbreviations

ARMD	Age Related Macular Degeneration
BCVA	Best Corrected Visual Acuity
Blind	VA<3/60 with available correction
CBSN	Central Bureau of Statistics, Nepal
CNS	Central Nervous System
CSC	Cataract Surgical Coverage
CSR	Cataract Surgical Rate: Number of cataract operations per million population per year
DR	Diabetic Retinopathy
EPI	Expanded Programme of Immunisation
GoN	Government of Nepal
ICCE	Intra-capsular Cataract Extraction
IDB	International Database – demographic data from US Census Bureau
IOL	Intra-ocular lens
MVI	Moderate Visual impairment – presenting VA <6/18 – 6/60
NAMS	National Academy of Medical Sciences
NBS	Nepal Blindness Survey
NGO	Non-governmental organisation
NNJS	Nepal Netra Jyoti Sangh
Phaco	Cataract surgery with phaco-emulsification and aspiration technique
PVA	Presenting Visual Acuity
RAAB	Rapid Assessment of Avoidable Blindness
SICS	Small Incision Cataract Surgery
SVI	Severe Visual Impairment – presenting VA <6/60 – 3/60
TUTH	Tribhuwan University Teaching Hospital
U5MR	Under 5 Year Mortality Rate
VA	Visual Acuity
VAD	Vitamin A Deficiency
WHO	World Health Organization



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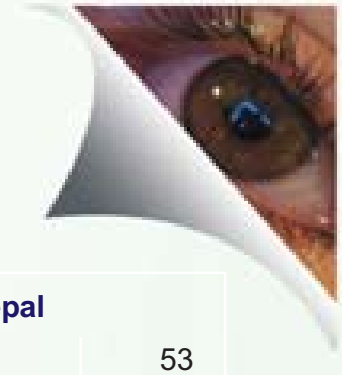

Summary

Nepal is one of the first countries where a nation-wide population-based survey on blindness and visual impairment was done in 1980-81. A total of 39,887 people of all ages were examined. Results from this survey helped to mobilise support and to build an elaborate eye care infrastructure in the country.

Between 2006 and 2010, population based surveys on blindness and visual impairment were conducted in all 14 zones of Nepal. Customised blindness surveys were conducted in Gandaki, Lumbini and Narayani Zone, while in the other 11 zones the rapid assessment of avoidable blindness (RAAB) methodology was used. In total, 39,908 people aged 50 years and older were examined. The main purpose of these surveys was to assess the prevalence of blindness and visual impairment, to compare the present situation of blindness and visual impairment with the findings of the Nepal Blindness Survey (NBS) in 1981, to evaluate the achievement and the impact of the eye care system and to provide baseline data for future planning of eye care services in Nepal.

The eye care infrastructure in 1981 was minimal, with only one eye hospital and 4 eye departments in general hospital for the entire country. In 2010, there were 20 dedicated eye hospitals, 19 eye departments and 63 primary eye care centres. The number of ophthalmologists increased from 7 to 147.

The number of cataract operations increased from 1,000 in 1981 to more than 200,000 in 2010. However, majority of the cataract operations are performed on people from outside Nepal, mainly Indians, and around 45% (90,000) on Nepali citizens.

The impact of the expansion of eye care services between 1981 and 2011 is best visible in the reduction of the prevalence of blindness and visual impairment. In actual numbers the achievements are far less outspoken because the number of people aged 50+ more than doubled between 1981 and 2011 and the life expectancy at birth increased from 48 to 66 years.

The custom survey in Gandaki Zone covered people aged 45 and above but where possible the prevalence was calculated for the age group 50+ specifically. The other two custom surveys and all the RAABs examined people of age 50 years and older only. The reports from the custom surveys differed from those generated by the RAABs, especially on prevalence at different visual acuity levels. Age and sex adjusted prevalence and estimated number of cases with certain conditions were not available for all conditions in the custom surveys. To estimate numbers of affected persons or eyes the sample prevalence was used or extrapolations were made.

For comparison of findings between the NBS (all ages) and the recent surveys (50+ only) assumptions were made which are described in details at the relevant tables.

Blindness

The weighted average sample prevalence of blindness (presenting VA<3/60 in the better eye) in the recent surveys in Nepal was 2.5% (95% CI: 2.3 - 2.6%) in people aged 50 and older. It ranged from 0.8% in Bagmati to 6.9% in Narayani zone (except Chitawan district). The prevalence of severe visual impairment was 3.0% (95%CI: 2.8 - 3.2%) and of moderate visual impairment 11.6% (95%CI: 11.3 - 11.9%).

The age and gender adjusted prevalence of blindness is 2.0% (95%CI: 1.9 - 2.2%) for Nepal, with a range of 0.6% in Bagmati to 6.3% in Narayani zone. The prevalence in males did not differ significantly from that in females.

Compared with the NBS the prevalence of blindness (all ages) reduced from 0.84% in 1981 to an estimated 0.35% in 2011, a reduction of 58%. The number of blind persons reduced from 117,600 in

1981 to an estimated 93,400 persons of all ages in 2010, 20.6% less.

Low vision, requiring low vision services

The prevalence of low vision in people aged 50+ is 1.3% for Nepal and an estimated 35,800 people aged 50+ are affected. The actual number is likely to be much higher since there are also many people below the age of 50 with permanent low vision.

Causes

In the recent surveys, cataract is the main cause of bilateral blindness in all zones, with a weighted average of 62.2% for Nepal. Other causes are posterior segment disease (16.5%), glaucoma (5.9%), corneal scar other than trachoma (5.2%) and uncorrected aphakia (3.4%). Blindness in Nepal is treatable in 66%, preventable in 16% and permanent in 19% of the affected persons. For bilateral blindness at PVA<6/60 cataract blindness is the main cause in 68%, followed by posterior segment disease (11%) and uncorrected refractive errors (9%). At this level 79% of blindness is treatable, 7% preventable and 12% permanent.

Compared with 1981 the proportion of blind eyes due to cataract and to trachoma has reduced. The proportion of blind eyes due to non-trachomatous scarring and phthisis, glaucoma and other posterior segment diseases has increased.

Cataract

The sample prevalence of bilateral cataract blindness with best corrected VA (BCVA) <6/60 in people aged 50+ was available for all zones. The weighted average prevalence for Nepal was 3.2% (95% CI: 3.0 - 3.4%), 2.8% for males and 3.5% for females. For this VA the prevalence in males was significantly lower (p<0.0001) than in females.

The sample prevalence of bilateral cataract blindness with BCVA<3/60 in Nepal was 1.0% (95% CI: 0.9 - 1.1%). For this level no data were available for Gandaki, Lumbini and Narayani zone.

Age and sex adjusted data on bilateral blindness and visual impairment were not available for Gandaki, Lumbini and Narayani zones. Where possible the sample prevalence was used or extrapolations were made to get the most realistic estimates. The prevalence of people with bilateral cataract was 1.3% for BCVA<3/60, 3.1% for BCVA<6/60 and 8.5% for BCVA<6/18. In entire Nepal, an estimated 35,900 people aged 50+ are blind due to cataract, 86,500 cannot see 6/60 and 239,700 cannot see 6/18 in the better eye. In the NBS, an estimated 87,500 people were blind due to cataract, 140,800 could not see 6/60 and 256,900 could not see 6/18 in the better eye. The number of patients with advanced cataract blindness has reduced by about half while the number of patients with early bilateral cataract increased by 70%.

Cataract Surgical Coverage (CSC)

The CSC in persons in Nepal is high with 85% at VA<3/60, 70% at VA<6/60 and 54% at VA<6/18. The variation between zones ranges from 37% (VA<6/60) in Narayani to 94% in Bagmati zone. The CSC in eyes is lower with 67% at VA<3/60, 58% at VA<6/60 and 39% at VA<6/18. This indicates that many people are happy with one operated eye. CSC in females in most zones is lower than in males but this is not significant. The coverage in Bagmati, Rapti and Karnali zones is so high that cataract blindness is controlled there. This is a great improvement compared to 1981 when the CSC in persons at VA<3/60 was estimated at 35% for Nepal.

Visual outcome after cataract surgery

In 1981, intra-capsular cataract extraction (ICCE) with aphakic spectacles was the standard surgical technique. In 1981, more than half of the operated patients were functionally blind due to lost or

unreplaced glasses. Today more than 90% of all cataract operations in Nepal are with IOL implantation and the majority with Small Incision Cataract Surgery (SICS) or phaco. In the recent surveys, 85% had and IOL implanted which also resulted in an improvement of the visual outcome: 64% can see 6/18 or better with available correction, 20% can see 6/60 and 16% cannot see 6/60. This outcome can be improved even further with adequate optical correction and implantation of IOLs with the correct power.

Majority of people are operated in NGO hospitals (63%) and in eye camps (25%), far less in Government hospitals (6%) or in private hospitals (5%)

Barriers to cataract surgery

In Nepal, 'Cannot afford' is the major barrier to surgery in people bilaterally blind (VA<6/60) due to cataract with 23%. It is followed by 'No company' (18%), 'Unaware of treatment' (15%), 'Old age, no need' (12%), 'No services' and 'Contra-indications' (5%), 'Wait for maturity', 'How to get surgery' and 'Fear of operation'(5%), 'No time'(3%) and the remaining causes, each by 1%. However, the variation in barriers between the different zones is high. 'Cannot afford' is a rather uncommon barrier in Karnali, Kosi and Rapti Zones.

In 1981, 34% of patients indicated that 'Cannot afford' was the main barrier, followed by 'Unaware of treatment' (19%) and 'How to get surgery' (11%).

Trachoma

The recent surveys indicate that trachomatous corneal scarring causes 1.0% of all bilateral blindness in Nepal in people aged 50+, around 850 cases. It occurs only in Mahakali & Seti, in Janakpur and in Karnali zone (4.2%, 2.6% and 2.5% respectively). In terms of blind eyes, trachomatous scarring is the main cause in Bheri in 1.1%, in Janakpur in 1.5%, in Karnali in 2.2% in Mahakali and Seti in 1.7% and in Sagarmatha in 0.4%. It causes 0.6% of all blind eyes. No data are available for Gandaki, Lumbini and Narayani.

In 1981, trachoma was the second major cause of blindness in females with 4% (2822 females). No blind males due to trachoma were seen.

Childhood blindness

Childhood blindness was not covered in the recent surveys because these focussed on people aged 50+ only. However, there is a relation between the under 5 year mortality rate (U5MR) and the prevalence of childhood blindness. The U5MR reduced from 142 in 1990 to 48 in 2011. Using U5MR as a proxy, this suggests that the prevalence of childhood blindness reduced from 0.68% in 1981 to 0.4% in 2011. Extrapolated to the corresponding population, the number of blind children reduced slightly from 4,300 to 4,100.

Prognoses for future

The population of Nepal is growing by about 1.4% per year. The number of children aged 0-14 reduces slightly after 2011; the number of people aged 15-49 also gradually reduces and the proportion of people aged 50+ continues to increase by 30-40% per decade. Besides that, the average life expectancy also increased from 48 in 1981 to 66 in 2011. The annual increase in output of the eye care programme in Nepal has to be in the range of 10-15% to compensate for the annual increase for ageing trend (4%), the increased life expectancy (5%) and the increased demand for better vision (5%).

Conclusions

- There has been an enormous expansion of infrastructure, equipment and human resources for eye care services throughout Nepal between 1981 and 2011

- Eye care services are not integrated in general health care services and provide limited coverage of remote rural areas. Coverage is insufficient in a number of zones.
- There is too much emphasis on financial sustainability and less attention for reduction of avoidable blindness in Nepal
- The number of cataract operations is high, but 64% is on foreign patients
- Eye care in Nepal is mainly driven by NGOs, there is little involvement by GoN.
- The capacity of the eye care programme is sufficient but needs further expansion to cater for future needs
- The prevalence of blinding trachoma has reduced

Recommendations:

1. Integration of eye care and general health programmes at district and zonal level.
   a. Primary eye care service should be provisioned at community level
   b. Cataract surgical services should be available in all district headquarter of the country
   c. Develop referral network between grassroots level eye care service to district level eye care services in collaboration with non governmental organizations.
2. The eye care programme of Nepal should focus on the elimination of avoidable blindness in Nepal.
   a. Focus on the needs of local population
   b. Expand eye care services to rural communities: vision testing and cataract identification service should be available in all village level health institutions
   c. Increase the number of cataract operations on Nepali citizens
3. Decentralise the eye care programme to the zones.
   a. Develop VISION 2020 action plans for each zone
   b. This should change local competition into local cooperation
   c. Provide possibilities to use local solutions to local problems
   d. Extra inputs to zones that have less developed eye care services
4. Develop adequate infrastructure to provide optical services throughout Nepal.
   a. Refraction and optical dispensing service should be expanded to constituent to reduce uncorrected refractive errors
5. Experiment with special programmes to control blindness from Diabetic Retinopathy and Glaucoma.
   a. Actual prevalence of Diabetes and Diabetic Retinopathy need to revealed and mapping
   b. Glaucoma identification service need to be expanded to district level eye care programme

Chapter 1. Introduction

1.1 Eye care in Nepal

Nepal is one of the first countries in the world where a country-wide population-based survey on blindness and visual impairment was conducted (1980-'81). At that time the eye care facilities in Nepal were minimal and the needs were huge. There was a great need to know the magnitude of blindness and visual impairment, the main causes and to understand the epidemiology in order to develop adequate plans to prevent and control blindness.

The impact of this study was enormous. Within 20 years the eye care infrastructure in Nepal developed from a very basic level to one of the most advanced and efficient systems in the world.

History of eye care programme in Nepal

In 1980, the Government of Nepal (GoN) and the World Health Organization (WHO) launched the Nepal National Programme for Prevention and Control of Blindness. At that time, there were 7 ophthalmologists in Nepal and 16 eye beds in Kathmandu, and around 1000 surgeries were performed annually. One of the first activities was to initiate the Nepal Blindness Study of 1981. With the results of this study, advocacy generated a flood of donor assistance to develop eye care services in Nepal. Initially, all funds were routed through the WHO, charging 13% overheads.

To avoid this, international donors started to work directly with national NGOs.

The period between 1980 and the mid Nineties saw the rapid expansion of eye care infrastructure, training of human resources and increase of input and output of eye health care.

With the influx of massive support for eye care, and overburdened by other serious health problems that had to be solved without any assistance, the Government of Nepal gradually withdrew from eye care and left it to the NGOs. The role of the GoN in eye care gradually declined and now reached a stage where it has very little role in eye care.

Against this background VISION 2020: The Right to Sight was launched on 19 November 1999 with the Secretary of Health as the chairman of the Apex Body for Eye Health in Nepal.

Nepal Netra Jyoti Sangh (NNJS)

Nepal Netra Jyoti Sangh (NNJS) was established in 1978 as a National Society for Comprehensive Eye Care under the Health Co-ordination Committee of the Social Services National Co-ordination Council. Later, it was strengthened in 1980 as a full-fledged non-governmental social welfare organization dedicated to facilitate an easy approach to provide all the possible facilities with regard to the treatment of eye patients in Nepal. The NNJS extends its co-operations towards the application and fulfilment of National Program and Policies of Government of Nepal aimed at the well being of the eye patients. The NNJS is a non-profit making, non-governmental, welfare oriented social organization to represent Government of Nepal and the Social Welfare Council of Nepal in the sphere of eye care activities.

The NNJS is a central coordinating body for technical manpower and maintains links with eye hospitals and eye care centres, Government of Nepal and both national and international non-governmental organizations with regard to almost all of the eye related programs and quality control of eye care in Nepal. It plays a significant role in the evaluation and monitoring of the existing programs, mobilizes internal and external resources, involves active community participation and promotes self-reliance.

The main objectives of NNJS are:

- To reduce the avoidable blindness below 0.5 % (PVA<6/60) and below 0.3% (PVA<3/60)

prevalence rate by clearing the backlog.

- To reduce incidence rate of preventable blindness by creating awareness in eye health and health seeking behaviour.
- To establish adequate and sustainable eye care infrastructure, enabling more accessible and affordable service.
- To create sufficient human resource in eye care.
- To establish international linkage keeping update the indigenous technology with recent development and advancement in eye care.
- To establish quality assurance system in eye care service delivery system

Main activities of the eye care programme

In 2011, there are 14 Eye Hospitals and 52 Primary Eye Care Centres running under the umbrella of NNJS. About 90% of eye care services of Nepal are delivered through the service network of NNJS. There are national level vertical programme such as National Trachoma Programme, National Low Vision Programme, National Eye Health Education Programme running under NNJS.

Tilganga Institute of Ophthalmology:

Tilganga Institute of Ophthalmology (TIO), the implementing body of Nepal Eye Program, is a non-profit, community-based non-governmental organization that is committed to providing quality ophthalmic care to the people of Nepal and developing nations. The TIO incorporates three principal divisions: the Comprehensive Quality Eye Services (Surgicentre, Eye Bank and Outreach programs), the Ophthalmic Products (Fred Hollows Intraocular Lens Manufacturing) and the production of Human Resources for Eye Health (Education/Training and Research). TIO was established in June 1994 by the name of Tilganga Eye Centre, which since April 2009, has been recognized as the Tilganga Institute of Ophthalmology.

Up to 2011, TIO had examined 2.7 million patients and performed 0.2 million surgeries in its premises and at the Hetauda Community Eye Hospital, Community Eye Centres and Outreach Clinics. This Institute produced more than 500 skilled human resources at different levels through academic and training programs. Fred Hollows Intra-ocular Lens Laboratory, as the first and only intra-ocular lens manufacturing unit in Nepal, has made cataract surgery affordable for the local and global markets. The Nepal Eye Bank has been helping to reduce incidents of corneal blindness. TIO is helping globally through innovation and the formulation of new clinical practices that are published in papers, indexing in journals and dissemination at different international events. TIO is one of the growing organizations in Nepal. As a member of the Apex Body for Eye Health in Nepal, TIO is involved in different activities towards achieving the goals of Vision 2020 in Nepal and in extending its services domestically and internationally through partnership with national and international organizations.

Cataract surgery

The total output of cataract surgery has increased from 93,300 in 2001 to 197,900 in 2009. The number of operations on Nepali patients was 31,400 (33.6%) in 2001 and 80,500 (40.1%) in 2009. The remaining operations were conducted on Indian patients.

The capacity for cataract surgery is huge but cataract remains the major cause of avoidable blindness and visual impairment in Nepal. Obviously, eye care services in Nepal are affordable and acceptable for many Indians who have to travel far, while many Nepali citizens with cataract are confronted with many barriers. Costs are a major barrier, while, ironically, recent research demonstrated that cataract

surgery will significantly improve the socio-economic situation of the patients as well as the direct family.[1]

Trachoma control

Since the launching of the National Trachoma Control Programme in 2002, 10.6 million doses of Zithromax have been administered and blindness has been averted in 15,161 persons through trichiasis surgery. The prevalence of active trachoma has been reduced from 8.6% to 5%, but not yet in all endemic areas. There is still a backlog of an estimated 35,000 unoperated trichiasis cases.

Vitamin A supplementation

Vitamin A supplementation was started nearly two decades ago and still relies on distribution of Vitamin A capsules to the population at risk like pregnant women and young children. As the coverage increased to 90% the nutritional blindness declined significantly. However, blinding xerophthalmia still occurs in food deficit areas. Milder forms of VAD also occur in older children. A change in policy to fortify essential food products with Vitamin A has so far not been materialised. The dependency on foreign drugs remains high while local alternatives are available. VAD control should become an integral part of the nutrition and food security policy of Nepal.

Refractive errors

Refractive error has emerged as the commonest cause of ocular morbidity and a significant cause of visual impairment. The need for adequate refractive correction, including presbyopia, is high.

Integration of eye care into general health care

The success of eye care in Nepal has at the same time its weakest spot. The eye care programme runs as a parallel system and is independent of the general health system. It is not a part of the extensive network of general health care services up to the ward level and hence fewer referrals take place through that network.

1.2 Earlier surveys

Several studies on blindness and visual impairment have been conducted in Nepal. The best known is the Nepal Blindness Survey (NBS) 1981.[2] This is probably the most comprehensive and best documented blindness surveys ever and was the starting point of the development of the eye care programme in Nepal.

In 1995, a population-based study was conducted in Lumbini and Bheri zones, after local eye hospitals had been established in each of these zones in 1985 and 1983 respectively. The study aimed to estimate the prevalence of blindness and assess the impact of the Lumbini and Bheri eye care programmes on cataract blindness.[3]

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[1] *Polack S, Kuper H. The Cataract Impact Study. Summary report. London, UK: International Centre for Eye Health, London School of Hygiene & Topical Medicine; 2010. Available from: https://www.iceh.org.uk/display/WEB/Cataract+impact+study*

[2] *Brilliant GE, Pokhrel RP, Grasset NC, et al. The epidemiology of blindness in Nepal: Report of the 1981 Nepal Blindness Survey. Chelsea, MI: The Seva Foundation, 1988, Chelsea, USA*

[3] *G P Pokharel, G Regmi, S K Shrestha, A D Negrel, L B Ellwein. Prevalence of blindness and cataract surgery in Nepal. Br J Ophthalmol 1998;82:600–605*

Table 1. Earlier blindness surveys in Nepal

SURVEY YEAR	1981 [1]	1995 [2]
Sample size	39,887 (all ages)	5,112 (45+)
Sampling unit	Households	Households
Zones	All 14 zones	Lumbini, Bheri
Total no. of clusters	105 x 380	48 x 100
Coverage	93.5%	90.0%
Causes of blindness		
1. Cataract	66.8	66.4
2. Posterior segment	13.9	3,1
3. Glaucoma	3.2	1.7
4. Trachoma (CO)	2.4	2.9
5. Other corneal scars	8.4	0.8
6. Refractive error	0.0	6.6
7. Other	5.3	18.5
Bilateral Blindness (age group)	5.4% (50+)	3.0% (45+)
Bilateral Blindness (in whole population)	0.84%	
Cataract Surgical Coverage <3/60	35%	58%
Cataract Surgical Coverage <6/60		42%

The prevalence of blindness has reduced slightly from 5.4% in 1981 to 3.0% in 1995 in population aged 45+ years. The cataract surgical coverage increased from 44% to 58% suggesting that the improvement, if any, was mainly caused by the increase in cataract surgery.

1.3 Definitions

The definition of blindness used in Nepal differs from the definition used by the WHO. Both use presenting visual acuity (with available correction) as basis for their definition, but in Nepal the threshold is at 6/60, where as the WHO in the ICD-10 uses 3/60 (Table 2).

According to the ICD-10, blindness is defined as best corrected visual acuity <3/60 in the better eye, or a visual field restricted to less than 10 degrees around the visual axis.

When using the ICD-10 definition for blindness, uncorrected refractive errors are not included. Since that is a major reason for visual impairment the WHO now advises to measure both pinhole visual acuity, as a substitute for best corrected visual acuity (BCVA), as well as presenting visual acuity (PVA). Assessment of visual fields is very difficult and time consuming under field conditions and therefore often omitted in population-based surveys.

Table 2. Categories of visual impairment used in Nepal surveys and by WHO definition

Distance visual acuity with available correction		
Presenting Visual Acuity	**Categories WHO**	**Categories Nepal**
Can see 6/18 or better	Mild or no visual impairment 0	Mild or no visual impairment
Cannot see 6/18, can see 6/60	Moderate visual impairment 1	Visual impairment
Cannot see 6/60, can see 3/60	Severe visual impairment 2	Blindness (Economic Blindness)
Cannot see 3/60, can see 1/60	Blindness 3	Blindness (Social Blindness)
Cannot see 1/60, light perception	Blindness 4	Blindness (Manifest Blindness)
No light perception	Blindness 5	Blindness (Absolute Blindness)

By using presenting visual acuity, uncorrected refractive errors are also included in the prevalence of blindness and visual impairment. This is in line with the latest WHO recommendation.[4]

In this report, the definitions according to the WHO are used to facilitate the comparison of results internationally. Where necessary the prevalence of best corrected visual acuity <3/60 or blindness according to the Nepal definition is also provided to make comparison with earlier surveys possible. Visual acuity levels are indicated where needed.

The visual field has not been measured in any of the surveys presented here due to logistic constraints. It may therefore be possible that people with severely restricted visual fields but intact central vision, like in late stages of glaucoma, have not been qualified as visually impaired or blind. The estimates presented in this report may therefore give an under-estimate of the actual situation.

In the RAABs, prevalence for presenting visual acuity (PVA) and best corrected visual acuity (BCVA) are given for PVA<3/60 as well as PVA<6/60. In the three custom surveys from Gandaki, Lumbini and Narayani zones the definitions are mixed and some results are not comparable with those from RAAB.

1.4 Development of the Nepal eye care programme

The eye care programme in Nepal was in very rudimentary stage three decades ago. There were only 7 ophthalmologists in the whole country, nearly all of them based in Kathmandu, for approximately 15 million population. In 1974, with public support, the first eye hospital of Nepal, the Nepal Eye Hospital, was established in Kathmandu.

The Nepal Prevention and Control of Blindness Project, in collaboration with the Government of Nepal and the World Health Organization, was established in 1980. The project conducted a nationwide blindness survey as initial bench mark for the national eye care programme in 1981. The Nepal Blindness Survey (1981) demonstrated that blindness was a major public health problem in the country. The Government eye care infrastructure and human resources were not sufficient to cope with this huge magnitude of blindness, and support from various national and international organizations was solicited to develop an adequate eye care system in the country.

Nepal Netra Jyoti Sangh (National Society for comprehensive eye care) a non-governmental organization,

[4] *WHO Change the Definition of Blindness.*

was the pioneer non-governmental organization to take a lead in this combat against blindness in Nepal. Nepal Netra Jyoti Sangh (NNJS), established in 1978 with the aim to create an extensive eye care network in the country, was able to deliver comprehensive eye care service to all sections of people in Nepal, irrespective of race, cast or income. The Government of Nepal then placed most of its eye care programme and its manpower under NNJS management in early 1980. The NNJS thus became responsible to develop eye care services in Nepal, including the coordination of services by different partner organizations in various part of the country.

A geographical approach was adopted and all supporting I/NGOs were given responsibility to develop the eye care services in specified area(s) under the umbrella of the NNJS. Specific program objectives, based on the NBS survey results, were defined and Nepal began to build the physical and human infrastructure necessary to address the problem. Primary, secondary and tertiary eye care facilities dedicated to the prevention and treatment of eye diseases were established in the areas of the country with greatest need. The program simultaneously implemented a strategy of training eye care professionals at all levels to staff the hospitals and clinics as they became operational. The initial master plan for eye care in Nepal focused on capacity building in eye care such as development of infrastructure and human resource to clear the huge backlog of blindness in the country.

Tilganga Eye Centre, another NGO established in 1990, also developed as an institute of ophthalmology, at present covering the need of eye care services at the central and eastern regions of the country. It has its base hospital in Kathmandu, a community hospital in Hetauda and has a network of 9 community eye care centres at district level.

Another NGO involved in eye care services are Lions Clubs. They are running an eye hospital in Kathmandu and contribute to surgical eye camps and other community eye care services, mainly focussed on cataract surgical services.

Nepal Red Cross Society also runs an eye hospital in Janakpurdham, eastern terai of Nepal and shoulders the partnership for various community based eye care programme.

Mechi Eye Hospital in the eastern region of the country is run by a separate NGO called Mechi Eye Hospital Sangh. (Table 3)

Table 3. Infrastructure development in the eye care services in Nepal

Item	1980	2000	2010
Eye units of general hospitals	4	-	19
Eye Hospitals	1	17	21
Eye Beds	50	2000	4000
Primary Eye Care Centres	0	40	63
Cataract operations / year (Nepalese population)	1,000	40,385	>90,000
Ophthalmic consultations/year (Nepalese population)	10,000	884,635	>1,500,000
Functional Eye Bank	0	1	1
National programs for training Ophthalmologists	0	1	6
National programs for training Ophthalmic Assistants	0	1	4
Ophthalmic drug production	1	2	5
IOL factory	0	0	1
National program for training optometrists	0	1	1

The ophthalmic assistant training was initiated by the Government of Nepal in 1981. In 1988 Tribhuwan University Teaching Hospital (TUTH) started MD Ophthalmology courses. At present there are four institutions training ophthalmic assistants with an annual output of 40 to 60 graduates. TUTH produces 6 ophthalmologists per year. In 2003 the National Academy of Medical Sciences (NAMS) also started the intake of MD Ophthalmology. NAMS is now producing on average 16 ophthalmologists per year. (Table 4)

Table 4. Development of human resources for eye care

Human Resource category	1980	2000	2010
Ophthalmologists	7	76	147
Optometrist	0	5	56
Ophthalmic assistants	0	161	275
Eye workers	0	0	205
Orthoptician	1	3	8

Nepal launched its Vision 2020 program in 1999 with the then Minister of Health and the current President of Nepal Dr Ram Baran Yadav signing the declaration of support in the presence of the then Prime Minister Hon'ble Krishna Prasad Bhattarai.

After the launching of VISION 2020 in the country, the Apex Body for Eye Health (Prevention of Blindness Committee) was formed at the Ministry of Health and Population.

The composition of the Committee is as following:

1. Secretary, Ministry of Health and Population, — Chairperson
2. Chief, Policy, Planning and Foreign AID Division, — Member Secretary
3. Director General Of Health Services, — Member
4. Chairman Nepal Netra Jyoti Sangh, — Member
5. Director Tilganga Eye Centre, — Member
6. President , Nepal Ophthalmic Society, — Member
7. Representative WHO, — Member
8. Director, B. P. Koirala Lions Centre for Ophthalmic Studies, — Member
9. Director, Nepal Eye Hospital, — Member
10. Head of Eye Department, Military Hospital, — Member

The main responsibilities of the Apex Body for Eye Health are:

1. To formulate and implement a national eye care policy and program to achieve the goal of VISION 2020: The Right To Sight.
2. To act as directing, facilitating and coordinating authority on eye care.
3. To encourage technical cooperation between member organizations for eye care.
4. To ensure equitable access to eye care services.

Strategic plan 2000-2019

A sub-committee constituted by the Apex Body for Eye Health prepared a document outlining a 20-year plan through several planning meetings and an intensive workshop during August 4-6, 2001. The plan was adopted in a national workshop on eye care held from September 19-21, 2001.

This long-term plan proposes activities to reduce the disease burden (blindness), to control specific diseases, to strengthen human resource development, to develop infrastructure and technology and

to strengthen coordination, advocacy, information and resources for Vision 2020.

In 2011 a mid-term review of VISION 2020 Nepal was conducted. It revealed that the prevalence of blindness reduced from 0.84% in 1981 to 0.39% in 2010, but the number of blind persons remained the same, despite the impressive expansion of the eye care facilities and human resources. This is mainly due to population growth and increase of the life expectancy, but also to a large extent by the case selection of the patients..

The main conclusions of this review are:

- eye care in Nepal is disease-oriented, is specialist-centered and technology driven;
- the eye hospitals largely depend on income from cataract surgery. More than 50% of the cataract operations are performed on foreign patients who come to the hospital by themselves and hardly any efforts are made to reach the Nepali population with more difficult access;
- no integration with general health care services limits adequate referrals and access to eye care;
- basic eye care facilities are hardly available beyond district headquarters;
- there are limited facilities to address the increase in uncorrected refractive errors;
- use of eye care services by women is low while two-third of all blindness is in women;

The major recommendations are that eye care services in Nepal should be re-oriented towards prevention and control of blindness and visual impairment as a development issue. Hospitals and NGOs working in eye care should work in partnership. The Government of Nepal should take ownership for eye care again and start the process of integrating eye care in to the overall health care system.

1.5 Performance of the Nepal eye care programme

Table 5 shows the number of cataract operations performed between 1995 and 2010 in entire Nepal on Nepali citizens. The actual number of cataract operations performed in the eye hospitals and eye camps in Nepal is much higher, but 70 to 75% of all operations are done on citizens from India.

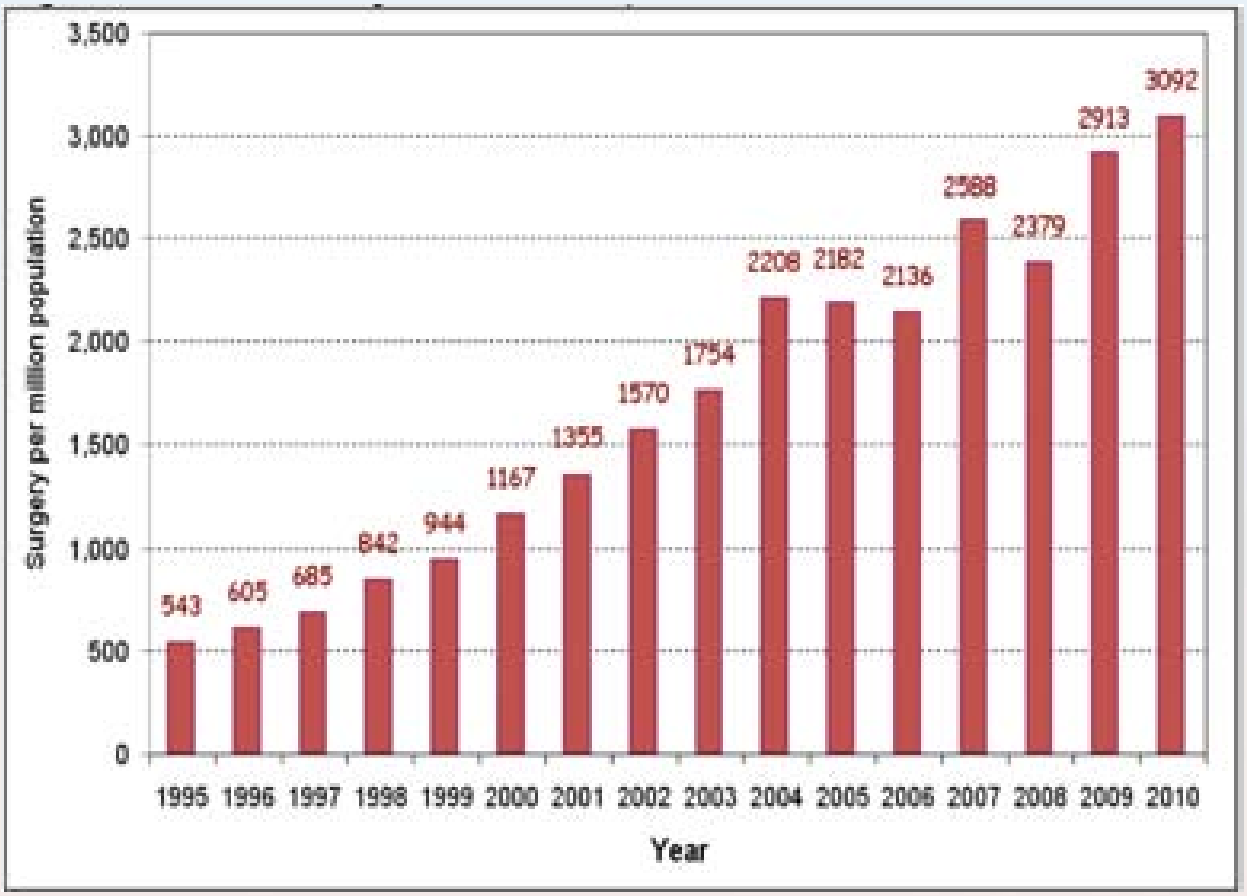
Figure 1 shows the increase in the CSR for the Nepali population only.

Table 5. Cataract operations in Nepal since 1995

	All cataract	On Nepali population		
Year	operations	Cataract	Population	CSR
1995		11,002	20,244,193	543
1996		12,535	20,703,737	605
1997		14,505	21,173,711	685
1998		18,238	21,652,237	842
1999		20,892	22,141,578	944
2000		26,413	22,641,978	1167
2001	93,298	31,370	23,151,423	1355
2002	113,368	37,154	23,672,329	1570
2003	127,233	42,444	24,200,222	1754
2004	143,728	54,629	24,739,887	2208
2005		55,178	25,291,586	2182
2006		55,220	25,855,589	2136
2007	149,210	68,418	26,432,168	2588
2008		64,296	27,021,606	2379
2009	197,885	80,456	27,624,188	2913
2010		87,324	28,240,207	3092

The annual increase of the cataract surgical rate (CSR) in Nepali patients only is clearly visible from Figure 1.

Figure 1. Cataract Surgical Rate in Nepal from 1995 to 2010



Chapter 2. Survey design

2.1 Population of Nepal

Population data for Nepal are not available from one source and not always consistent.

The Central Bureau of Statistics in Nepal (CBSN) conducts a national census every 10 years. The latest census was carried out in 2011, but at this moment only preliminary data for the whole country are available. Population data by 5-year age group and by sex for each district and zone are available for 2001.[5] But the sum of the population in the 14 zones (22,798,134) differs from the total population given for Nepal in 2001 (23,151,423). These differences may have been caused by the civil unrest at the time of the census as in some districts it was not possible to complete the census.

Bilateral Cataract blind detected in Survey

Another source of population data is the International Database (IDB) from the US Census Bureau. This website provides population data and population projections for all countries in the world, including a breakup by 5-year age group and by sex. The population data for Nepal from the IDB are higher than those from the CBSN: the population for 2001 is given as 23,151,423 by the CBSN against 25,335,614 by the IDB, a difference of nearly 9%. For 2011 the IDB indicates a total population of 29,391,883 while the preliminary data just released by the CBSN indicate 26,620,809 (9.1% less), with 1,917,903 Nepalese living abroad.

In the RAABs that were conducted between 2008 and 2010, data from the 2001 national census were used because age and sex specific projections of the population by zone were not available for the years in between. This may have caused underestimates of the actual number of people and eyes (50+) that were affected. In order to get more realistic estimates of the situation today the age and sex specific population data from the International Database (IDB) were used for the year 2011.

Figure 2. Distribution of population by district in Nepal

[5] *Central Bureau of Statistics, Nepal. http://www.cbs.gov.np*
[6] *International Data Base, US Census Bureau http://www.census.gov/population/international/data/idb/country.php*

The geographical distribution of the population in Nepal varies strongly. The population density is very high in the urban centres, while there are vast areas in the mountains with only a few persons per square kilometre. The trends indicate that the population of the urban centres and in the plains of the Terai is increasing much faster than in the more remote mountain areas. The map with the distribution of population by district is shown in Figure 2.

Important demographic and health indicators from the past and projections for the future are shown in table 6.

Table 6. Health indicators for Nepal

	1981	1991	2001	2011	2021	2031
Midyear population (x1,000)	15,011	19,448	25,336	26,621	34,699	39,314
Growth rate	2.4	2.8	2	1.6	1.4	1.1
Life expectancy at birth	48	55	63	67	69	72
Infant mortality rate	114	92	61	45	32	23
Under 5 mortality rate	189	135	79	48	40	28
% expenditure on health			5.1	6.0		
Measles vaccination coverage	2	57	71	86		
Vitamin A distribution	-	-	95	97		
HDI	0.242	0.340	0.398	0.485		

2.2 Survey designs

Custom blindness surveys in Gandaki (2002), Lumbini (2006) and Narayani zone (2006):

In the Gandaki survey of 2002, 4,365 eligible people were recruited from three districts: Kaski, Lamjung and Syangja. The other three districts in this zone (Gorkha, Manang and Tanahu) were not sampled. The survey design and selection of clusters was similar to the procedure used in the Lumbini and Bheri zone in 1995 and according to standardized and accepted protocols. This survey used separate enumeration of eligible persons, a central examination site and a cluster size of 170-350 persons, much larger than the cluster size of 50 used in the RAABs. This was compensated for by an assumed Design Effect of 2.0, which is much higher than in RAAB. Residents of 45 years of age and older were eligible. The surveys in Lumbini and Narayani zone conducted in 2006 followed the same methodology but examined residents of 50 years and older.

The survey team consisted of one ophthalmologist, two ophthalmic assistants, and one interviewer. Eligible persons were examined with a retro-illuminated tumbling E chart, direct ophthalmoscope, streak retinoscope, handheld slit lamp and a Perkins handheld tonometer.

Rapid assessment of avoidable blindness (RAAB):

RAAB uses sound epidemiological methods to collect data on the magnitude and causes of blindness and visual impairment. RAAB focuses on the prevalence of the main causes of avoidable blindness in the VISION 2020 programme, like cataract, refractive errors, trachoma, onchocerciasis, and childhood blindness. This is because the aim of VISION 2020: The Right to Sight is to eliminate the avoidable blindness by the year 2020. But also other causes of blindness are recorded. The main purpose of RAAB is to provide baseline data on blindness to design and plan new intervention programmes and to monitor ongoing eye care programmes in the surveyed area.

RAAB is rapid, because it only includes the over-50 age group, where the prevalence is highest, so that sample size requirements are minimised. RAAB is simple, because it uses straightforward sampling and examination techniques, and data analysis is automatic though the software and does not require

a statistician. RAAB is relatively cheap, as it does not require separate enumeration of eligible persons prior to the examination, the eye examination can be completed in a few minutes only, it does not require expensive ophthalmic equipment, and can be carried out by local staff. A RAAB is ideally carried out at the level of a district or province that has a population size of 0.5 to 5 million people. The sample size required for a RAAB is usually between 2,000 and 5,000 people. The sample size needed for the survey is calculated using an automated programme within the RAAB software package. The sample size is largely determined by the expected prevalence of blindness in the area, which can be estimated from existing surveys or from the WHO estimates for the region. RAAB uses a standard cluster size of 50 eligible people and one cluster can be completed by one team in one day.

All eligible people undergo a standardised ophthalmic examination at their households. The team measures a distance of 3 and 6 meters with a rope or tape, marking these on the floor. Visual acuity (VA) is measured with a Snellen tumbling E chart, using optotype size 18 (60) on one side and size 60 (200) on the other side at a 6 or 3 metre distance. Each eye is tested with available correction (presenting visual acuity = PVA) and with pinhole correction, as a proxy for best corrected visual acuity (BCVA). This allows each eye to be classified as:

- can see 6/18
- cannot see 6/18 but can see 6/60
- cannot see 6/60 but can see 3/60
- cannot see 3/60 but can see 1/60
- light perception
- no light perception.

The classification above is with available correction (PVA) as well as with best correction (BCVA). The visual acuity in the person is determined by the VA in the better eye.

The lens status of all participants is assessed by torch and by distant direct ophthalmoscopy, by an ophthalmologist in a shaded or dark environment. All eyes that cannot see 6/18 with available correction are examined with a direct ophthalmoscope and a portable slit lamp, to assess the cause of the visual impairment. Only the primary cause of blindness or visual impairment is recorded. If there are two or more primary disorders, equally contributing to the visual loss, then the WHO convention is to record the cause that is easiest to treat or to prevent. All information is recorded on a standardised form. People who have a vision-impairing cataract are asked why they have not undergone cataract surgery, and up to two responses are marked per person in pre-coded categories. Those who have undergone cataract surgery are asked about the details of their operation (e.g. place, age, type of operation, satisfaction). People with a treatable eye condition are referred for appropriate treatment. The following automated data analyses are performed on the cleaned data set:

- prevalence of blindness, severe (SVI), and moderate visual impairment (MVI)
- age- and sex-adjusted prevalence of blindness, SVI, and MVI
- prevalence of avoidable blindness, SVI, and MVI
- causes of blindness, SVI, and MVI
- cataract surgical coverage
- outcome after cataract surgery
- causes of poor outcome
- barriers to uptake of cataract surgery.

All tables report results for men and women separately, as well as together.

The results from the RAAB can be used to develop a VISION 2020 action plan, to plan the cataract surgical services required, for instance, or to identify problems, such as poor outcomes after surgery or significant barriers to surgery, so that strategies can be developed to increase the efficiency, quality and output of the programme. RAAB can be repeated every 5-10 years to monitor ongoing programmes.

The RAAB methodology was used in the remaining 11 zones. Survey teams of Tilganga Eye Centre and of Nepal Netra Jyoti Sangh were trained in March 2008 in two separate sessions. These teams subsequently implemented RAAB surveys in the 11 zones between 2008 and 2010.

Figure 3 shows the map of Nepal and the location of the different zones.

Figure 3. Map of Nepal showing all zones

Table 7 shows the population in each of the zones in 2001 and in 2011 (preliminary data CBSN). The total population of Nepal increased by 15% in 10 years. The changes by zone show considerable variation, from an increase of 27.9% in Bagmati zone to a reduction of 2.1% in Dhawalagiri zone.

Table 7. Population by zone in 2001 and 2011 (preliminary data for 2011 CBSN)

	Population 2001			Population 2011			Decadal
Area	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**	**change**
Bagmati	3,008,487	1,536,172	1,472,315	3,849,011	1,940,826	1,908,185	27.9%
Bheri	1,417,085	712,336	704,749	1,716,467	842,075	874,392	21.1%
Dhawalagiri	556,191	257,828	298,363	544,615	243,351	301,264	-2.1%
Gandaki	1,487,954	698,249	789,705	1,554,069	710,569	843,500	4.4%
Janakpur	2,557,004	1,306,605	1,250,399	2,871,577	1,418,130	1,453,447	12.3%
Karnali	309,084	156,984	152,100	393,374	198,156	195,218	27.3%
Kosi	2,110,664	1,050,813	1,059,851	2,325,243	1,119,703	1,205,540	10.2%
Lumbini	2,526,868	1,242,093	1,284,775	2,846,506	1,352,075	1,494,431	12.6%
Mahakali	860,475	426,204	434,271	971,438	461,091	510,347	12.9%
Mechi	1,307,669	649,356	658,313	1,433,369	684,735	748,634	9.6%
Narayani	2,466,138	1,266,282	1,199,856	2,993,114	1,509,176	1,483,938	21.4%
Rapti	1,286,806	631,206	655,600	1,474,545	689,928	784,617	14.6%
Sagarmatha	1,926,143	970,453	955,690	2,075,570	1,001,467	1,074,103	7.8%
Seti	1,330,855	659,340	671,515	1,571,911	756,149	815,762	18.1%
Nepal	**23,151,423**	**11,563,921**	**11,587,502**	**26,620,809**	**12,927,431**	**13,693,378**	**15.0%**

Table 8 shows when the different surveys were conducted in the 14 zones, as well as the sample size and the coverage. The sample size varied in each zone as it was calculated on the basis of the expected prevalence of blindness in that particular zone. In some of the very remote and scarcely populated districts, the sample size was deliberately kept low in order to keep the burden to the survey teams acceptable. The three custom surveys have larger samples because they used larger clusters (170 – 200 persons) requiring higher design effects and therefore larger sample sizes.

All surveys combined, a total of 39,908 persons were examined. In Gandaki Zone, residents aged 45 years or older were sampled. In all other zones residents of randomly selected clusters aged 50 years and older were sampled. The coverage ranged between 85.3% (Gandaki and Narayani zone) and 99.7% (Dhawalagiri and Mechi zone).

Table 8. Period of survey, type of survey, sample size and coverage

Zone	Start	End	Type	Sample size	Examined	Coverage
Bagmati	2008 - 3	2008 - 7	RAAB	2,050	1,908	93.1%
Bheri	2009 - 4	2009 - 6	RAAB	3,049	2,993	98.2%
Dhawalagiri	2010 - 9	2010 - 9	RAAB	3,000	2,990	99.7%
Gandaki *	2002 - 9	2002 - 12	Custom	5,863	5,002	85.3%
Janakpur	2008 - 5	2008 - 6	RAAB	1,800	1,705	94.7%
Karnali	2008 - 4	2008 - 10	RAAB	1,197	1,171	97.8%
Kosi	2008 - 7	2009 - 4	RAAB	3,050	2,895	94.9%
Lumbini	2006 - 9	2006 - 12	Custom	5,916	5,138	86.8%
Mahakali + Seti	2008 - 4	2008 - 10	RAAB	2,751	2,513	91.3%
Mechi	2009 - 9	2009 - 12	RAAB	3,050	3,041	99.7%
Narayani	2006 - 4	2006 - 12	Custom	5,533	4,717	85.3%
Rapti	2010 - 3	2010 - 3	RAAB	2,998	2,921	97.4%
Sagarmatha	2008 - 5	2009 - 3	RAAB	3,050	2,914	95.5%
Nepal				**43,307**	**39,908**	**92.2%**

*: 45 years and older

A few surveys combined fieldwork more than 1 zone. The surveys in Bagmati and Janakpur zone were conducted as one study. The data were separated by zone afterwards and analysed separately. Also Karnali, Mahakali and Seti were conducted as one study. Karnali was analysed separately, but Mahakali and Seti were considered together as one.

The survey in Gandaki covered Kaski, Tanahu and Syangja districts; Gorkha, Manang and Lamjung district were not included.

The survey in Narayani zone only covered Rautahat district; Bara, Makwanpur and Parsa districts were not covered and Chitwan district was included in the survey of Lumbini zone.

The survey in Lumbini covered all districts in that zone plus Chitwan district in Narayani zone.

The survey in Karnali zone did not cover Dolpa and Humla district.

Because Mahakali and Seti Zone were combined, these are shown as one zone and the population is the combined population of the two zones. Similarly, for Lumbini Zone, the population of Chitawan District is included, while the population of the same district is excluded from Narayani Zone.

Table 9 shows the districts included in the sample. It also indicates the sample design (number of clusters x cluster size).

Table 9. Sample design and districts sampled in each zone

Zones	Design	Districts covered
1. Bagmati	41 x 50	Bhaktapur, Dhading, Kathmandu, Kavrepalanchok, Lalitpur, Nuwakot, Rasuwa, Sindhupalchok
2. Bheri	61 x 50	Banke, Bardiya, Dailekh, Jajarkot, Surkhet
3. Dhaulagiri	60 x 50	Baglung, Mustang, Myagdi, Parbat
4. Gandaki	25 x 175	Kaski, Syangja, Tanahu *(Gorkha, Manang and Lamjung not covered)*
5. Janakpur	36 x 50	Dhanusa, Dolakha, Mahottari, Ramechhap, Sarlahi, Sindhuli
6. Karnali	24 x 50	Jumla, Kalikot, Mugu *(Dolpa and Humla not covered)*
7. Koshi	61 x 50	Bhojpur, Dhankuta, Morang, Sankhuwasabha, Sunsari, Terhathum
8. Lumbini	32 x 175	Arghakhanchi, Gulmi, Kapilvastu, Nawalparasi, Palpa, Rupandehi, Chitwan
9. Mahakali + Seti	54 x 50	Baitadi, Dadeldhura, Darchula, Kanchanpur, Achham, Bajhang, Bajura, Doti, Kailali
10. Mechi	61 x 50	Ilam, Jhapa, Panchthar, Taplejung
11. Narayani	32 x 175	Rautahat *(Bara, Makwanpur, Parsa and Chitwan not covered)*
12. Rapti	60 x 50	Dang Deukhuri, Pyuthan, Rolpa, Rukum, Salyan
13. Sagarmatha	61 x 50	Khotang, Okhaldhunga, Saptari, Siraha, Solukhumbu, Udayapur,

2.3 Selection of clusters and subjects for the sample

Selection of clusters and subjects in three custom surveys (Gandaki, Lumbini and Narayani Zone)

For each survey sampling clusters were created by grouping adjacent village wards with less than 850 people and subdividing those with more than 1700 people into segments, so that each sampling frame cluster had between 850 and 1700 people. The sampling frame contained nearly 1000 of such clusters. The sample size was calculated based on an estimated cataract blindness prevalence (VA <6/60) of 8% with a maximum error of 15% with 95% confidence. With an expected examination participation rate of 85% and a Design Effect of 2.0, the required sample size was 4619. Then 25 clusters were randomly selected from Gandaki and 32 each from Lumbini and Narayani Zones. Each selected cluster would contain approximately 170–340 people aged 45 years or older in Gandaki zone and 50 years or older in Lumbini and Narayani zones.

After that, house to house enumeration of all eligible people aged 45 (50) years or older (who were living permanently in the cluster for at least the last 6 months) was carried out in each of the selected clusters. All enumerated people were invited for eye examinations in a central location. Subjects physically unable to come to the examination site were offered an examination at home.

Treatment of minor ocular conditions was provided at the examination site free of charge. Those who required cataract surgery were referred to the nearby eye hospital for free surgery.

Selection of clusters and subjects in the 11 RAABs

For each RAAB a sampling frame was made of all wards in that zone with the population in each ward, according to the latest national census from 2001. In each zone the required number of wards was selected by systematic sampling, using a special module in the RAAB software. This ensures that the

random selection of wards is done with a probability proportional to the size of the population of each ward.

From each selected ward, 50 residents aged 50 years and older were selected using the compact segment sampling methodology. This means that the selected ward was divided in segments of approximately equal population, enough to provide 50 residents aged 50+. With approximately 13% of the population aged 50+, a group of 50 / 13% = 385 residents of all ages is likely to have 50 residents aged 50+ in their midst.

For easy calculation we advised to work with segments of around 400 people of all ages. The average population per ward was around 700. Larger wards were subdivided in smaller segments of approximately 400 residents. When a ward was selected with less than 400 inhabitants, the geographically 'next nearest' ward was selected to complete the examination of 50 subjects.

In case of larger wards that had to be subdivided into several segment, the next step was to check the map of the ward at the local office and to mark out the segments on the map, each with a number. Then ballot papers were made with corresponding numbers, these were folded and tossed and the village headman was invited to draw two ballots: the first number for the segment of the ward where all households were visited to find the 50 eligible residents for examination. The second ballot was to be used in case the first segment would not provide all 50 people for the cluster.

Within the selected segment of the ward the survey team went door-to-door to all households in that segment to find eligible people and asked them to be examined. If they refused, or were not found at home, efforts were made to revisit them. People who were absent for a long time or kept refusing were included in the survey, and were not replaced by others who happened to be at home. The team continued in the same segment until 50 forms were completed.

Treatment of minor ocular conditions was provided at the examination site free of charge. Those who required cataract surgery were referred to the nearby eye hospital for free surgery.

Ethnic differences

Information on the ethnic background of the subjects was not included in the recent population-based studies. Hence no information is available about the relation between ethnic background and prevalence of visual impairment in Nepal.

Geographical conditions

Information on the geographical location of the subjects (terai, hills or mountains) was included in the three custom surveys, but not in the RAAB survey format. Hence these data are too limited to assess a possible relation between geographical conditions and visual impairment in Nepal.

2.4 Weighting factors

The weighting factors are calculated on the basis of the total population of all districts in each zone. With exception of the districts listed in table 10, all zones in Nepal are included in the surveys. The population aged 50+ varied between 19,424 in Karnali and 389,776 in Lumbini (including Chitwan district). Obviously, the results of Lumbini zone should carry more weight in the national average than the results from Karnali. For this purpose weighting factors were calculated which are used in the calculation of the weighted average prevalence for Nepal as a whole. The weighting factor is the number of the people (males; females) aged 50+ in the zone divided by the number of the people (males; females) aged 50+ in entire Nepal.

As shown in Table 10, the results of Lumbini count 20 times heavier (13.71 / 0.68 = 20.2) than those of Karnali zone. In the calculations of these weighting factors we have used the total population of all districts in that zone, even if some districts were not sampled. The reason is that it is assumed that the prevalence of blindness and other indicators from that survey are valid for all districts in that zone. The second reason is that extrapolations are made to the total population of the zone to estimate the actual number of cases with the various conditions. The only exception is Lumbini, where the survey

also included Chitwan district in Narayani zone, which was not included in the survey in Narayani in the same year. The population aged 50+ of Chitwan district was added to the 50+ population of the other districts in Lumbini zone and it was not included in the 50+ population of Narayani zone.

Table 10. Weighting factors for 14 zones (based on population data 2001)

	Number of people aged 50+			Weighting factors		
Zone	**Males**	**Females**	**Total**	**Males**	**Females**	**Total**
Bagmati	189,754	180,538	370,292	12.99%	13.05%	13.02%
Bheri	91,536	80,987	172,523	6.27%	5.85%	6.07%
Dhawalagiri	40,039	42,031	85,937	2.87%	3.18%	3.02%
Gandaki	112,330	118,812	231,142	7.69%	8.59%	8.13%
Janakpur	165,819	151,696	317,515	11.35%	10.97%	11.16%
Karnali	10,392	9,032	19,424	0.71%	0.65%	0.68%
Kosi	134,111	129,670	263,781	9.18%	9.37%	9.28%
Lumbini	201,232	188,544	389,776	13.78%	13.63%	13.71%
Mahakali + Seti	125,871	125,098	250,969	8.62%	9.04%	8.82%
Mechi	82,638	76,501	159,139	5.66%	5.53%	5.60%
Narayani	123,362	108,303	231,665	8.45%	7.83%	8.15%
Rapti	64,873	60,570	125,443	4.44%	4.38%	4.41%
Sagarmatha	116,841	109,542	226,383	8.00%	7.92%	7.96%
Nepal	**1,460,693**	**1,383,296**	**2,843,989**	**100.00%**	**100.00%**	**100.00%**

The sample size varied considerably between the zones. (Table 10) This has no direct influence on the value of the average estimate for entire Nepal, but will be expressed in the variation around the estimate (the 95% Confidence Interval) in the individual zones.

Since only 8 out of the 74 districts were not included we may extrapolate the weighted average to the total population of the country. The calculation of the total number of cases for entire Nepal is based on this assumption.

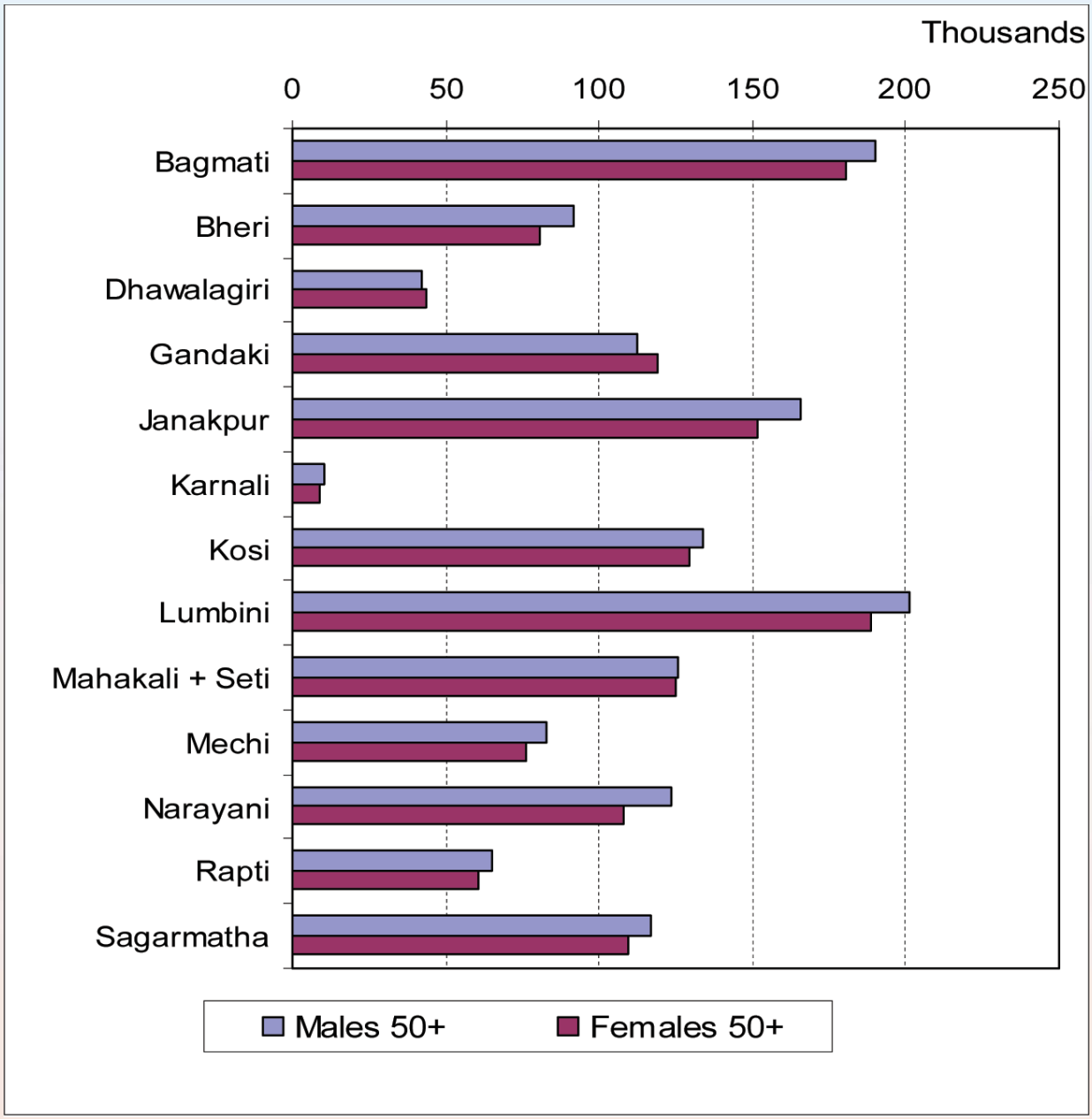
To calculate the weighted average, the prevalence of a condition in each of the 13 zones is multiplied by the weighing factor of the corresponding zone and the sum of these resulting coefficients is the national weighted average for that condition.

The weighted average for all 13 zones is representative for entire Nepal. With a total sample size of 39,908 the accuracy of the national estimates will be very high.

Figure 4 shows the number of males and females by zone, based on the 2001 national census. In most zones males outnumber females, except in Dhawalagiri and Gandaki zones.

Visual acuity examination at house in survey

Figure 4. Males and females aged 50+ by zone (2001 census)



Chapter 3. Findings of recent surveys

3.1 Sample results from surveys per zone and for Nepal

Definitions of blindness and visual impairment in this report use the standard WHO categories. The findings of the Gandaki survey are, as much as possible, calculated for the age group 50+ to make them comparable with the other surveys. If data are not available the fields are left empty in the tables; when calculated differently this is indicated in a footnote. It is assumed that the prevalence found in zones where not all districts were sampled is representative for the entire zone, including the districts that were not sampled.

The sample size in each of the 14 zones differed. This will affect the precision of the estimate, as indicated by the 95% Confidence Interval (95% CI) for each of the results in the different zones. Table 9 shows the sample size and the coverage in each zone.

Table 11 shows the number of cases seen with bilateral blindness and the sample prevalence of bilateral blindness in people aged 50+ (pinhole VA<3/60 in the better eye) for all 14 zones. A weighted prevalence estimate is also calculated for the whole of Nepal.

Table 11. Prevalence of bilateral blindness in sample (pinhole VA<3/60 in the better eye)

	Males		Females		Total		
Zone	**n**	**%**	**n**	**%**	**n**	**%**	**95% CI**
Bagmati	8	0.9%	7	0.7%	15	0.8%	(0.4 - 1.2%)
Bheri	39	2.7%	62	4.0%	101	3.4%	(2.5 - 4.2%)
Dhawalagiri	13	0.9%	15	0.9%	28	0.9%	(0.6 - 1.3%)
Gandaki	15	0.9%	25	1.2%	40	1.1%	(0.8 - 1.4%)
Janakpur	14	1.8%	20	2.2%	34	2.0%	(1.3 - 2.7%)
Karnali	7	1.1%	12	2.3%	19	1.6%	(0.9 - 2.4%)
Kosi	22	1.6%	44	2.8%	66	2.3%	(1.7 - 2.9%)
Lumbini	44	1.8%	42	1.6%	86	1.7%	(1.3 - 2.1%)
Mahakali + Seti	28	2.4%	39	2.9%	67	2.7%	(1.7 - 3.6%)
Mechi	30	1.9%	36	2.5%	66	2.2%	(1.6 - 2.7%)
Narayani	120	5.6%	181	7.1%	301	6.4%	(5.0 - 7.8%)
Rapti	14	1.0%	18	1.2%	32	1.1%	(0.7 - 1.6%)
Sagarmatha	11	0.8%	25	1.6%	36	1.2%	(0.7 - 1.8%)
Nepal (weighted)	**365**	**1.9%**	**526**	**2.3%**	**891**	**2.1%**	**(2.0 - 2.3%)**

The sample prevalence of bilateral blindness (pinhole VA<3/60 in the better eye) in people aged 50+ ranged from 0.8% in Bagmati Zone to 6.4% in Narayani Zone. In males the prevalence varied from 0.8% in Sagarmatha Zone to 5.6% in Narayani Zone, in females from 0.7% in Bagmati Zone to 7.1% in Narayani Zone. The weighted average prevalence of blindness for Nepal is 2.1%; 1.9% for males and 2.3% for females. The difference in prevalence of blindness between males and females is not significant in any zone.

The high prevalence of blindness in Narayani Zone (actually only Rautahat District) is striking. The investigators attribute this high prevalence to a combination of factors: the high incidence of cataract in the Terai area, the high level of illiteracy in the population surveyed (93.1%), the low cataract surgical coverage (37.3%), and the unsatisfactory visual outcome of cataract operations. Besides that the civil

[7] *Sapkota YD, Sunuwar M, Naito T, Akura J, Adhikari HK. The Prevalence of Blindness and Cataract Surgery in Rautahat District, Nepal. Ophthalmic Epidemiology, 2010;17:82–89*

unrest during that period may also have restricted people with cataract blindness to travel to the local hospital for eye care services.[7] The coverage of the survey is the lowest in this district, together with Gandaki (85.3%).

The sample prevalence of bilateral blindness with available correction (presenting VA<3/60 in the better eye) in people aged 50+ ranged from 0.8% in Bagmati Zone to 6.9% in Narayani Zone. In males the prevalence varied from 0.8% in Sagarmatha Zone to 5.9% in Narayani Zone, in females from 0.7% in Bagmati Zone to 7.7% in Narayani Zone. The weighted average prevalence of blindness for Nepal 2.4%; 2.1% for males and 2.7% for females. Also here the prevalence in Narayani zone is nearly twice as high as in the second highest, Bheri zone. (Table 12)

Table 12. Prevalence of bilateral blindness in sample (presenting VA<3/60 in the better eye)

	Males		Females		Total		
Zone	**n**	**%**	**n**	**%**	**n**	**%**	**95% CI**
Bagmati	8	0.9%	7	0.7%	15	0.8%	(0.4 - 1.2%)
Bheri	43	2.9%	68	4.4%	111	3.7%	(2.8 - 4.6%)
Dhawalagiri	19	1.4%	23	1.4%	42	1.4%	(0.9 - 1.9%)
Gandaki	28	1.7%	41	2.0%	67	1.8%	(1.4 - 2.1%)
Janakpur	15	1.9%	24	2.6%	39	2.3%	(1.5 - 3.1%)
Karnali	15	2.3%	25	4.8%	40	3.4%	(2.1 - 4.7%)
Kosi	24	1.8%	44	2.8%	68	2.3%	(1.7 - 3.0%)
Lumbini	60	2.5%	57	2.1%	117	2.3%	(1.7 - 2.8%)
Mahakali + Seti	32	2.7%	40	3.0%	72	2.9%	(1.9 - 3.8%)
Mechi	34	2.2%	46	3.1%	80	2.6%	(2.0 - 3.3%)
Narayani	127	5.9%	197	7.7%	324	6.9%	(5.5 - 8.3%)
Rapti	23	1.7%	36	2.3%	59	2.0%	(1.4 - 2.7%)
Sagarmatha	11	0.8%	28	1.8%	39	1.3%	(0.8 - 1.9%)
Nepal (weighted)	**439**	**2.2%**	**636**	**2.7%**	**1,073**	**2.5%**	**(2.3 - 2.6%)**

Table 13 gives the sample prevalence of blindness according to the Nepal definition (PVA < 6/60 in the better eye). Also here the prevalence in Narayani Zone (Rautahat district) is strikingly higher. Figure 5 shows the data from Table 21 in a graph.

Table 13. Prevalence of bilateral blindness in sample (presenting VA<6/60 in the better eye)

	Males		Females		Total		
Zone	**n**	**%**	**n**	**%**	**n**	**%**	**95% CI**
Bagmati	18	2.1%	14	1.3%	32	1.7%	(1.3 - 2.1%)
Bheri	90	6.2%	126	8.2%	216	7.2%	(6.3 - 8.1%)
Dhawalagiri	46	3.3%	54	3.4%	100	3.3%	(2.8 - 3.9%)
Gandaki	53	3.2%	75	3.6%	128	3.4%	(3.1 - 3.7%)
Janakpur	43	5.5%	51	5.5%	94	5.5%	(4.7 - 6.3%)
Karnali	22	3.4%	43	8.2%	65	5.6%	(4.6 - 6.5%)
Kosi	52	3.9%	108	7.0%	160	5.5%	(4.9 - 6.2%)
Lumbini	121	5.0%	116	4.3%	237	4.6%	(4.0 - 5.2%)
Mahakali + Seti	52	4.4%	71	5.3%	123	4.9%	(4.1 - 5.7%)
Mechi	61	3.9%	100	6.8%	161	5.3%	(4.6 - 6.0%)
Narayani	345	16.0%	476	18.6%	821	17.4%	(16.3 - 18.5%)

Rapti	42	3.0%	70	4.6%	112	3.8%	(3.2 - 4.4%)
Sagarmatha	47	3.4%	66	4.3%	113	3.9%	(3.2 - 4.5%)
Nepal (weighted)	**992**	**5.0%**	**1,370**	**5.7%**	**2,362**	**5.5%**	**(5.2 - 5.7%)**

Figure 5. Sample prevalence of bilateral blindness (presenting VA<6/60 in the better eye)

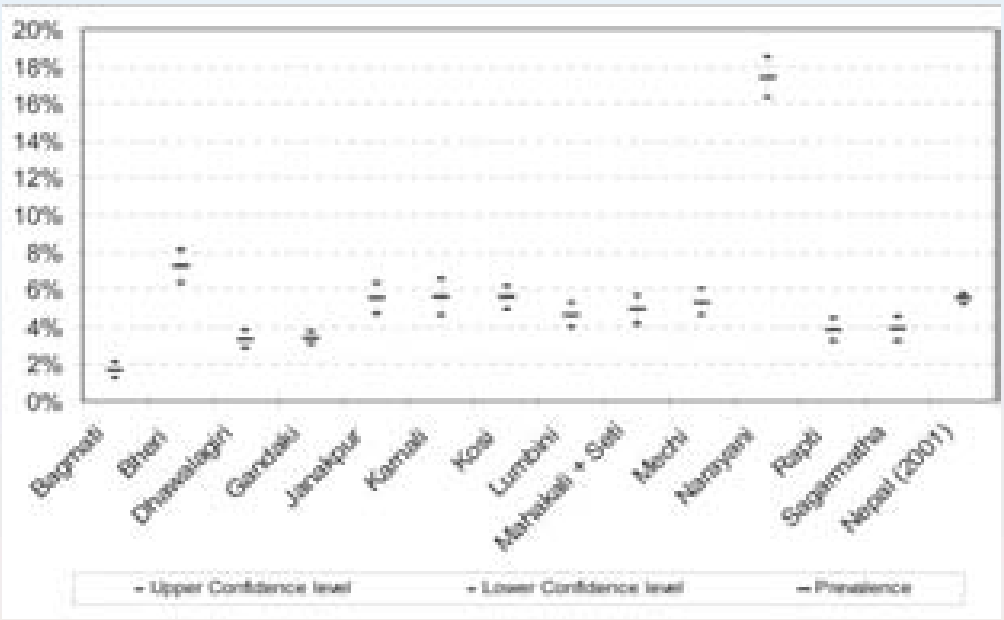


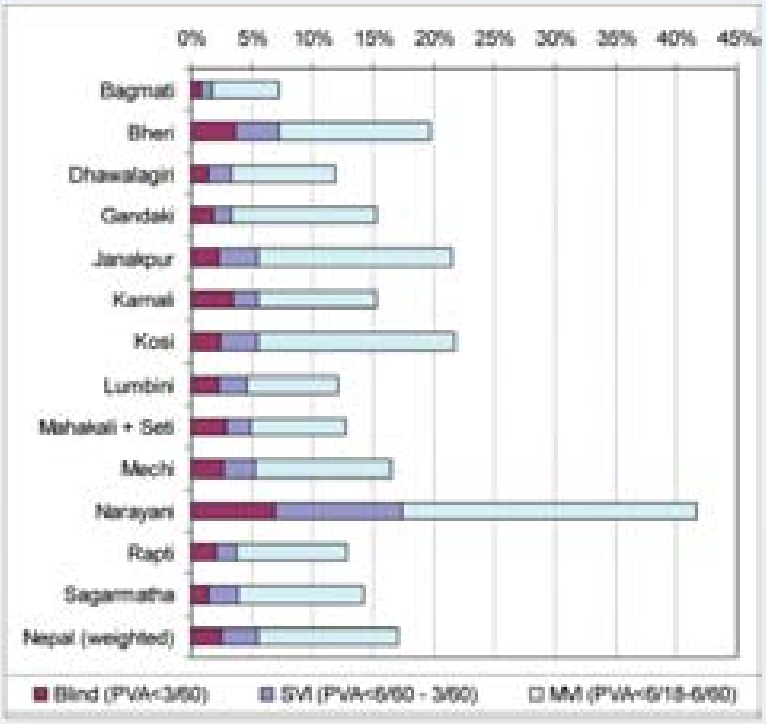
Table 14 Lists the sample prevalence of blindness, severe visual impairment (SVI) and moderate visual impairment (MVI), measured by the presenting VA in the better eye. 17.1% of the population of Nepal is visually impaired with a presenting VA<6/18 in the better eye. The prevalence is lowest in Bagmati zone (7.2%) and highest in Narayani zone (41.7%)

Table 14. Prevalence of blindness, severe (SVI) and moderate visual impairment (MVI) in the sample (PVA in the better eye)

	Blind (PVA<3/60)		SVI (PVA<6/60–3/60)		MVI (PVA<6/18–6/60)		VI (PVA<6/18)
Zone	**n**	**%**	**n**	**%**	**n**	**%**	**%**
Bagmati	15	0.8%	17	0.9%	105	5.5%	7.2%
Bheri	111	3.7%	105	3.5%	374	12.5%	19.7%
Dhawalagiri	42	1.4%	58	1.9%	256	8.6%	11.9%
Gandaki	67	1.8%	59	1.6%	446	11.9%	15.3%
Janakpur	39	2.3%	55	3.2%	274	16.1%	21.6%
Karnali	40	3.4%	25	2.1%	114	9.7%	15.3%
Kosi	68	2.3%	92	3.2%	471	16.3%	21.8%
Lumbini	117	2.3%	120	2.3%	385	7.5%	12.1%
Mahakali + Seti	72	2.9%	51	2.0%	195	7.8%	12.7%
Mechi	80	2.6%	81	2.7%	342	11.2%	16.5%
Narayani	324	6.9%	497	10.5%	1,144	24.3%	41.7%
Rapti	59	2.0%	53	1.8%	261	8.9%	12.8%
Sagarmatha	39	1.3%	74	2.5%	301	10.3%	14.2%
Nepal (weighted)	**1,073**	**2.5%**	**1,287**	**3.0%**	**4,668**	**11.6%**	**17.1%**

The data from table 22 are shown graphically in Figure 6. The high prevalence in Narayani is striking.

Figure 6. Prevalence of blindness, SVI and MVI in the sample



The prevalence of bilateral cataract with pinhole VA<3/60 in the better eye is shown in table 15. This prevalence is not available for Gandaki, Lumini and Narayani zone. The weighted prevalence for Nepal is 1.0%. The lowest prevalence is seen in Bagmati zone (0.3%), the highest in Bheri zone (1.6%).

Table 15. Sample prevalence of bilateral cataract blindness (pinhole VA<3/60 in better eye)

	Males		Females		Total		
Zone	**n**	**%**	**n**	**%**	**n**	**%**	**95% CI**
Bagmati	2	0.2%	3	0.3%	5	0.3%	(0.0% - 0.5%)
Bheri	16	1.1%	31	2.0%	47	1.6%	(1.0% - 2.2%)
Dhawalagiri	7	0.5%	8	0.5%	15	0.5%	(0.3% - 0.7%)
Gandaki *							
Janakpur	7	0.9%	14	1.5%	21	1.2%	(0.7% - 1.8%)
Karnali	3	0.5%	4	0.8%	7	0.6%	(0.2% - 1.1%)
Kosi	10	0.7%	28	1.8%	38	1.3%	(0.9% - 1.7%)
Lumbini *							
Mahakali + Seti	17	1.5%	20	1.5%	37	1.5%	(0.8% - 2.2%)
Mechi	21	1.3%	24	1.6%	45	1.5%	(1.0% - 2.0%)
Narayani *							
Rapti	5	0.4%	8	0.5%	13	0.5%	(0.1% - 0.8%)
Sagarmatha	7	0.5%	19	1.2%	26	0.9%	(0.5% - 1.3%)
Nepal (weighted)	**95**	**0.8%**	**159**	**1.2%**	**254**	**1.0%**	**(0.9% - 1.1%)**

** Only available for PVA<6/60 in the better eye*

Table 16 shows the sample prevalence of bilateral cataract blindness with BCVA<6/60 (Nepal definition of blindness). The lowest prevalence is seen in Bagmati zone (0.5%) and the highest prevalence in Narayani zone (14.9%). The weighted prevalence for Nepal is 3.2%. The prevalence in males was significantly lower (p<0.0001) compared to females.

Table 16. Sample prevalence bilateral cataract blindness (pinhole VA<6/60 in the better eye)

	Males		Females		Total		
Zone	**n**	**%**	**n**	**%**	**n**	**%**	**95% CI**
Bagmati	4	0.5%	5	0.5%	9	0.5%	(0.1% - 0.9%)
Bheri	33	2.3%	49	3.2%	82	2.7%	(1.8% - 3.7%)
Dhawalagiri	13	0.9%	18	1.1%	31	1.0%	(0.5% - 1.5%)
Gandaki	29	1.7%	54	2.6%	83	2.2%	(1.9% - 2.5%)
Janakpur	16	2.0%	29	3.2%	45	2.6%	(1.8% - 3.5%)
Karnali	10	1.5%	11	2.1%	21	1.8%	(0.8% - 2.8%)
Kosi	25	1.9%	68	4.4%	93	3.2%	(2.6% - 3.9%)
Lumbini	69	2.8%	61	2.3%	130	2.5%	(2.1% - 3.0%)
Mahakali + Seti	26	2.2%	33	2.5%	59	2.3%	(1.6% - 3.1%)
Mechi	32	2.0%	53	3.6%	85	2.8%	(2.1% - 3.5%)
Narayani	295	13.7%	406	15.9%	701	14.9%	(13.8% - 16.0%)
Rapti	8	0.6%	25	1.6%	33	1.1%	(0.5% - 1.7%)
Sagarmatha	22	1.6%	38	2.5%	60	2.1%	(1.4% - 2.7%)
Nepal (weighted)	**582**	**2.8%**	**850**	**3.5%**	**1,432**	**3.2%**	**(3.0% - 3.4%)**

3.2 Permanent low vision, requiring low vision services

Table 17 lists the number and prevalence of people aged 50+ in the sample with low vision that cannot be improved with optical correction, surgery or medication. These are people who need counselling, coaching, mobility training and visual aids to function optimally.

If the weighted average prevalence of low vision is extrapolated to the total population aged 50+ in the 14 zones, there would be an estimated 35,900 people aged 50+ affected in Nepal; 18,900 males and 17,000 females. The actual number is likely to be much higher since there are also many people below the age of 50 with permanent low vision.

Table 17. Low vision (Pinhole VA<6/18 in better eye, not due to cataract or refractive error)

	Males		Females		Total	
Zone	**n**	**%**	**n**	**%**	**n**	**%**
Bagmati	10	1.2%	4	0.4%	14	0.7%
Bheri	23	1.6%	28	1.8%	51	1.7%
Dhawalagiri	37	2.7%	24	1.5%	61	2.0%
Gandaki *						
Janakpur	5	0.6%	5	0.5%	10	0.6%
Karnali	2	0.3%	3	0.6%	5	0.4%
Kosi	29	2.2%	40	2.6%	69	2.4%
Lumbini *						
Mahakali + Seti	11	0.9%	14	1.0%	25	1.0%
Mechi	16	1.0%	27	1.8%	43	1.4%

Narayani *						
Rapti	15	1.1%	16	1.0%	31	1.1%
Sagarmatha	20	1.5%	23	1.5%	43	1.5%
Nepal (weighted)	**168**	**1.3%**	**184**	**1.2%**	**352**	**1.3%**

* *No data available*

3.3 Age and sex adjusted prevalence

Most blinding eye diseases are age-related and their prevalence may also differ by sex. Ideally, the age and sex composition of the sample is similar to that of the entire zone where the survey was conducted. In that case the sample is representative for the zone and the sample prevalence is equal to the age and sex adjusted prevalence. However, often the age and sex composition of the sample differs from the actual population. To correct this, and in order to make extrapolations to the actual population in the zone, the RAAB software calculates the age and sex specific prevalence in the sample and multiplies this with the actual population in the corresponding age and sex group of the survey area. The estimated number of cases per age group are added and the sum is divided by the total population aged 50+ for males, females and both sexes together to give the age and sex adjusted prevalence. The adjusted prevalence represents best the actual situation in the survey area.

In the 10 RAABs the age and sex adjusted prevalence is calculated automatically and is shown in the tables below. The age and sex adjusted prevalence has also been extrapolated to the corresponding population groups (aged 50+) to obtain estimates of the number of affected persons. For the three custom surveys these were not available and the sample prevalence for the various levels of VA were used instead. The population data used are from the 2001 national census of Nepal, because this gives data on the population by 5 year age group for individual zones.

Except for Gandaki Zone (2002), all surveys were conducted between 2006 and 2010. The latest national census of 2011 estimated the population aged 50+ in entire Nepal in 2011 at 3.62 million, 30% more as the 2.78 million in 2001. The weighted average adjusted prevalence for Nepal was also extrapolated to the population of 2011 (Nepal 2011) to give the most actual estimate of affected persons or eyes.

In table 18 the age and sex adjusted prevalence of bilateral blindness (pinhole<3/60 in the better eye)in people aged 50+ and the estimated number of cases in each zone are indicated. The highest adjusted prevalence is found in Narayani zone (6.3%), and the lowest in Bagmati Zone (0.6%). The adjusted prevalence in women is in all zones higher than in men, except for Bagmati Zone. The difference, however, is never significant.

Table 18. Adjusted prevalence of bilateral blindness (pinhole VA<3/60 in the better eye) and estimated number of cases (aged 50+)

	Males		Females		Total		
Zone	**n**	**%**	**n**	**%**	**n**	**%**	**Var. (CI 95%)**
Bagmati	1,309	0.7%	1,071	0.6%	2,380	0.6%	(0.2% - 1.1%)
Bheri	1,911	2.4%	2,758	4.0%	4,669	3.2%	(2.3% - 4.0%)
Dhawalagiri	299	0.7%	363	0.8%	662	0.8%	(0.4% - 1.1%)
Gandaki *	1,004	0.9%	1,191	1.2%	2,195	0.9%	(0.6% - 1.2%)
Janakpur	2,817	1.7%	3,774	2.5%	6,591	2.1%	(1.4% - 2.8%)
Karnali	109	1.0%	176	1.9%	285	1.5%	(0.7% - 2.2%)
Kosi	1,690	1.4%	3,233	2.7%	4,923	2.1%	(1.5% - 2.7%)
Lumbini *	3,626	1.8%	2,938	1.6%	6,564	1.7%	(1.3% - 2.1%)
Mahakali + Seti	2,701	2.1%	3,689	2.9%	6,390	2.5%	(1.6% - 3.5%)

Mechi	1,371	1.7%	1,699	2.2%	3,070	1.9%	(1.4% - 2.5%)
Narayani *	6,860	5.6%	7,660	7.1%	14,520	6.3%	(5.6% - 7.0%)
Rapti	582	0.9%	595	1.0%	1,177	0.9%	(0.5% - 1.4%)
Sagarmatha	945	0.8%	1,905	1.6%	2,850	1.2%	(0.6% - 1.7%)
Nepal (2001)	**25,224**	**1.8%**	**31,052**	**2.3%**	**56,276**	**2.0%**	**(1.9% - 2.2%)**
Nepal (2011)	**31,607**	**1.8%**	**41,121**	**2.3%**	**72,469**	**2.0%**	**(1.9% - 2.2%)**

* No adjusted prevalence available. Sample prevalence used instead

The sum of the estimated number of cases from all zones provides a reliable estimate of all people bilaterally blind (pinhole VA<3/60 in the better eye) aged 50+ in entire Nepal and is estimated at 56,300 (95%CI: 52,000 – 60,400) based on the 2001 population. If based on the estimated population aged 50+ for 2011 of 3.62 million, then the number of bilateral blind people aged 50+ in 2011 is estimated at 72,500 (95%CI: 66,900 – 77,800).

The sampling error for the prevalence estimate of that condition in cluster sampling is calculated by the RAAB software, using the formula's provided by Bennett, Woods et al (1991). Bennett S, Woods T, Liyanage WM, Smith DL.A simplified general method for cluster-sample surveys of health in developing countries. World Health Stat Q. 1991;44(3):98-106. This is expressed in the variation around the prevalence (95% Confidence interval) given in Table 18 and 19. In the three custom surveys the sampling error is not available for cluster sampling but is calculated as for simple random sampling.

Because of the difference in sample size in each zone, the variation around the estimate at 95% probability, also known as the precision or accuracy of the estimate, may also vary considerably. In Karnali (sample size 1,197) the variation is much higher (± 1.29%) compared to Bheri Zone (sample size 3049) with a variation of ± 0.88%.

The second factor determining the precision of the estimate is the 'level of homogeneity' of the condition: whether the condition is spread evenly in the community or not. This is expressed as the Design Effect (DEff). If the condition is evenly spread throughout the survey area, DEff approaches 1, If spread more unevenly DEff increases to 2, 3 or even 4. Finally, the cluster size has an influence on DEff. With a cluster size smaller than 20 cluster sampling approaches simple random sampling. With a cluster size of 100 or more, the DEff is in the range of 2 or higher. DEff can only be calculated from the findings of a survey, that means after the survey is completed. Experience from previous RAABs shows that for (cataract) blindness with a cluster size of 50 the DEff is usually around 1.5.

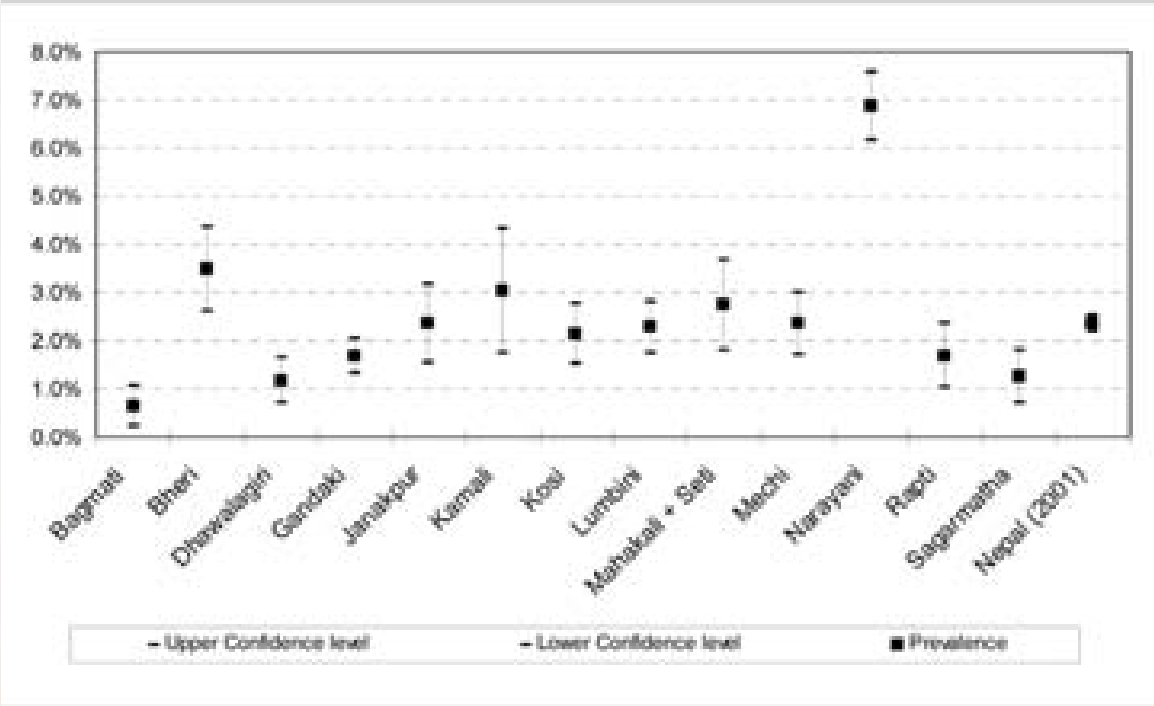
The age and sex adjusted prevalence for presenting VA<3/60 in the better eye (Table 19) is on average nearly 8% (relatively) lower than the sample prevalence. That means that using the sample results would have caused an 8% over-estimation of the magnitude of blindness. This is due to the fact that in all zones relatively more elderly people were seen and less people in the younger age groups, compared to the actual population in the zone.

Table 19. Adjusted prevalence of bilateral blindness (presenting VA<3/60 in the better eye) and estimated number of cases (aged 50+)

	Males		Females		Total		
Zone	**n**	**%**	**n**	**%**	**n**	**%**	**Var. (CI 95%)**
Bagmati	1,309	0.7%	1,071	0.6%	2,380	0.6%	(0.2% - 1.1%)
Bheri	2,124	2.7%	3,030	4.4%	5,154	3.5%	(2.6% - 4.4%)
Dhawalagiri	435	1.0%	566	1.3%	1,001	1.2%	(0.7% - 1.6%)
Gandaki *	1,888	1.7%	1,979	1.7%	3,867	1.7%	(1.3% - 2.0%)
Janakpur	3,020	1.8%	4,446	2.9%	7,466	2.4%	(1.5% - 3.2%)
Karnali	212	2.0%	376	4.2%	588	3.0%	(1.7% - 4.3%)

Kosi	1,839	1.5%	3,233	2.7%	5,072	2.1%	(1.5% - 2.8%)
Lumbini *	4,932	2.5%	3,997	2.1%	8,930	2.3%	(1.8% - 2.8%)
Mahakali + Seti	3,094	2.5%	3,799	3.0%	6,893	2.7%	(1.8% - 3.7%)
Mechi	1,573	1.9%	2,188	2.9%	3,761	2.4%	(1.7% - 3.0%)
Narayani *	7,260	5.9%	8,337	7.7%	15,913	6.9%	(6.2% - 7.6%)
Rapti	897	1.4%	1,218	2.0%	2,115	1.7%	(1.0% - 2.3%)
Sagarmatha	945	0.8%	2,123	1.8%	3,068	1.3%	(0.7% - 1.8%)
Nepal (2001)	**29,528**	**2.1%**	**36,364**	**2.7%**	**66,208**	**2.4%**	**(2.2% - 2.5%)**
Nepal (2011)	**37,001**	**2.1%**	**48,155**	**2.7%**	**85,259**	**2.4%**	**(2.2% - 2.5%)**

Figure 7. Adjusted prevalence of bilateral blindness (PVA<3/60 in the better eye) with 95% CI in people aged 50+



The data from table 19 is also shown in figure 7. The square represents the calculated prevalence and the line the variation around that estimate. It is clearly visible that Narayani Zone has the highest prevalence. The prevalence in Karnali zone is also high and has the widest variation around the estimate because it has the smallest sample size (1,197). The variation around the weighted prevalence in Nepal is very narrow compared to that of the individual zones because of the large (combined) sample size. The width of the variation is also an indicator whether the condition under investigation (blindness) is evenly spread in the population of the zones. When it is spread evenly, the variation is less than when the condition is spread unevenly within the zone.

Table 20 shows the prevalence and the estimated number of cases of bilateral blindness according to the Nepal definition (PVA<6/60 in the better eye) in each zone and in Nepal. This estimate includes patients blind due to refractive errors.

Table 20. Adjusted prevalence of bilateral blindness (PVA<6/60 in the better eye) and estimated number of cases 50+ (Nepal definition)

	Males		Females		Total		
Zone	**n**	**%**	**n**	**%**	**n**	**%**	**Var. (CI 95%)**
Bagmati	2,845	1.5%	2,129	1.2%	4,974	1.3%	(0.9% - 1.7%)
Bheri	4,475	5.7%	5,621	8.1%	10,096	6.8%	(5.9% - 7.7%)
Dhawalagiri	1,102	2.6%	1,320	3.0%	2,422	2.8%	(2.3% - 3.3%)
Gandaki *	3,548	3.2%	4,313	3.6%	7,861	3.4%	(3.1% - 3.7%)
Janakpur	8,856	5.3%	8,953	5.9%	17,809	5.6%	(4.8% - 6.4%)
Karnali	299	2.9%	656	7.3%	955	4.9%	(3.9% - 5.9%)
Kosi	4,154	3.5%	8,051	6.8%	12,205	5.2%	(4.5% - 5.8%)
Lumbini *	9,991	5.0%	8,097	4.3%	18,089	4.6%	(4.1% - 5.2%)
Mahakali + Seti	5,007	4.0%	6,754	5.4%	11,761	4.7%	(3.9% - 5.5%)
Mechi	2,924	3.5%	4,808	6.3%	7,732	4.9%	(4.1% - 5.6%)
Narayani *	19,722	16.0%	20,145	18.6%	39,867	17.2%	(16.4% - 18.0%)
Rapti	1,690	2.6%	2,293	3.8%	3,983	3.2%	(2.6% - 3.8%)
Sagarmatha	3,948	3.2%	5,072	4.3%	9,020	3.7%	(3.1% - 4.4%)
Nepal (2001)	**68,561**	**4.8%**	**78,213**	**5.7%**	**146,774**	**5.2%**	**(5.0% - 5.4%)**
Nepal (2011)	**85,911**	**4.8%**	**103,574**	**5.7%**	**189,008**	**5.2%**	**(5.0% - 5.4%)**

* No adjusted prevalence available. Sample prevalence used instead.

The adjusted prevalence of blindness (PVA<6/60 in the better eye) in Narayani Zone (17.2%) is 13 times higher compared to Bagmati Zone (1.3%). The weighted average adjusted prevalence of blindness (PVA<6/60 in the better eye) is 5.2%. Nearly 146,800 people aged 50+ are estimated to be affected. If extrapolated against the population data in 2011 (census) then 189,000 people aged 50+ cannot see 6/60 in the better eye.

Table 21 shows the adjusted prevalence of moderate visual impairment (MVI). The highest prevalence is found in Narayani Zone (24.3%), and the lowest in Bagmati Zone (4.4%). In entire Nepal there are an estimated 313,100 people affected: 153,500 males and 159,500 females. If extrapolated against the population data in 2011 then 403,200 people aged 50+ have moderate visual impairment in the better eye.

Table 21. Adjusted prevalence of moderate visual impairment (PVA<6/18 – 6/60 in the better eye) and estimated number of cases 50+

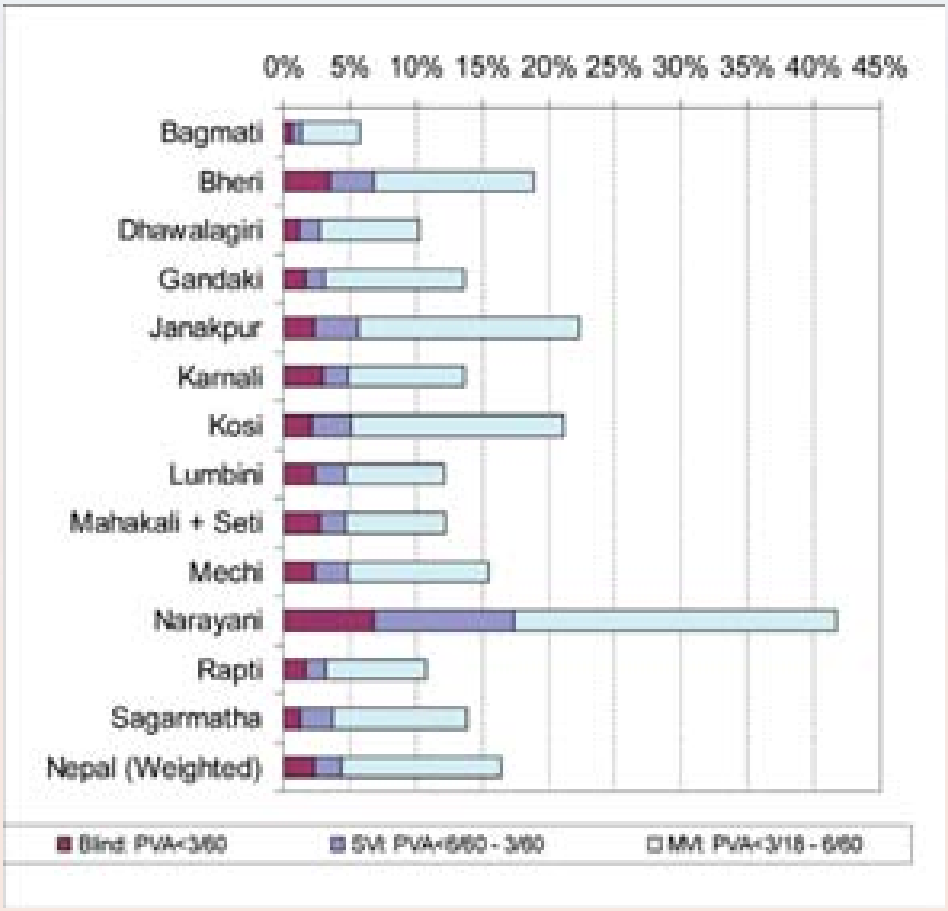
	Males		Females		Total		
Zone	**n**	**%**	**n**	**%**	**n**	**%**	**Var. (CI 95%)**
Bagmati	8,335	4.4%	8,104	4.5%	16,439	4.4%	(3.4% - 5.5%)
Bheri	8,735	11.1%	9,137	13.2%	17,872	12.1%	(10.0% - 14.2%)
Dhawalagiri	2,946	7.0%	3,442	7.8%	6,388	7.4%	(6.1% - 8.7%)
Gandaki *	11,862	10.6%	12,453	10.5%	24,315	10.5%	(9.7% - 11.3%)
Janakpur	26,192	15.8%	26,649	17.6%	52,841	16.6%	(14.3% - 19.0%)
Karnali	606	5.8%	1,089	12.1%	1,695	8.7%	(6.6% - 10.8%)
Kosi	19,118	16.1%	18,700	15.9%	37,818	16.0%	(14.0% - 17.9%)
Lumbini *	15,072	7.5%	14,122	7.5%	29,194	7.5%	(6.8% - 8.2%)
Mahakali + Seti	8,260	6.6%	10,885	8.7%	19,145	7.6%	(6.3% - 9.0%)
Mechi	7,260	8.8%	9,655	12.6%	16,915	10.6%	(9.1% - 12.1%)

Narayani *	29,977	24.3%	26,318	24.3%	56,295	24.3%	(23.0% - 25.6%)
Rapti	4,361	6.7%	5,119	8.5%	9,480	7.6%	(6.2% - 8.9%)
Sagarmatha	10,825	8.7%	13,861	11.7%	24,686	10.2%	(8.2% - 12.1%)
Nepal (2001)	**153,549**	**10.7%**	**159,534**	**11.7%**	**313,083**	**11.1%**	**(10.8% - 11.4%)**
Nepal (2011)	**192,406**	**10.7%**	**211,263**	**11.7%**	**403,172**	**11.1%**	**(10.8% - 11.4%)**

** Estimates based on extrapolations from sample prevalence.*

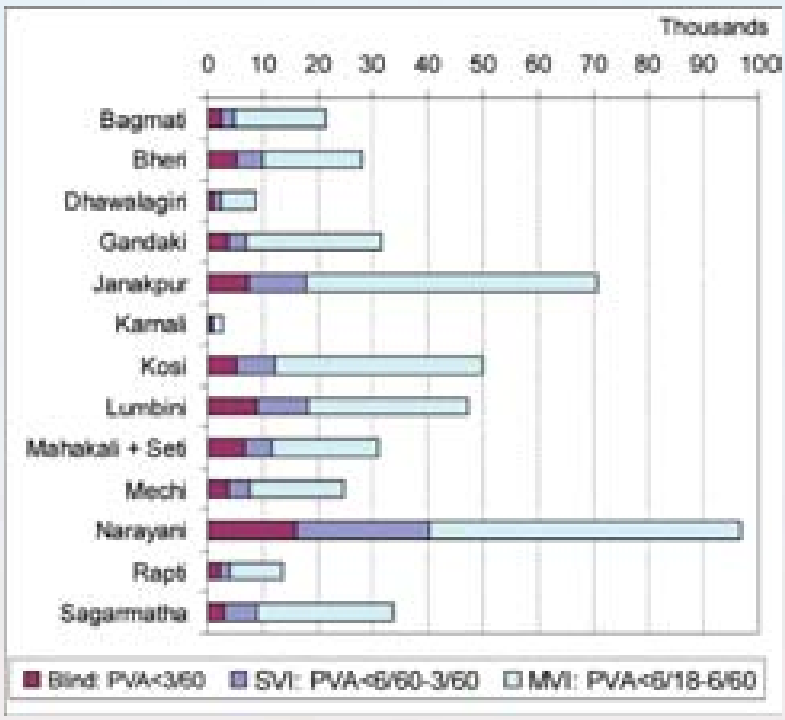
Figure 8 shows the adjusted prevalence of bilateral blindness, SVI and MVI. This should be compared with the sample prevalence as shown in Figure 6. In all zones except Janakpur, the adjusted prevalence is slightly lower than the age and sex adjusted prevalence. In Gandaki, Lumbini and Narayani the sample prevalence was used.

Figure 8. Adjusted prevalence of blindness, severe visual impairment (SVI) and visual impairment (MVI) with available correction in the better eye



The estimated number of persons blind, with SVI and with MVI in each zone are shown in Figure 9. Zones with a large population are expected to have more blind and visually impaired people compared to less populated zones. The population of Bagmati and Lumbini zone are nearly the same but the number of blind and severely visually impaired persons in Lumbini is more than double that of Bagmati zone. The same applies for Gandaki, compared with Kosi and Narayani zones.

Figure 9. Estimated number of people with bilateral blindness. severe visual impairment (SVI) and visual impairment (VI) with available correction in the better eye by zone



The adjusted prevalence for blindness due to cataract has been calculated as well for each of the 14 zones. (Table 22) For Gandaki, Lumbini and Narayani zones no adjusted data on bilateral blindness due to cataract (BCVA<3/60 in the better eye) were available. To get a fair estimate of the number of cases, extrapolations of the sample prevalence were used.

Table 22. Adjusted prevalence of bilateral cataract blindness (pinhole VA<3/60 in the better eye) and estimated number of cases in people aged 50+

	Males		Females		Total		
Zone	**n**	**%**	**n**	**%**	**n**	**%**	**Var. (CI 95%)**
Bagmati	215	0.11%	484	0.27%	699	0.19%	(0.1% - 0.4%)
Bheri	762	0.97%	1,330	1.92%	2,092	1.41%	(0.8% - 2.0%)
Dhawalagiri	141	0.34%	205	0.47%	346	0.40%	(0.2% - 0.6%)
Gandaki *	655	0.58%	937	0.79%	1,592	0.69%	
Janakpur	1,395	0.84%	2,609	1.72%	4,004	1.26%	(0.7% - 1.8%)
Karnali	48	0.46%	45	0.50%	93	0.48%	(0.0% - 0.9%)
Kosi	766	0.64%	2,051	1.74%	2,817	1.19%	(0.8% - 1.6%)
Lumbini *	1,977	0.98%	1,602	0.85%	3,579	0.92%	
Mahakali + Seti	1,710	1.36%	1,912	1.53%	3,622	1.44%	(0.7% - 2.2%)
Mechi	945	1.14%	1,147	1.50%	2,092	1.31%	(0.8% - 1.8%)
Narayani *	5,924	4.80%	6,615	6.11%	12,539	5.41%	
Rapti	185	0.29%	237	0.39%	422	0.34%	(0.0% - 0.7%)
Sagarmatha	588	0.47%	1,441	1.21%	2,029	0.84%	(0.4% - 1.3%)
(Nepal (2001)	**15,310**	**1.06%**	**20,615**	**1.51%**	**35,925**	**1.28%**	**(1.2% - 1.4%)**
(Nepal (2011)	**19,184**	**1.06%**	**27,300**	**1.51%**	**46,263**	**1.28%**	**(1.2% - 1.4%)**

* Estimates based on extrapolations from sample prevalence.

Data are available for the sample prevalence of bilateral cataract blindness (pinhole VA<6/60 in the better eye – Nepal definition) in Gandaki, Lumbini and Narayani. Table 23 shows the adjusted prevalence of bilateral cataract blindness and the estimated number of cases in people aged 50+.

Table 23. Adjusted prevalence of bilateral cataract blindness (pinhole VA<6/60 in the better eye – Nepal definition) and estimated number of cases in people aged 50+

	Males		Females		Total		
Zone	**n**	**%**	**n**	**%**	**n**	**%**	**Var. (CI 95%)**
Bagmati	544	0.3%	738	0.4%	1,282	0.3%	(0.2% - 0.4%)
Bheri	1,596	2.0%	2,108	3.0%	3,704	2.5%	(2.2% - 2.8%)
Dhawalagiri	289	0.7%	459	1.0%	748	0.9%	(0.7% - 1.1%)
Gandaki *	1,941	1.7%	3,105	2.6%	5,124	2.2%	(2.0% - 2.4%)
Janakpur	3,314	2.0%	5,099	3.4%	8,413	2.6%	(2.2% - 3.1%)
Karnali	132	1.3%	142	1.6%	274	1.4%	(0.9% - 1.9%)
Kosi	1,930	1.6%	5,061	4.3%	6,991	3.0%	(2.5% - 3.4%)
Lumbini *	5,698	2.8%	4,258	2.3%	9,862	2.5%	(1.8% - 3.3%)
Mahakali + Seti	2,593	2.1%	3,173	2.5%	5,766	2.3%	(2.0% - 2.6%)
Mechi	1,507	1.8%	2,596	3.4%	4,103	2.6%	(2.2% - 2.9%)
Narayani *	16,864	13.7%	17,183	15.9%	34,428	14.9%	(14.2% - 15.5%)
Rapti	311	0.5%	739	1.2%	1,050	0.8%	(0.6% - 1.1%)
Sagarmatha	1,878	1.5%	2,920	2.5%	4,798	2.0%	(1.7% - 2.3%)
(Nepal (2001)	**38,597**	**2.7%**	**47,581**	**3.5%**	**86,543**	**3.1%**	**(3.0% - 3.2%)**
(Nepal (2011)	**48,364**	**2.7%**	**63,010**	**3.5%**	**111,374**	**3.1%**	**(3.0% - 3.2%)**

** No adjusted prevalence available. Sample prevalence used instead.*

There are an estimated 86,500 people blind due to cataract in the 14 zones: 38,600 men and 47,600 women. The adjusted prevalence of cataract blindness in women is 23% higher than in men and this is a significant difference. Part of it is due to the fact that women live longer and therefore have a higher risk of developing cataract. The other factor may be that less women are operated upon, compared to men.

Extrapolation of the weighted prevalence against the population of Nepal in 2011 indicates that there are an estimated 111,400 people blind due to cataract in Nepal: 48,400 men (43.4%) and 63,000 women (56.6%). Also here the prevalence in females is significantly higher than in males.

Many people with visual impairment due to cataract do not want to wait until their vision has reduced to less than 3/60. Many of them want to remain productive and independent and ask for cataract surgery at an earlier stage. Therefore people with (severe) visual impairment should be taken into consideration as well when assessing the need for cataract surgery.

Table 24 shows the adjusted prevalence of people with bilateral cataract and BCVA<3/60, <6/60 and <6/18 in each zone and for Nepal: 1.3%, 3.1% and 8.5% respectively. The variation is considerable and varies from 1.9% in Bagmati to 21.5% in Narayani.

In entire Nepal an estimated 35,900 people aged 50+ are blind due to cataract, 86,500 cannot see 6/60 and 239,700 cannot see 6/18 in the better eye. Extrapolated to the population 50+ in 2011, 46,300 are blind, 111,400 cannot see 6/60 and 308,700 cannot see 6/18 in the better eye due to cataract.

With economic development and the increase of urban professionals, the demand for early cataract surgery is likely to increase. Eye care services have to respond to that positively. People should not

loose their job first because they have to wait for cataract surgery. They should be operated in time so that they can continue their work.

Table 24. Adjusted prevalence of BCVA<3/60, <6/60 and <6/18 due to cataract and the estimated number of cases in people aged 50+

	Pinhole VA<3/60		Pinhole VA<6/60		Pinhole VA<6/18	
Zone	**n**	**Prev.**	**n**	**Prev.**	**n**	**Prev.**
Bagmati	699	0.2%	1,282	0.3%	7,014	1.9%
Bheri	2,092	1.4%	3,704	2.5%	11,393	7.7%
Dhawalagiri	346	0.4%	748	0.9%	3,342	3.9%
Gandaki *	1,592	0.7%	5,124	2.2%	20,973	9.1%
Janakpur	4,004	1.3%	8,413	2.6%	31,114	9.8%
Karnali	93	0.5%	274	1.4%	748	3.9%
Kosi	2,817	1.2%	6,991	3.0%	23,296	9.8%
Lumbini *	3,579	0.9%	9,862	2.5%	23,550	6.0%
Mahakali + Seti	3,622	1.4%	5,766	2.3%	12,072	4.8%
Mechi	2,092	1.3%	4,103	2.6%	11,485	7.2%
Narayani *	12,539	5.4%	34,428	14.9%	49,832	21.5%
Rapti	422	0.3%	1,050	0.8%	3,760	3.0%
Sagarmatha	2,029	0.8%	4,798	2.0%	17,492	7.2%
Nepal (2001)	**35,925**	**1.3%**	**86,543**	**3.1%**	**239,702**	**8.5%**
Nepal (2011)	**46,263**	**1.3%**	**111,446**	**3.1%**	**308,676**	**8.5%**

** Estimates based on extrapolations from sample prevalence.*

The adjusted prevalence of bilateral blindness, BCVA<6/60 and BCVA<6/18 due to cataract in people aged 50+ in each zone is also shown in Figure 6, together with the weighted average prevalence. There is a considerable variation in the prevalence. The highest prevalence of operable cataract is found in Narayani zone and the lowest in Bagmati zone.

Figure 10. Adjusted prevalence of bilateral cataract with BCVA<3/60, <6/60 and <6/18

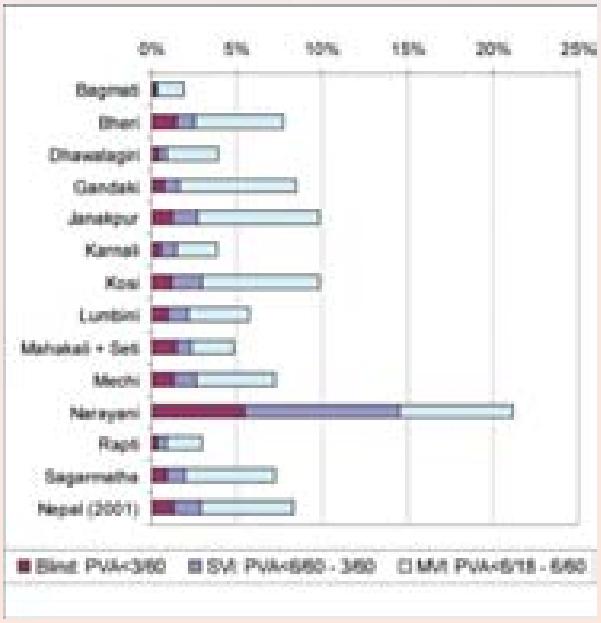
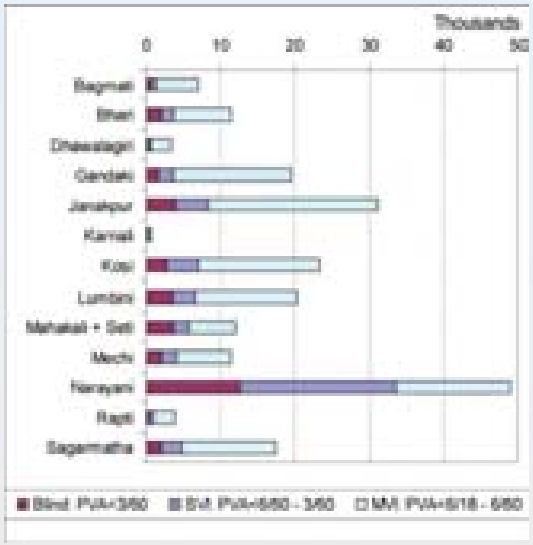


Figure 11 shows the estimated number of patients with bilateral blindness, BCVA<6/60 and BCVA<6/18 due to cataract. Narayani, Janakpur, Kosi, Lumbini and Gandaki zone have the highest number of patients with operable cataract.

Figure 11. Estimated cases with bilateral cataract and BCVA<3/60, <6/60 and <6/18



The number of people visually impaired due to cataract are shown in Tables 22-24. However, many people with cataract in one eye also want cataract surgery. Hence the number of eyes with operable cataract may be a better indicator of the total workload on cataract surgery. Table 25 gives the prevalence and the estimated number of eyes with cataract at three levels of visual acuity. The highest number of operable eyes are found in Narayani, Janakpur, Lumbini and Mahakali & Seti zone. If we assume the weighted average to be representative for entire Nepal then there are 333,100 eyes with pinhole VA<6/60 due to cataract in Nepal.

Table 25. Adjusted prevalence and estimated number of eyes with cataract and BCVA<3/60, <6/60 and <6/18

	Pinhole VA<3/60		Pinhole VA<6/60		Pinhole VA<6/18	
Zone	**Eyes**	**Prev.**	**Eyes**	**Prev.**	**Eyes**	**Prev.**
Bagmati	11,989	1.6%	14,564	2.0%	30,109	4.1%
Bheri	14,503	4.9%	19,190	6.5%	40,376	13.6%
Dhawalagiri	3,201	1.9%	4,584	2.7%	11,460	6.7%
Gandaki *			19,571	4.2%		
Janakpur	26,197	4.1%	38,651	6.1%	93,851	14.8%
Karnali	1,007	2.6%	1,527	3.9%	2,866	7.4%
Kosi	15,795	3.3%	29,195	6.2%	65,081	13.7%
Lumbini *			34,593	4.4%		
Mahakali + Seti	25,877	5.2%	31,923	6.4%	49,756	9.9%
Mechi	12,322	3.9%	18,148	5.7%	34,422	10.8%
Narayani *			92,725	20.0%		
Rapti	4,525	1.8%	6,933	2.8%	15,938	6.4%
Sagarmatha	14,197	2.9%	21,501	4.4%	49,966	10.3%
Nepal (2001)	**129,613**	**6.6%**	**333,104**	**11.9%**	**393,825**	**20.1%**
Nepal (2011)	**183,162**	**6.6%**	**428,954**	**11.9%**	**556,531**	**20.1%**

Estimates based on extrapolations from sample prevalence.

3.4 Cataract operations

The adjusted prevalence of eyes operated for cataract is shown in Table 26. The total prevalence and number of operated eyes is higher in females, but in two zones (Dhawalagiri and Gandaki) more males are operated upon than females.

Table 26. Adjusted prevalence and estimated number of (pseudo)aphakic eyes - people 50+

	Males		Females		Total		
Zone	**n**	**%**	**n**	**%**	**n**	**%**	**Var. (CI 95%)**
Bagmati	20,641	5.4%	24,575	6.8%	45,216	6.1%	(4.9% - 7.3%)
Bheri	8,249	5.2%	12,249	8.9%	20,498	6.9%	(5.9% - 7.9%)
Dhawalagiri	3,561	4.3%	3,390	3.9%	6,951	4.0%	(3.1% - 5.0%)
Gandaki *	4,184	3.7%	3,681	3.1%	7,864	3.4%	(2.8% - 4.0%)
Janakpur	23,658	7.1%	24,599	8.1%	48,257	7.6%	(6.2% - 9.0%)
Karnali	1,108	5.3%	1,033	5.7%	2,141	5.5%	(4.0% - 7.0%)
Kosi	10,469	4.4%	12,518	5.3%	22,986	4.9%	(3.5% - 6.2%)
Lumbini *	9,909	4.9%	10,506	5.6%	20,415	5.3%	(4.7% - 5.9%)
Mahakali + Seti	13,262	5.3%	19,240	7.7%	32,503	6.5%	(5.3% - 7.7%)
Mechi	6,801	4.1%	6,939	4.5%	13,740	4.3%	(3.2% - 5.5%)
Narayani *	7,431	6.0%	6,793	6.3%	14,224	6.2%	(5.5% - 6.9%)
Rapti	7,434	5.7%	7,454	6.2%	14,888	5.9%	(4.8% - 7.1%)
Sagarmatha	8,374	3.4%	11,949	5.0%	20,323	4.2%	(3.3% - 5.1%)
(Nepal (2001)	**125,081**	**5.1%**	**144,925**	**6.1%**	**270,006**	**5.6%**	**(5.3% - 5.8%)**
(Nepal (2011)	**183,772**	**5.1%**	**220,614**	**6.1%**	**403,617**	**5.6%**	**(5.3% - 5.8%)**

** No adjusted prevalence available. Sample prevalence used instead.*

3.5 Cataract Surgical Coverage (CSC)

Cataract surgical coverage (persons) is a coverage and an impact indicator to measure which proportion of people blind, with SVI or with MVI due to bilateral cataract, have been operated in one or both eyes. Similarly CSC (eyes) is used to measure the proportion of eyes that are blind, with SVI or with MVI due to bilateral cataract, have been operated upon. Because the VA at the time of surgery is usually not known, the CSC is calculated at three different levels of VA: <3/60, <6/60 and <6/18. These levels are intended to represent the threshold VA below which cataract surgery is usually indicated in the country of concern. In Nepal the level in rural areas may lie at <6/60, while in urban areas <6/18 should be the norm. The CSC indicators give an impression about which part of the cataract problem has been addressed so far.

Table 27 shows the CSC (eyes) for the 14 zones. The CSC (eyes; VA<3/60) is highest in Bagmati and lowest in Mechi Zone. The CSC (eyes) in Gandaki, Lumbini and Narayani is not known and could not be extracted from the publications. The weighted average for Nepal indicates that 67.1% of the cataract eyes with VA<3/60 have been operated upon, 57.9% of the cataract eyes with VA<6/60 and 39.4% of the cataract eyes with VA<6/18. Although the CSC for males is slightly higher than for females, this difference is not significant for Nepal as a whole.

Table 27. Cataract surgical coverage (in %) in eyes

	CSC (eyes) <3/60			CSC (eyes) <6/60			CSC (eyes) <6/18		
Zone	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**
Bagmati	78.3	79.8	79.1	74.6	76.1	75.5	60.0	58.9	59.3
Bheri	62.2	62.2	62.2	52.9	55.7	54.6	33.3	36.6	35.3
Dhawalagiri	73.4	67.7	70.5	65.6	58.4	62.0	42.0	35.9	38.8
Gandaki *									
Janakpur	72.0	65.5	68.4	61.4	54.9	57.8	35.5	34.1	34.8
Karnali	77.1	62.4	69.9	64.8	52.5	58.8	50.9	35.0	42.5
Kosi	69.1	58.2	62.6	52.0	41.9	45.9	27.3	26.9	27.1
Lumbini *									
Mahakali + Seti	57.7	61.0	59.6	51.5	55.4	53.8	39.6	42.9	41.5
Mechi	62.1	53.4	57.5	52.0	41.7	46.4	35.0	26.2	30.0
Narayani *									
Rapti	80.7	75.6	78.0	74.1	64.4	68.7	52.1	45.6	48.5
Sagarmatha	62.3	62.4	62.4	49.7	51.9	51.0	29.4	30.1	29.8
Nepal (weighted)	**68.9**	**65.7**	**67.1**	**59.5**	**56.6**	**57.9**	**40.0**	**38.8**	**39.4**

* *Cataract Surgical Coverage for eyes not assessed*

Table 28 shows the CSC (persons), indicating the proportion of people with bilateral cataract and pinhole VA<3/60, <6/60 or <6/18 in the better eye who had a cataract operation in one or both eyes. The CSC (persons) is always higher than the CSC (eyes) because when a person bilateral blind due to cataract is operated in one eye only, he is counted as 'covered', while in CSC (eyes) only one of the two eyes is covered. The reasoning is that the operation of one eye in a bilateral cataract blind person may change him or her into a sighted person.

The CSC for persons is high with 84.6% for persons with bilateral cataract and VA<3/60, 70.2% for bilateral cataract and VA<6/60 and 54.5% for bilateral cataract and VA<6/18. The coverage in Bagmati Zone is especially impressive: 96.5%, 94.1% and 76% respectively. That means that in this zone cataract blindness is well under control. Also Rapti and Karnali Zone have high coverage indicators. The CSC in Narayani Zone is much lower compared to the other zones. Just as the high prevalence of blindness due to cataract it indicates that this zone still has a considerable cataract backlog that needs to be addressed.

Table 28. Cataract surgical coverage (in %) in persons

	CSC (persons) <3/60			CSC (persons) <6/60			CSC (persons) <6/18		
Zone	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**
Bagmati	96.8	96.2	96.5	94.2	94.0	94.1	76.4	75.6	76.0
Bheri	83.2	82.0	82.4	71.3	75.7	74.1	50.7	54.6	53.1
Dhawalagiri	89.9	67.7	70.5	83.8	78.3	81.0	59.0	51.3	54.9
Gandaki *				68.1	52.6	59.5			
Janakpur	87.9	81.1	84.1	76.8	69.8	72.7	46.7	47.6	47.2
Karnali	92.1	88.6	90.4	78.7	74.4	76.7	67.2	50.7	58.5
Kosi	85.9	74.8	79.1	72.5	57.5	62.9	39.2	38.3	38.7
Lumbini *				61.7	70.8	66.6			
Mahakali + Seti	80.7	84.1	82.7	74.0	76.8	75.6	61.4	61.9	61.7

Mechi	75.9	73.6	74.7	70.1	59.5	64.3	46.6	37.1	41.1
Narayani *				39.3	35.8	37.3			
Rapti	94.8	92.3	93.5	92.7	81.5	86.5	75.8	64.4	69.3
Sagarmatha	87.7	79.3	82.6	71.4	67.2	68.9	44.4	39.6	41.5
Nepal (weighted)	**87.6**	**82.9**	**84.6**	**72.4**	**68.8**	**70.2**	**55.7**	**53.5**	**54.5**

** Cataract Surgical Coverage for persons at PVA<3/60 and at PVA<6/18 not assessed*

3.6 Causes of blindness

The causes of blindness, SVI and MVI in RAAB are calculated from the sample data. Also, because the diagnostic facilities for posterior segment disease are limited, glaucoma, diabetic retinopathy (DR), age related macula degeneration (ARMD) and other posterior segment disease and disorders of the central nervous system (CNS) are often reported as posterior segment disease. (Table 29)

Table 29. Principal cause in bilateral blind people (PVA<3/60 in the better eye) aged 50+ in the sample population in 14 zones.

Zone	Refr. error	Cata-ract	Apha-kia	Com-plicat	Trach scar	Phthi-sis	Other scar	Globe	Glau-coma	DR	Post. segm
Bagmati	-	53.3	-	-	-	6.7	-	6.7	6.7	-	26.7
Bheri	-	65.8	1.8	1.8	-	3.6	9.9	1.8	6.3	-	9.0
Dhawalagiri	-	57.1	-	-	-	-	4.8	-	11.9	-	26.3
Gandaki *											
Janakpur	-	66.7	5.1	-	2.6	-	7.7	-	5.1	2.6	10.3
Karnali	-	67.5	7.5	2.5	2.5	2.5	2.5	-	7.5	-	7.5
Kosi	-	64.7	1.5	0.0	-	-	7.4	1.5	4.4	-	20.6
Lumbini *											
Mahakali + Seti	-	62.5	4.2	2.8	4.2	1.4	2.8	-	9.7	-	12.5
Mechi	-	77.5	1.3	1.3	-	2.5	3.8	-	3.8	-	10.1
Narayani *											
Rapti	-	40.7	15.3	-	-	8.5	10.2	-	-	-	25.4
Sagarmatha	-	66.7	5.1	-	-	-	5.1	7.7	5.1	-	10.3
Nepal (weighted)	**-**	**62.2**	**3.4**	**0.6**	**1.0**	**2.5**	**5.2**	**2.5**	**5.9**	**0.4**	**16.5**

** Principal causes of blindness in bilateral blind persons not available for PVA<3/60*

The major cause of blindness in persons is cataract with an estimated 62.2% (52.8% in blind eyes) for Nepal. Mechi Zone (77.5%) has the highest proportion of cataract and Rapti Zone the lowest (40.7%). Posterior segment disease is the second cause, glaucoma the third. Corneal scars and phthisis are also common, corneal scars from trachoma are now far less common.

Cataract is also the main cause (52.8%) in eyes (Table 30). The proportion of non-trachomatous scarring and phthisis is higher in eyes because this is mostly unilateral.

Table 30. Main cause of blindness (PVA<3/60) in eyes (in %) of people aged 50+ in the sample population in 14 zones.

Zone	Refr. error	Cata-ract	Apha-kia	Com-plicat	Trach scar	Phthi-sis	Other scar	Globe	Glau-coma	DR	Post. segm
Bagmati	0.7	42.6	0.7	6.8	-	7.4	2.0	7.4	4.1	1.4	27.0
Bheri	0.2	53.2	2.1	3.0	1.1	5.8	12.6	3.6	6.2	-	12.1
Dhawalagiri	0.7	54.0	1.1	-	-	9.1	7.3	0.4	5.8	-	21.5
Gandaki *											
Janakpur	-	56.7	3.5	3.0	1.5	4.5	10.9	1.0	3.5	1.0	14.4
Karnali	0.5	50.8	7.1	3.3	2.2	7.7	10.9	2.7	4.4	-	10.4
Kosi	-	53.8	1.3	2.2	-	3.5	12.2	5.8	1.9	1.0	18.0
Lumbini *											
Mahakali + Seti	0.5	55.6	2.0	2.7	1.7	7.1	13.5	-	7.1	-	9.8
Mechi	-	61.8	1.5	2.3	-	8.1	6.1	2.8	5.3	0.3	11.5
Narayani *											
Rapti	1.8	46.7	7.2	-	-	10.2	12.9	2.7	2.7	0.6	15.3
Sagarmatha	0.8	55.9	2.7	1.2	0.4	7.8	10.5	3.9	3.9	-	12.9
Nepal (Weighted)	**0.4**	**52.8**	**2.3**	**3.0**	**0.6**	**6.6**	**9.4**	**3.5**	**4.3**	**0.6**	**16.4**

** Principal causes of blindness in blind eyes not available for PVA<3/60*

Table 31 gives the proportion of blindness (PVA<3/60) in persons and in eyes by category: avoidable (treatable + preventable) and permanent. For Nepal 81% of all bilateral blindness is avoidable, varying from 67% in Bagmati to 92% in Karnali. For blind eyes the proportions are more or less similar.

Table 31. Categories of avoidable bilateral blindness in the sample population in 14 zones.

	People with PVA<3/60 in better eye				Eyes with PVA<3/60			
	Treatable	Preventable		Permanent	Treatable	Preventable		Permanent
Zone		PHC/ PEC	Ophth. services			PHC/ PEC	Ophth. services	
Bagmati	53%	7%	7%	33%	44%	9%	12%	34%
Bheri	68%	14%	8%	11%	56%	20%	9%	16%
Dhawalagiri	57%	5%	12%	26%	56%	16%	6%	22%
Gandaki *								
Janakpur	72%	10%	8%	10%	60%	17%	8%	15%
Karnali	75%	8%	10%	8%	58%	21%	8%	13%
Kosi	66%	7%	4%	22%	55%	16%	5%	24%
Lumbini *								
Mahakali + Seti	67%	8%	13%	13%	58%	22%	10%	10%
Mechi	79%	6%	5%	10%	63%	14%	8%	14%
Narayani *								
Rapti	56%	19%	0%	25%	56%	23%	3%	18%
Sagarmatha	72%	5%	5%	18%	59%	19%	5%	17%
Nepal (Weighted)	**66%**	**9%**	**7%**	**19%**	**56%**	**17%**	**8%**	**20%**

** Principal causes of blindness in blind eyes not available for PVA<3/60*

Table 32 shows the main cause of bilateral severe visual impairment and blindness (PVA<6/60 in the better eye). The major cause is cataract with an estimated 67.7% for Nepal, higher than in blindness alone (52.8%). Narayani Zone (85.9%) has the highest proportion of cataract, Rapti Zone the lowest (42.9%). Posterior segment disease (11.3%) was less than in blindness alone, varying between 22.0% in Dhawalagiri and 3.5% in Narayani zone. Uncorrected refractive errors (URE) are not a common cause of blindness, but much more frequent in severe and moderate visual impairment. URE was highest in Lumbini zone (31.4%) and absent in Karnali and Mechi zone.

Table 32. Principal cause in bilateral blindness (PVA<6/60 in the better eye) in people aged 50+ in the sample population in 14 zones.

Zone	Refr. error	Cata-ract	Apha-kia	Com-plicat	Trach scar	Phthi-sis	Other scar	Globe	Glau-coma	DR	Post. segm
Bagmati	6.3	65.6	3.1	-	-	3.1	-	3.1	3.1	3.1	12.5
Bheri	6.5	68.1	1.4	1.9	-	1.9	7.4	0.9	3.7	-	8.3
Dhawalagiri	4.0	62.0	-	1.0	-	1.0	5.0	-	5.0	-	22.0
Gandaki	13.2	64.5	-	0.8	-	-	3.1	2.3	0.8	0.4	14.9
Janakpur	4.3	78.7	4.3	-	1.1	-	4.3	-	2.1	1.1	4.3
Karnali	-	78.5	6.2	1.5	1.5	1.5	1.5	-	4.6	-	4.6
Kosi	4.4	71.3	1.3	1.3	-	-	4.4	1.3	2.5	0.6	13.1
Lumbini	31.4	48.1	-	-	-	-	3.8	0.4	0.8	-	15.3
Mahakali + Seti	5.7	67.5	3.3	1.6	2.4	0.8	2.4	-	5.7	-	10.6
Mechi	-	79.5	0.6	1.9	-	1.2	1.9	0.6	2.5	-	11.8
Narayani	7.3	85.9		0.3		2.3	0.1	0.7		3.5	
Rapti	8.9	42.9	15.2	-	-	4.5	5.4	-	2.7	0.9	19.6
Sagarmatha	0.9	77.0	3.5	0.9	-	-	2.7	2.7	2.7	-	9.7
Nepal (weighted)	**9.1**	**67.7**	**2.4**	**0.7**	**0.3**	**0.9**	**3.2**	**1.1**	**2.5**	**0.7**	**11.3**

The categories of avoidable bilateral blindness (Nepal definition: PVA<6/60) is shown in table 33. In Nepal 88% of all bilateral blindness and severe visual impairment (PVA<6/60 in the better eye) is avoidable; 79% is treatable and 8% is preventable. Permanent blindness is 12%. The percentage of avoidable bilateral blindness varies from 78% in Dhawalagiri to 96% in Janakpur and Narayani.

Eye Examination at home

Table 33. Categories of avoidable bilateral blindness (PVA<6/60) in the sample population in 14 zones.

	People with PVA<6/60 in the better eye			
		Preventable		
Zone	**Treatable**	**Permanent**	**Ophth. services**	**PHC/PEC**
Bagmati	75%	3%	6%	16%
Bheri	76%	9%	4%	9%
Dhawalagiri	66%	6%	5%	22%
Gandaki	78%	3%	1%	17%
Janakpur	87%	5%	3%	4%
Karnali	85%	5%	5%	5%
Kosi	77%	4%	3%	14%
Lumbini	80%	4%	1%	16%
Mahakali + Seti	76%	6%	6%	11%
Mechi	80%	3%	2%	12%
Narayani	93%	2%	1%	4%
Rapti	67%	10%	4%	20%
Sagarmatha	81%	3%	3%	12%
Nepal (weighted)	**79%**	**4%**	**3%**	**12%**

Figure 12a and 12b illustrate the differences in the categories of bilateral blindness for PVA<3/60 and for PVA<6/60 as shown in table 31 and table 33 respectively.

Figure 12a. Causes of bilateral blindness in persons by category (PVA<3/60)

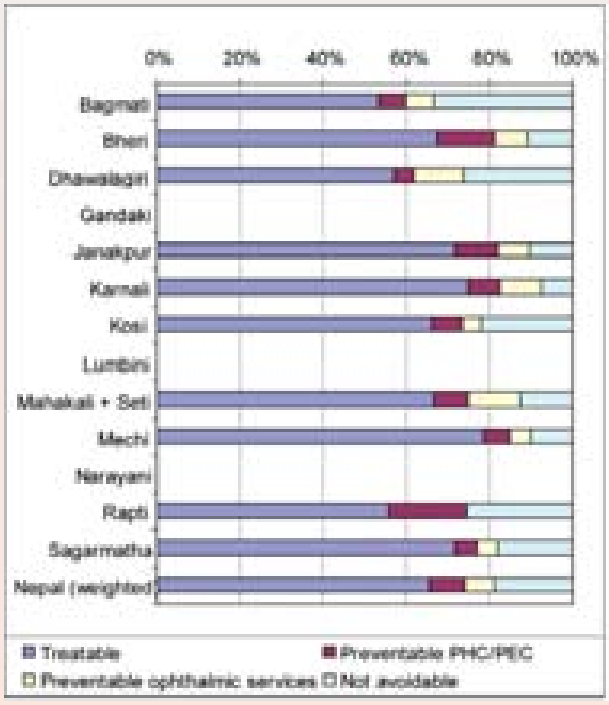
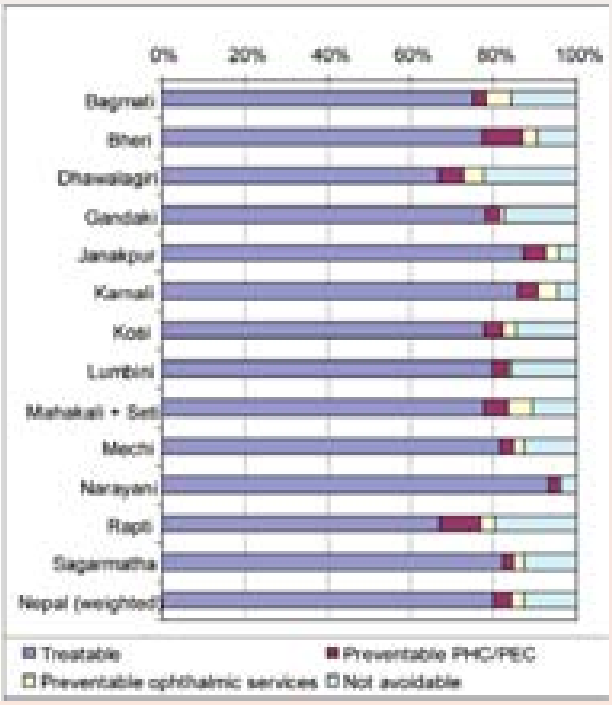


Figure 12b. Causes of bilateral blindness by category (PVA<6/60)



Trachomatous corneal scar

The recent surveys are not the best way to assess the trachoma situation. Blindness and visual impairment from trachomatous scarring in people aged 50+ will be diagnosed, but especially active trachoma in young children remains undetected.

The recent surveys indicate that trachomatous corneal scarring causes 0.97% (823 cases) of all bilateral blindness in Nepal in people aged 50+. It occurs only in Mahakali & Seti, in Janakpur and in Karnali zones (4.2%, 2.6% and 2.5% respectively). In terms of blind eyes, trachomatous scarring is the main cause in Bheri in 1.1%, in Janakpur in 1.5%, in Karnali in 2.2% in Mahakali and Seti in 1.7% and in Sagarmatha in 0.4%. It causes 0.62% of all blind eyes. No data are available for Gandaki, Lumbini and Narayani. These data are too limited to determine whether trachoma is still a public health problem in Nepal.

3.7 Barriers

Not all people who are blind or severely visually impaired due to cataract are operated upon. Many are not and often they have valid reasons for it. If the barriers to cataract surgery are known, it becomes possible to design special intervention activities to overcome such barriers.

It should be realized that the procedure in RAAB to interview patients to find out more about the reasons why they have not been operated yet is not ideal. The ophthalmologist is not a neutral person and a patient may not reveal the actual barrier(s) but perhaps one that may sound acceptable to the interviewer. Secondly, the interview may not be detailed enough and the interviewer may not be trained enough to ask neutral questions and to interpret answers correctly.

However, the findings on barriers from the RAAB make planners aware about the importance of these factors and they can provide a good starting point for more detailed qualitative assessments on barriers to cataract surgery.

Examination in field setting

There can be considerable variation in barriers between different zones and even between males and females. Local factors like the quality and reputation of the eye services, literacy of the patients, availability, accessibility and affordability of eye care services, the approach of eye care staff, socio-economic situation in the zone, all influence the uptake of cataract surgery. The above factors should be well considered during the planning of future eye care activities in the individual zones.

In general, the Cataract Surgical Coverage is high in Nepal and the number of people who are blind

or visually impaired due to cataract is low in most zones.

According to the weighted average for Nepal, 'Cannot afford' is the major barrier to surgery in people bilaterally blind (VA<6/60) due to cataract with 23%. It is followed by 'No company' (18%), 'Unaware of treatment' (15%), 'Old age, no need' (12%), 'No services' and 'Contra-indications (5%), 'Wait for maturity', 'How to get surgery' and 'Fear of operation'(5%), 'No time'(3%) and the remaining causes, each by 1%. However, the variation in barriers between the different zones is high. Notably, 'Cannot afford' is a rather uncommon barrier in Karnali, Kosi and Rapti Zone.

Also for unilateral blindness the major barrier is 'Cannot afford' (19%). 14% is not blind in the other eye and indicates no need for surgery. Other barriers are 'Waiting for maturity' (13%), 'No company' (13%), 'Unaware of treatment' (12%), 'No time' (7%), 'Old age, no need' (7%) and 'No services' (3%).

Also here the variation of barriers is considerable and they may have to be addressed differently in the various zones.

The barriers to cataract surgery for people with bilateral and with unilateral cataract are shown in table 34 and table 35 respectively.

Table 34. Barriers to cataract surgery in people bilaterally blind due to cataract (pinhole VA<6/60)

Barriers	Bagm.	Bheri	Dhaw.	Gand.	Janak.	Karn.	Kosi	Lumb.	Ma + Se	Mech.	Naray.	Rapti	Sagar.	Nepal
Unaware of treatment	13	15	15	30	32		6		4	3	27	8	5	15
Destiny/God's will							6			1			3	1
Wait for maturity		21	21			6			9	1	4		12	5
No services		2	2	17	3	50	11		4	15		8	2	6
How to get surgery		6	6		5		18		4			13	3	5
Cannot afford	25	36	36	13	16	6	6		32	39	39	8	17	23
No company	13	15	15	17	16	19	11		26	19	24	21	23	18
No time							13		8			5	11	3
Old age: no need	25				8	13	21		6	16		29	17	12
One eye not blind		3	3			6	1		4		3		3	1
Fear of operation		2	2	16	8		5		2	5	3	5	3	5
Fear of loosing sight					3		1					3	2	1
Contra-indication	25			6	8		2		2	1			2	6
All barriers	**100**	**100**	**100**	**100**	**100**	**100**	**100**		**100**	**100**	**100**	**100**	**100**	**100**

Table 35. Barriers to cataract surgery in people with unilateral severe visual impairment due to cataract (pinhole VA<6/60)

Barriers	Bagm.	Bheri	Dhaw.	Gand.	Janak.	Karn.	Kosi	Lumb.	Ma + Se	Mech.	Naray.	Rapti	Sagar.	Nepal
Unaware of treatment	34	11	23		10	6	4		3			2	4	12
Destiny/God's will	1		2				1			1			2	1
Wait for maturity	14	28	8		14	16	6		22	3		4	14	13
No services	3	5	7			31	16		5	2		4	3	5
How to get surgery	1	2	2		2	3	11		5			8	2	3
Cannot afford	15	33	3		21	1	9		23	43		8	18	19
No company	6	8	12		24	17	9		18	13		11	16	13
No time	5	3	11		5	9	10		7	2		14	7	7
Old age: no need	3	1	15		4	1	11		2	12		18	12	7
One eye not blind	8	4	13		13	9	16		15	20		29	19	14
Fear of operation	5	1	1		2	6	5					1	4	2
Fear of loosing sight		2			1	1	1							
Contra-indication	6	1	4		4		2		1	2		3		3
All barriers	**100**	**100**	**100**		**100**	**100**	**100**		**100**	**100**		**100**	**100**	**100**

3.8 Visual outcome

In RAAB, all eligible persons have their visual acuity measured with the available correction and with pinhole. This also includes people who were operated for cataract in one or both eyes. Results on visual outcome after cataract surgery in RAAB are usually worse than those obtained from outcome monitoring systems. The reason is that RAAB includes people who were operated last month as well as 20 years ago, by good eye surgeons as well as less good surgeons, in a well equipped hospital as well as under improvised conditions. Cataract visual outcome studies are usually done in well equipped hospitals by well-trained staff under controlled conditions. Visual outcome is measured at a fixed interval after cataract surgery, usually after 1 year. The risk of contracting a concurrent sight threatening eye disease or a late complication of the surgery is relatively low. However, the visual outcome from a population-based study shows what is seen by the general public and this may determine their faith in cataract surgical services.

Visual outcome after cataract surgery is categorised as 'good' (can see 6/18), 'borderline' (VA<6/18 – 6/60) and 'poor' (cannot see 6/60). When measured as presenting vision, it will include those patients who do not have the optimal optical correction. This may also include IOLs implanted with incorrect power.

Please note that the number of cases in the non-IOL group can be small and therefore changes in a few patients may result in dramatic changes in percentages. Secondly, not all non-IOL cases are intentionally intra-capsular cataract extractions (ICCE). It may include planned IOL surgeries where no IOL was implanted because of a surgical complication. Thirdly, patients who had ICCE or ECCE without IOL were mostly operated upon many years earlier, when IOL implantation was not as common as it is today. That means they are older and had more chance of developing other eye diseases like glaucoma, ARMD, DR, optic atrophy, etc. All these factors may affect the visual outcome in this group negatively.

The outcome data in Gandaki, Lumbini and Narayani zones were collected in the same manner as described above, but were represented differently in the publications. Where corresponding data could not be found the fields are left blank. In the weighted average, these blank fields are not included in the calculation.

Table 36 shows visual outcome with presenting VA in the 14 zones. The proportion of 'good' outcome varies from 48% in Narayani to 79% in Bagmati Zone, the proportion of 'poor' outcome from 11% in Bagmati and Sagarmatha to 25% in Rapti Zone.

Table 36. Proportion of good, borderline and poor outcome (PVA) in eyes after cataract surgery

	IOL			Non-IOL			Total		
Zone	**good**	**b-line**	**poor**	**good**	**b-line**	**poor**	**good**	**b-line**	**poor**
Bagmati	81%	11%	9%	59%	5%	36%	79%	10%	11%
Bheri	68%	18%	14%	42%	25%	33%	63%	19%	18%
Dhawalagiri	64%	22%	14%	56%	6%	38%	64%	21%	15%
Gandaki	73%	17%	6%	44%	6%	50%	64%	15%	21%
Janakpur	73%	17%	11%	25%	18%	57%	67%	17%	16%
Karnali	81%	10%	9%	37%	17%	46%	66%	12%	22%
Kosi	66%	22%	12%	17%	29%	54%	62%	23%	15%
Lumbini	64%	28%	8%	16%	25%	59%	59%	28%	14%
Mahakali + Seti	74%	17%	9%	48%	18%	34%	67%	17%	16%
Mechi	60%	22%	18%	0%	14%	86%	56%	21%	23%
Narayani	57%	33%	10%	24%	28%	48%	48%	32%	20%
Rapti	67%	18%	15%	0%	2%	98%	58%	16%	25%
Sagarmatha	81%	16%	3%	18%	15%	67%	73%	16%	11%
Nepal (weighted)	**70%**	**20%**	**10%**	**30%**	**17%**	**53%**	**64%**	**20%**	**16%**

Good outcome: presenting VA ³3d6/18

Borderline outcome: presenting VA <6/18 – 6/60

Poor outcome: presenting VA <6/60

Table 37 gives the visual outcome after cataract surgery with pinhole correction as a proxy for best correction. By comparing the percentages by presenting vision with those by pinhole vision it can be quickly evaluated what proportion of visual outcome can be improved by optical correction alone. (Table 39)

Table 37. Proportion of good, borderline and poor outcome (pinhole VA) in eyes after cataract surgery

	IOL			Non-IOL			Total		
Zone	**good**	**b-line**	**poor**	**good**	**b-line**	**poor**	**good**	**b-line**	**poor**
Bagmati	85%	9%	6%	64%	9%	27%	84%	9%	8%
Bheri	77%	12%	11%	49%	21%	30%	71%	14%	15%
Dhawalagiri	75%	18%	7%	56%	13%	31%	74%	18%	8%
Gandaki	88%			64%			80%	7%	13%
Janakpur	86%	6%	8%	40%	36%	25%	81%	9%	10%
Karnali	89%	6%	5%	65%	15%	20%	81%	9%	10%
Kosi	74%	15%	11%	17%	33%	50%	69%	16%	15%
Lumbini	89%	5%	6%	52%	27%	21%	85%	8%	7%
Mahakali + Seti	86%	6%	8%	56%	17%	27%	78%	9%	13%
Mechi	77%	10%	13%	10%	19%	71%	73%	10%	17%
Narayani	85%	8%	7%	61%	17%	22%	79%	10%	11%
Rapti	80%	10%	10%	19%	58%	23%	73%	16%	12%
Sagarmatha	85%	13%	2%	22%	22%	56%	78%	14%	8%
Nepal (weighted)	**83%**	**9%**	**8%**	**45%**	**24%**	**32%**	**78%**	**11%**	**11%**

Good outcome: presenting VA ³3d6/18

Borderline outcome: presenting VA <6/18 – 6/60

Poor outcome: presenting VA <6/60

In 1998, the WHO published recommendations for the visual outcome after cataract surgery (Table 38).[9] It should be noted that visual outcome is usually measured one year after the operation. However, in a population-based survey like RAAB the post-operative period may vary from one day to more than 20 years. Other eye disorders may have caused visual impairment after initial good sight restoration by cataract surgery. Also the quality of the surgical skills of the surgeon and the surgical facilities may have varied.

None of the zones in Nepal was able to comply with these guidelines.

[9] *Informal consultation on analysis of blindness prevention outcomes. WHO, Geneva, February 1998. WHO/PBL/98.68.*

Table 38. WHO recommendations of visual outcome after cataract surgery

Postoperative visual acuity	Available correction	Best correction
Good (6/6 – 6/18)	>80%	>90%
Borderline (<6/18 – 6/60)	<15%	<5%
Poor (<6/60 – 3/60)	<5%	<5%

If the causes of poor outcome are identified it becomes possible to take remedial action. The four main causes of poor outcome are:

- Selection – concurrent eye disease(s) causing visual impairment
- Surgery – surgical complications
- Spectacles – absent or inadequate optical correction
- Sequelae – long-term complications of cataract surgery

Table 39 shows that considerable improvement of visual outcome after cataract surgery can be achieved by providing pinhole correction. For entire Nepal, good outcome increased by 18%, borderline outcome reduced by 96% and poor outcome reduced by 53%. With optimal refraction the improvement may even be better than with pinhole vision alone.

Poor outcome reduced most in Karnali, Rapti and Lumbini zone. Bagmati and Sagarmatha zone had fairly good outcomes already and the improvements with pinhole are only modest. It is obvious that optimal optical correction after cataract surgery is essential in achieving good visual outcome.

Table 39. Change in proportion of good, borderline and poor outcome with pinhole correction.

	IOL			Non-IOL			Total		
Zone	**good**	**b-line**	**poor**	**good**	**b-line**	**poor**	**good**	**b-line**	**poor**
Bagmati	5%	-26%	-37%	7%	51%	-33%	5%	-20%	-35%
Bheri	11%	-50%	-27%	14%	-19%	-10%	11%	-36%	-20%
Dhawalagiri	15%	-22%	-100%	0%	54%	-23%	14%	-17%	-88%
Gandaki	17%			31%			20%	-114%	-62%
Janakpur	15%	-183%	-38%	38%	50%	-128%	17%	-89%	-60%
Karnali	9%	-67%	-80%	43%	-13%	-130%	19%	-33%	-120%
Kosi	11%	-47%	-9%	0%	12%	-8%	10%	-44%	0%
Lumbini	28%	-460%	-33%	69%	7%	-181%	31%	-250%	-100%
Mahakali + Seti	14%	-183%	-13%	14%	-6%	-26%	14%	-89%	-23%
Mechi	22%	-120%	-38%	100%	26%	-21%	23%	-110%	-35%
Narayani	33%	-313%	-43%	61%	-65%	-118%	39%	-220%	-82%
Rapti	16%	-80%	-50%	100%	97%	-326%	21%	0%	-108%
Sagarmatha	5%	-23%	-50%	18%	32%	-20%	6%	-14%	-38%
Nepal (weighted)	**16%**	**-161%**	**-35%**	**36%**	**19%**	**-82%**	**18%**	**-96%**	**-53%**

Good outcome: presenting VA ³6/18

Borderline outcome: presenting VA <6/18 – 6/60

Poor outcome: presenting VA <6/60

The proportion of IOL surgeries varies from 67% in Karnali to 94% in Dhaulagiri zone. Slightly more males than females received an IOL implant in most zones, the largest difference is seen in Karnali Zone (not significant). The weighted average for Nepal is 85%: 85% for men and 85% for women. (Table 40)

Table 40. Proportion IOL surgeries in sample

Zone	Males	Females	Total
Bagmati	90%	95%	92%
Bheri	81%	78%	79%
Dhawalagiri	95%	93%	94%
Gandaki	66%	71%	68%
Janakpur	89%	88%	89%
Karnali	63%	73%	67%
Kosi	92%	91%	92%
Lumbini	88%	89%	88%
Mahakali + Seti	76%	72%	74%
Mechi	95%	91%	93%
Narayani	77%	71%	74%
Rapti	90%	85%	87%
Sagarmatha	88%	88%	88%
Nepal (weighted)	**85%**	**85%**	**85%**

Table 41 shows the place of surgery by zone. Most patients are operated in NGO hospitals, with exception of Karnali and Rapti Zone where most operations took place in eye camps. Also in Bheri, Dhawalagiri, Kosi, Mahakali and Seti zone many patients were operated in eye camps.

Table 41. Place of surgery

Zone	Government hospital	NGO hospital	Private hospital	Eye camp / improvised
Bagmati	21%	56%	5%	19%
Bheri	2%	55%	7%	36%
Dhawalagiri	3%	62%	9%	26%
Gandaki	0%	80%	2%	18%
Janakpur	4%	85%	2%	9%
Karnali	7%	3%	0%	89%
Kosi	2%	46%	15%	37%
Lumbini *				
Mahakali + Seti	4%	51%	5%	40%
Mechi	1%	88%	2%	9%
Narayani *				
Rapti	1%	28%	1%	71%
Sagarmatha	6%	76%	8%	10%
Nepal (weighted)	**6%**	**63%**	**5%**	**25%**

** Data not available*

Table 42 shows the causes of poor outcome in the different zones in all operated eyes in the sample. A lot of variation is seen between the different zones.

Table 42. Causes of poor outcome (post-operative VA <6/60) in all operated eyes in sample

Zone	Selection	Surgery	Spectacles	Sequelae	No relation
Bagmati	48.4%	35.5%	9.7%	3.2%	3.2%
Bheri	32.5%	32.5%	25.0%	8.8%	1.3%
Dhawalagiri	43.2%	27.3%	13.6%	2.3%	13.6%
Gandaki	44.4%	0.0%	0.0%	55.6%	0.0%
Janakpur	28.2%	28.2%	15.4%	28.2%	0.0%
Karnali	33.3%	13.3%	23.3%	13.3%	16.7%
Kosi	15.9%	38.6%	9.1%	18.2%	18.2%
Lumbini *					
Mahakali + Seti	39.6%	28.3%	24.5%	7.5%	0.0%
Mechi	61.5%	23.1%	7.7%	6.2%	1.5%
Narayani *					
Rapti	59.0%	3.8%	31.4%	3.8%	1.9%
Sagarmatha	20.0%	4.0%	28.0%	20.0%	28.0%
Nepal (weighted)	**37.3%**	**23.7%**	**15.5%**	**16.9%**	**6.5%**

** Data not available*

Although a weighted average for entire Nepal is calculated, this is not very relevant. The remedial action to improve the visual outcome has to be taken at the level of the individual hospitals, based on the cause(s).

Adequate pre-operative examination of cataract patients may reduce the number of patients with concurrent blinding conditions who may not regain vision after surgery. Such patients may need counselling to provide them realistic expectations about their future vision. When surgery is a major cause of poor outcome, then review of the surgical procedures and routine monitoring of cataract surgical outcome may help to improve the outcome of cataract surgery. Adequate refraction services and individual adjustment of IOLs are likely to improve the visual outcome considerably, as shown in table 42. Late postoperative complications (sequelae) are more difficult to tackle; surgical procedures and post-operative care may play an important role here.

3.9 Uncorrected refracted errors

Uncorrected refractive errors (URE) for distant vision are a common cause of visual impairment in people aged 50+ (Table 43). In this age group it can also be caused by early cataract (swelling of the lens) and after cataract surgery.

Table 43. Proportion of SVI and MVI due to uncorrected refractive error and spectacle coverage in people aged 50+ by zone and by gender.

	SVI (PVA<6/60-3/60)			MVI (PVA<6/18-6/60)			Spectacle coverage		
Zone	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**
Bagmati	20%	14%	12%	31%	44%	38%	85%	77%	81%
Bheri	13%	16%	14%	34%	24%	28%	52%	41%	47%
Dhawalagiri	4%	10%	7%	34%	43%	39%	52%	2%	28%
Gandaki			13%						
Janakpur	11%	11%	11%	59%	55%	57%	34%	23%	29%
Karnali	14%	0%	4%	40%	38%	37%	30%	16%	23%
Kosi	14%	6%	9%	42%	46%	44%	66%	49%	58%
Lumbini			31%						
Mahakali + Seti	15%	16%	16%	62%	54%	57%	55%	35%	45%

Mechi	0%	0%	0%	49%	38%	43%	47%	45%	46%
Narayani			7%						
Rapti	42%	28%	34%	45%	45%	45%	35%	16%	26%
Sagarmatha	3%	5%	4%	27%	24%	25%	67%	41%	56%
Nepal (weighted)	**14%**	**11%**	**25%**	**33%**	**33%**	**66%**	**52%**	**37%**	**45%**

The spectacle coverage for distance vision is highest in Bagmati (81%) and lowest in Karnali zone. While the proportion of SVI and MVI caused by URE does not differ much between males and females, the spectacle coverage is much higher in males compared to females in nearly all zones.

3.10 Childhood blindness

All surveys covered in this report focused on people aged 50 years and older (Gandaki 45+). Children between 0 and 15 were not covered. The prevalence of blindness in people younger than 50 years of age is usually very low and a sample size of 30,000 or more is needed to obtain prevalence data of acceptable accuracy in this age group. However, the prevalence of childhood blindness may be low, the number of years a child has to live with this disability is many times more than that of an elderly person blind due to cataract.

Recently some new methods to assess childhood blindness have been developed.

1. The Key Informer Method (KIM) uses specially trained local volunteers to identify children with 'suspected' visual impairment in their own community and to bring these for examination by an ophthalmologist.[10]

2. When a larger series of RAABs (8 or more) are conducted, it is possible to combine this with a population-based survey on childhood blindness. This has been done successfully in Vietnam. Parallel to the examination of 50 persons aged 50 years and older in all selected clusters for the RAAB, 50 -100 children below the age of 15 are examined in the same cluster. Parents or caretakers are asked whether the child has any problems with vision in one or both eyes. If the answer is negative, the name, age and sex of the child is recorded. If the answer is positive the child is examined by the ophthalmologist of the RAAB team working in the same cluster. In that case a standard WHO Childhood Blindness Examination Form is completed. In this way a total of 30,000 to 40,000 children can be examined. This additional work can be done by adding one or two eye nurses to the standard RAAB team. All other logistics remain the same as a standard RAAB.

3. Using the Under 5 Mortality Rate as a proxy to estimate the prevalence of childhood blindness. When a new series of population-based surveys on blindness and visual impairment is planned in Nepal the inclusion of childhood blindness using options 1 or 2 should be considered.

[10] Muhit MA, Shah SP, Gilbert CE, Hartley SD, Foster A. The key informant method: a novel means of ascertaining blind children in Bangladesh. Br J Ophthalmol. 2007;91(8):995–9

Chapter 4 Results of recent studies compared with 1981 Nepal Blindness Survey

4.1 Study characteristics

The study design, the methodology, preparations, the implementation and the findings of the Nepal Blindness Survey (NBS) have been described in detail in the excellent book 'The Epidemiology of Blindness in Nepal - Report of the 1981 Nepal Blindness Survey, published by The Seva Foundation in 1988.

The main features of the NBS and the recent rapid assessments are listed in table 44.

Table 44. Sample size and coverage of NBS and recent blindness surveys

	Nepal Blindness Study	Recent surveys
Collection of data	1980 - 1981	2006 - 2010
Age groups	All ages	50+
Total sample size	42,648	43,307
Examined	39,887	39,908
Coverage	93.5%	92.2%
Sample sites / clusters	105	615

While the NBS covered all age groups, the recent surveys included only residents from 50 years and older. Where possible findings have been made comparable by extrapolations and the algorithm used has been explained.

When comparing the findings from both surveys, other factors like demography, literacy, general health care, human resources and infrastructure for eye care services, morbidity, have to be taken into account as well.

4.2 Demographic changes

The magnitude of blindness and visual impairment depends largely on the age and sex composition of the population. In order to evaluate the achievements made in the control of blindness and visual impairment in Nepal since the Nepal Blindness Survey of 1981, the demographic situation at the time these surveys were conducted has to be compared as well.

The total population of Nepal nearly doubled from 15,010,859 in 1981 to 28,584,975 in 2011 (prognosis Nepal Central Bureau of Statistics). Figure 13a shows the population by 10-years age group in 1981 and in 2011. The increase in each age group as percentage for males and for females is shown in Figure 13b.

Figure 13a. Population increase in Nepal by age group (1981 – 2011)

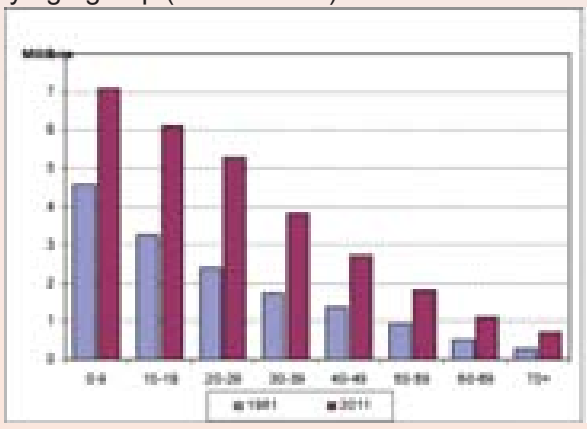


Figure 13b. Increase (in %) males and females (1981 – 2011)

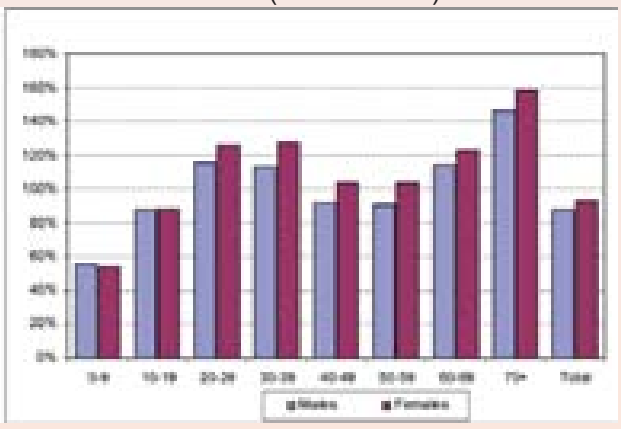


Figure 13b shows that the population increase was highest in the age group 70+, which is also the age group most at risk for blindness and visual impairment. The ratio males/females is more or less equal in 1981, but in 2011 the proportion of males between 30 and 45 reduces to 47-48%, most probably as a result of labour migration. Preliminary results of the 2011 National Census suggest that 1.9 million Nepali citizens are working outside the country. For the other age groups the differences in males/females ratio are minimal.

4.3 Other health indicators

Table 45 shows some of the common indicators of demography, health and development. Good progress is made in improving health care indicators and the vaccination coverage. Demographic indicators also show a reducing birth rate and an increasing life expectancy at birth, although this comes late in compared to other countries in the region. The literacy rate is still very low and much worse in women compared to men.

Table 45. Other health indicators

Health indicators	1981	1991	2001	2011
Midyear population (million)	15.011	19.448	23.151	26.621
0-14 years (million - %)	6.3 (42%)	8.3 (43%)	9.1 (39%)	10.2 (36%)
15-49 years (million - %)	7.0 (47%)	8.9 (46%)	11.3 (49%)	14.8 (52%)
50+ (million - %)	1.7 (11%)	2.2 (11%)	2.8 (12%)	3.6 (13%)
Growth rate (%)	2.4	2.8	2	1.6
Total fertility rate (births per woman)	5.8	5.6	3.9	2.5
Crude birth rate	41	40	30	22
Life expectancy at birth	48	55	63	66
Infant mortality rate (per 1,000 births)	114	92	61	39
Under 5 Mortality Rate (per 1,000 births)	189	135	79	48
Literacy rate			48.6	45
Measles vaccination [11]		57%	71%	86%
Vitamin A supplementation			65%	90%
Maternal mortality	539	539	415	229

4.4 Human resources, facilities and infrastructure

After the publication of the 1981 Nepal Blindness Survey, a flood of support started coming to Nepal to build up an elaborate eye health system. This is a striking illustration what impact good information and advocacy can have on the development of a health programme. (Table 46)

Eye care itself also changed tremendously. A cataract operation in 1981 would require the patient to be admitted for 5 days, food, beds, wards, nursing staff, caretakers, provision of aphakic spectacles, etc. Today, cataract surgery is, in most cases, completed in one day and the patient can see well again the next day. Nearly all patients receive an intra-ocular lens and reading glasses may be helpful but are no necessity any longer.

However, eye care in Nepal is very hospital and specialist oriented. Primary eye care and basic eye care workers hardly exist and referrals through the general health care system are rare. Most eye hospitals are located in the terai, close to the Indian border

Table 46 shows the development of the human resources and infrastructure for eye care. Despite the

[11] *Nepal 2009 EPI Fact Sheet. WHO, SEARO, 2010 http://www.searo.who.int/vaccine/LinkFiles/EPI2009/Nepal09.pdf*

impressive increase, the number of ophthalmic human resources is around half of the WHO norm for 2010. The capacity for cataract surgery is very high, as shown by the total number of cataract operations of 250,000 in 2011. However, 90,000 (36%) of all cataract operations are conducted on Nepali patients, giving a CSR of around 3100 in 2011.

Table 46. Human resource and infrastructure development for eye care in Nepal[11]

Health indicators	1981	2001	2011	WHO norm 2010
Ophthalmologists	7	76	147 (1:193,900)	1:100,000
Optometrists	0	5	56 (1:791,700)	1:100,000
Ophthalmic assistants	0	161	275 (1:103,600)	1:50,000
Eye nurses		52	90	
Eye hospitals / medical colleges	1	17	20	
Eye units in general hospitals	4		17	
Primary eye care centres	0	40	63	
Eye beds	50	2000	>4000	
Cataract operations (Total)	2,000		250,000	
Cataract operations (on Nepali's)		31,370	90,000	
CSR (Nepal)		1355	3100	

4.5 Prevalence of blindness in NBS (1981) and in recent surveys (2006-2010)

In the NBS, the prevalence of bilateral blindness (BCVA<3/60 in the better eye) was calculated for the total population of each zone, while the studies between 2002 and 2010 covered only people of 50 years and older. In the NBS, 21.3% of all blindness occurred in people younger than 50.[13]

To compare the findings of the recent surveys we have to estimate the prevalence of bilaterally blind in the age groups 0-14 and 15-49 and the number of people affected first.

The prevalence of blindness in people aged 0-49 in 2001 is likely to be less than the 21.3% in 1981. The Under 5 Mortality Rate (U5MR) in Nepal, a proxy for the prevalence of childhood blindness, declined from 142 in 1990 to 48 in 2009, which would approximately be equal to a reduction of the prevalence of childhood blindness from 1.0/1000 to 0.5/1000.[14]

The WHO review on the magnitude of blindness in 2002 indicated that for the Searo-D sub-region (which includes India, Nepal, Bangladesh and Pakistan) the prevalence of bilateral blindness in children aged 0-14 was 0.08% and for people aged 15-49, 0.2%. That would mean that for the population of 2001, 0.08% * 9,098,200 = 7,278 children aged 0-14 and 0.2% * 11,275,890 = 22,552 young adults aged 15-49 were blind in Nepal. Against the estimated 56,669 bilateral blind people aged 50+ in the recent surveys, this would mean that 35.5% of all blindness occurs in people aged 0-49. This proportion seems to high to be realistic. It might be explained by the fact that the surveys on which this review is based are mostly from 1981 to 2000.

We decided to use the 21.3% of blindness in persons aged 0-49 from the NBS, although it may be an over-estimation.

The second difference was the population data for people aged 50+ at the time of the recent surveys. Population data by 5-year age group and by sex for each zone, required for RAAB, was at the time

[13] *Nepal Blindness Survey, 1981. Table 4-14, page 126*

[14] *Gilbert C, Rahi J. Visual impairment and blindness in children. Magnitude and causes. Chapter 14a, page 278 in The Epidemiology of Eye Disease, third edition, London 2012*

[15] *Resnikoff S, Pascolini D, Etya'ale D, Kocur I, Pararajasegaram R, Pokharel GP, et al. Global data on visual impairment in the year 2002. Bull World Health Organ. 2004;82(11):844–51.*

the recent surveys were conducted only available for the year 2001. Projections for 2011 indicate that the population aged 50+ in Nepal increased by 30% between 2001 and 2011.

To make the number of cases of the 2006-2011 estimates comparable with the NBS estimates, the estimated cases aged 50+ by zone in 2006-2010 were divided by (100-21.3%) to add the affected persons aged 0-49 years. The result was then multiplied by 1.3 to correct for the population aged 50+ which increased by 30% between 2001 and 2011. Finally this number of estimated cases for 2011 was divided by the total population of each zone in 2011 to get the estimated prevalence of blindness in 2011 for all ages.

The limitation of this modelling is that there is considerable variation in the population growth from 2001 to 2011 in the different zones. The annual growth rate varies from -0.21% in Dhawalagiri to 2.79% in Bagmati zone. However, no detailed data are available on the changes in age and gender composition by zone between 2001 and 2011 and therefore the average for Nepal was used. (Table 47)

Table 47. Prevalence of bilateral blindness (BCVA<3/60 in better eye) and estimated cases in 1981 and in 2011

	NBS 1981			Surveys 2002-2010		
Zone	**$N_{total\ population}$**	**$P_{total\ population}$**	**n_{50+}**	**P_{50+}**	**$n_{total\ population}$**	**$P_{total\ population}$**
Bagmati	11,415	0.62%	2,380	0.64%	3,921	0.10%
Bheri	9,906	1.26%	4,669	3.15%	7,693	0.45%
Dhawalagiri	1,291	0.53%	662	0.77%	1,091	0.20%
Gandaki	5,574	0.46%	2,326	1.01%	3,832	0.25%
Janakpur	11,212	0.73%	6,591	2.08%	10,860	0.38%
Karnali	2,100	1.63%	285	1.47%	470	0.12%
Kosi	12,685	0.99%	4,923	2.08%	8,111	0.35%
Lumbini	11,262	0.75%	6,564	1.67%	10,815	0.38%
Mahakali + Seti	14,310	1.02%	6,390	2.55%	10,529	0.41%
Mechi	5,525	0.64%	3,070	1.93%	5,058	0.35%
Narayani	14,963	1.00%	14,783	6.38%	24,357	0.81%
Rapti	5,805	0.87%	1,177	0.94%	1,939	0.13%
Sagarmatha	11,575	0.98%	2,850	1.17%	4,696	0.23%
Nepal (weighted)	**117,623**	**0.84%**	**56,669**	**2.02%**	**93,372**	**0.35%**

Overall, the prevalence of blindness in the total population of Nepal declined significantly from 0.84% in 1981 to 0.35% in 2011, a reduction of 58.6%. The number of affected persons (all ages) reduced with 20.6% from 117,600 to 93,400.

When shown as graphs the changes by zone from table 47 are easier evaluated. Figure 14a shows the change in the prevalence of blindness, figure 14b the change in the estimated number of bilateral blind persons. The prevalence of blindness in all zones of Nepal decreased significantly between 1981 and 2001, with exception of Narayani zone.

In terms of numbers of blind people, the improvements are less impressive. In Janakpur, Lumbini and Mechi zones the number of blind people remained the same and in Narayani zone the number increased from 15,000 to 24,400. The reason is that the number of people aged 50+ in Nepal increased by more than doubled (112%) between1981 and 2011.

Figure 14a.

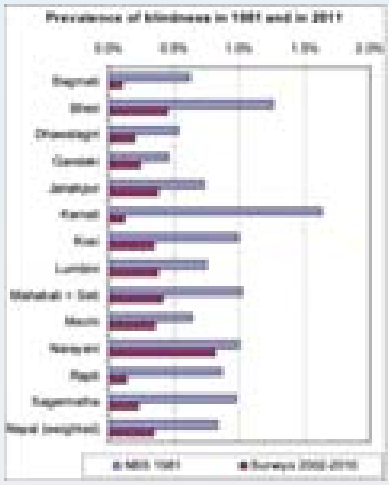
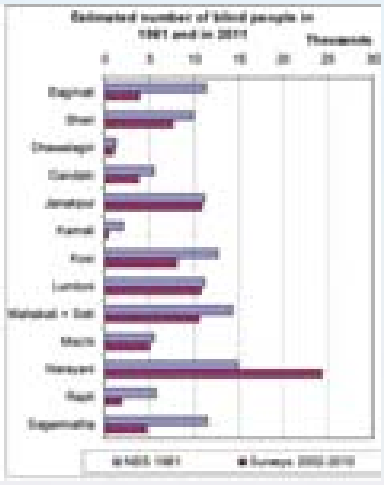


Figure 14b.



4.6 Causes of blindness and visual impairment

Although the NBS covered people of all ages and the recent surveys only people aged 50+, the causes are very well comparable. This is because in most countries 80-90% of all blindness occurs in people aged 50+ and the distribution by cause in the older age group is very dominant.[16]

The causes of blindness in eyes listed in the NBS and the recent surveys were categorised differently, but by regrouping the causes comparison is possible. The estimated number of blind eyes reduced by 28%, the causes changed considerably. The prevalence of cataract reduced by 21% and the prevalence of trachoma by 74%. The prevalence of other corneal scars and phthisis doubled, the prevalence of glaucoma increased by a third and the prevalence of other posterior segment disease increased by 22%. (Table 48)

Table 48. Causes of blindness in eyes in 1981 and in 2006-2010

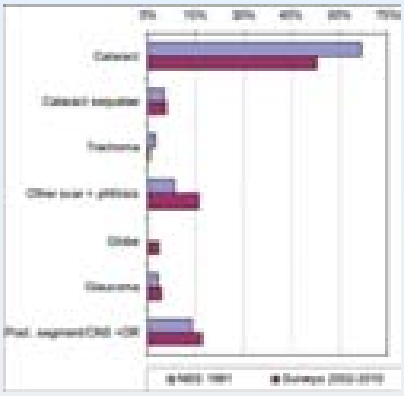
	NBS 1981		Surveys 2006-2010		Change	
Cause	**n**	**%**	**n**	**%**	**n**	**%**
Cataract	78,605	66.8%	49,366	52.9%	37.2%	-20.9%
Cataract sequelae	6,195	5.3%	5,348	5.7%	13.7%	8.8%
Trachoma	2,822	2.4%	575	0.6%	79.6%	-74.3%
Other scar + phthisis	9,862	8.4%	14,970	16.0%	-51.8%	91.2%
Globe			3,265	3.5%		
Glaucoma	3,819	3.2%	4,047	4.3%	-6.0%	33.5%
Post. segment/CNS +DR	16,318	13.9%	15,851	17.0%	2.9%	22.4%
Total	**117,621**	**100.0%**	**93,422**	**100.1%**	**20.6%**	**0.1%**

The reduction of blindness from cataract can be explained by the enormous increase in cataract surgery. Trachoma reduced as a result of specific intervention programmes under Nepal Trachoma Programme. Posterior segment disease increased because of the rise in absolute numbers of older people and the life expectancy of the population. The causes of corneal scarring and phthisis, trauma and corneal infection, did not reduce because of lack of primary eye care and treatment facilities in more remote rural areas. Relatively this became a more prominent cause of blindness.

The data from table 48 are also shown in figure 15.

[16] *Dineen B, Foster A, Faal H. A Proposed Rapid Methodology to Assess the Prevalence and Causes of Blindness and Visual Impairment. Ophthalmic Epidemiology. 2006;13(1):31–4*

Figure 15. Cause of blindness (BCVA<3/60) in eyes in 1981 and in 2010



4.7 Cataract

The prevalence of bilateral blindness from cataract and the number of affected patients was modelled in a similar way as all blindness in chapter 4.4. The modelling assumed that 5% of all blindness due to bilateral cataract occurs in persons younger than 50 and that the population 50+ in 2011 was 30% more than in 2001. From the age- and sex-specific prevalence of bilateral cataract blindness in the NBS it can be seen that approximately 5% of all bilateral cataract occurs in people below 50 years.[17] This is similar as in the Survey of Blindness, India from 1986-'89.[18]

Table 49 shows that the prevalence of blindness due to bilateral cataract reduced from 0.56% in 1981 to 0.19% in 2011, a reduction of 67%. The estimated number of people of all ages bilateral blind from cataract reduced from 78,608 in 1981 to 49,366 in 2011, a reduction of 37%. The reductions achieved in bilateral cataract blindness are much higher than those in all blindness.

Table 49. Prevalence of bilateral cataract blindness (BCVA<3/60 in better eye) and estimated cases in 1981 and in 2011

	NBS 1981			Surveys 2002-2010		
Zone	**N total population**	**P total population**	**n 50+**	**P 50+**	**n total population**	**P total population**
Bagmati	7,757	0.46%	699	0.19%	957	0.02%
Bheri	6,120	0.58%	2,092	1.41%	2,863	0.17%
Dhawalagiri	984	0.59%	346	0.40%	473	0.09%
Gandaki	2,921	0.26%	1,674	0.72%	2,291	0.15%
Janakpur	6,917	0.47%	4,004	1.26%	5,479	0.19%
Karnali	1,743	0.93%	93	0.48%	127	0.03%
Kosi	8,814	0.65%	2,817	1.19%	3,855	0.17%
Lumbini	7,252	0.53%	3,579	0.92%	4,897	0.17%
Mahakali + Seti	10,200	0.73%	3,622	1.44%	4,956	0.19%
Mechi	4,147	0.48%	2,092	1.31%	2,863	0.20%
Narayani	11,941	0.78%	12,606	5.44%	17,250	0.58%
Rapti	2,030	0.27%	422	0.34%	577	0.04%
Sagarmatha	7,778	0.60%	2,029	0.84%	2,777	0.13%
Nepal (weighted)	**78,604**	**0.56%**	**36,075**	**1.28%**	**49,366**	**0.19%**

[17] *Nepal Blindness Survey, 1981. Table 6-5, page 187*
[18] *ICMR-NPCB Collaborative Study on Prevalence of Cataract. New Delhi 1990. Madan Mohan*

In graphs the achievements become even more clear. Figure 16a shows the reduction in bilateral blindness from cataract. Except for Narayani, Mechi and Janakpur all zones saw a reduction to a third or less. In term of numbers of patients with bilateral cataract blindness, the number actually increased in Narayani and only reduced slightly in Janakpur, Mechi and Lumbini.

Figure 16a. Prevalence cataract blindness 1981 and 2011

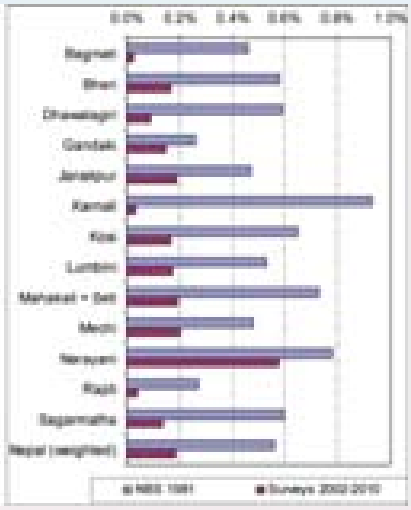
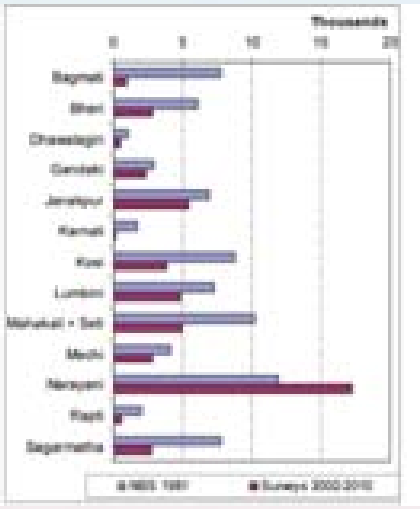


Figure 16b. Estimated number of cataract blind people 1981 and 2011



The achievement becomes even more impressive when it is realised that In 1981, one third of all aphakic Nepali's had been operated in India, while in 2009 all operations were conducted in Nepal. On top of that about 71% of the 198,000 cataract operations in Nepal were conducted on Indian patients.

In 1981, 21 persons (26 eyes) were seen where couching was applied. In the recent surveys 5 persons (6 eyes: Karnali: 1; Mahakali + Seti: 2; Sagarmatha: 3) had couching.

While the prevalence of bilateral blindness due to cataract and estimated numbers of affected people decreased between 1981 and 2011, the earlier stages of cataract have increased since 1981. While anybody with a VA<6/18 and cataract can be operated in Nepal, it seems that many patients wait until their vision gets worse. That is a pity because the longer patients wait with surgery, the higher the risk of losing productivity and income. It has been demonstrated that cataract surgery increases the socio-economic position of the patient and the immediate family. [1]

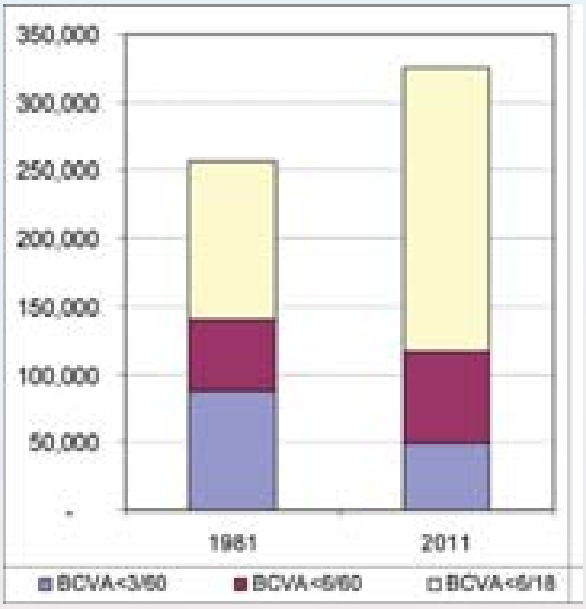
The number of people blind from cataract in the recent surveys was increased with 5% to include the people blind from cataract who are younger than 50 (Table 50). This makes it comparable with the results from 1981.

Table 50. Cataract surgical backlog (bilateral cataract) in 1981 and in 2011

Cause	1981	2011	Change
BCVA<3/60	87,459	46,263	-47.1%
BCVA<6/60	140,840	111,446	-20.9%
BCVA<6/18	256,887	308,676	20.2%

Figure 17 shows the cataract surgical backlog in Nepal in 1981 and in 2011. Cataract blindness reduced, but SVI and MVI due to cataract have increased.

Figure 17. Cataract surgical backlog in Nepal (1981 versus 2011)



4.8 Cataract Surgical Coverage

In 1981 a total of 105 persons had one or two aphakic eyes: a prevalence of 2.0% in people aged 50+. The prevalence of aphakia was highest in Kathmandu and in zones in the proximity of eye hospitals in Nepal and neighbouring India. Table 51 shows the cataract surgical coverage for persons and a VA<3/60 in 1981 and in 2006-2010.

Table 51. Cataract surgical coverage (persons; VA<3/60) in 1981 and in 2006-2010

	CSC (persons) <3/60	
Zone	**NBS 1981**	**Surveys 2006-2010**
Bagmati	30 - 50	96.5
Bheri	30 - 50	82.4
Dhawalagiri	>50	70.5
Gandaki	30 - 50	59.5
Janakpur	30 - 50	84.1
Karnali	<30	90.4
Kosi	30 - 50	79.1
Lumbini	30 - 50	66.6
Mahakali + Seti	>50	82.7
Mechi	<30	74.7
Narayani	<30	37.3
Rapti	30 - 50	93.5
Sagarmatha	<30	82.6
Nepal (weighted)	**35.0**	**84.6**

** Only available for PVA<6/60*

The CSC shows an impressive improvement in all zones, except for Narayani and to a lesser extent Gandaki zone.

4.9 Visual outcome

Surgical techniques have changes tremendously between 1981 and today. In 1981 intra-capsular cataract extraction (ICCE) with aphakic spectacles was the standard surgical technique. Today more than 90% of cataract operations are with IOL implantation and the majority with SICS or phaco.

The NBS does not provide data on visual outcome by zone. All aphakics were tested for visual acuity with plus-ten glasses and pinholes, but only a fraction of the patients who received glasses after surgery were using them at the time of examination. More than half of the operated eyes in the NBS were functionally blind due to broken or unreplaced glasses and postoperative complications. Unfortunately, this is not visible in Table 52 since this reports best corrected VA only.

The visual acuity of aphakics in the recent surveys was measured without and with pinhole. Table 52 indicates that the pinhole visual outcome of recent surgeries is better compared to 1981. It needs to be mentioned that since the introduction and subsequent wide spread use of IOLs, cataract is operated at a much earlier stage as in 1981. This also reduces the risk of complications and concurrent eye disease. But with the increasing life expectancy at birth the risk of concurrent eye disease also increases.

Table 52. Best corrected visual outcome after cataract surgery in 1981 and in 2006-2010

Visual outcome	NBS 1981	Surveys 2006-2010
³3d6/18	74.3%	78.4%
<6/18 - 6/60		11.0%
<6/18 - 3/60	7.4%	
<6/60		10.7%
<3/60	18.4%	

4.10 Barriers

In the NBS, all patients with unoperated cataract were interviewed. Only 23% knew that their visual problem was caused by cataract and of these 54% knew this could be operated. People in areas closer to eye hospitals in Nepal or India had better knowledge. The major reason for not being operated were costs of the operation, food and transport, not aware that treatment is possible and lack of transport. Even in 2011, many people are unaware that cataract is treatable and don't know when and where to ask for help. This is a sign of the limited reach and capacity of primary eye care in Nepal.

The barriers in 2006-2011 are more or less the same, although there is great variation between the different zones. (Table 53; see also tables 34 and 35).

Table 53. Barriers to cataract surgery

Barriers	NBS 1981	Surveys 2006-2010
Unaware of treatment	19%	15%
Destiny/God's will		1%
Wait for maturity		5%
No services		6%
How to get surgery	11%	5%
Cannot afford	34%	23%
No company	4%	18%

No time		3%
Old age: no need	4%	12%
One eye not blind	4%	1%
Fear of operation		5%
Fear of loosing sight		1%
Contra-indication		6%

4.11 Uncorrected refractive errors (URE)

There are no data from 1981 on URE because at that time visual acuity was measured with best correction, whereby URE was automatically excluded. Since VA is measured with available correction as well as with pinhole in the RAABs we know that URE are a major cause of visual impairment in people aged 50+ (see chapter 3.7, Table 49). The magnitude of URE in people younger than 50 is unknown.

4.12 Trachoma

Since the launch of the trachoma control programme in 2002, 10.6 million doses of Zithromax have been administered and 15,161 persons had eyelid surgery for trichiasis. However, another 35,000 patients with trichiasis still require surgery.[19]

Trachoma reduced from 2.4% (2,822 eyes) in 1981 to 0.6% (575 eyes) in 2011, despite the fact that the number of people 50+ more than doubled. That means that the intensity of the infection in children must have come down considerably. According to the Nepal Trachoma Programme more than 34,000 cases of trichiasis still require eyelid surgery.

4.13 Childhood blindness

In 1981, a total of 17,423 children aged 0-15 were examined in the NBS. In this sample a prevalence of bilateral blindness of 0.68 per 1000 children was found. A detailed analysis was given of the causes.

Although the recent surveys did not cover children, it may be possible to evaluate the changes in childhood blindness since 1981. Studies have shown that there is a relationship between the prevalence of blindness in children and the mortality rates in children under 5 years of age (U5MR). The U5MR in Nepal showed a declining trend from 142 in 1990 to 48 in 2009.[20] The corresponding estimates of the prevalence of blindness in children are shown in table 54.

Table 54. Estimates on childhood blindness in Nepal [10]

Year	U5MR	Prevalence childhood blindness (n / 1000)	
		survey	estimate from U5MR
1981	189	0.68	
1991	135		1.0
1995	117		0.8
2001	85		0.7
2005	62		0.6
2011	48		0.5

[19] *Mid Term Review of VISION 2020: The Right to Sight, Nepal 2011, Ministry of Health & Population, Government of Nepal, Kathmandu 2011. Page 26-27*

[20] *Statistical Yearbook for Asia and the pacific 2011. Economic and Social Commission for Asia and the Pacific (ESCAP). Table I.10 page 156. Available at: http://www.unescap.org/stat/data/syb2011/I-People/Child-health.asp*

The table suggests that the prevalence of childhood blindness reduced from 0.68% in 1981 to 0.5% in 2009. Extrapolated to the corresponding population, the number of bilateral blind children would have reduced slightly from 4,300 to 4,100. This is because the total number of children aged 0-14 increased from 6.3 to 10.2 million between 1981 and 2011.

With the expansion of the EPI programme, the high coverage of measles vaccination (86%) and the Vitamin A supplementation scheme (90%) the incidence and prevalence of nutritional blindness must have reduced considerably.

Chapter 5. Conclusions and recommendations

Eye care in Nepal has seen enormous developments over the past three decades. The findings of the NBS in 1981 have been instrumental in generating massive international support for eye care. The Government of Nepal and the national NGOs have been instrumental in transforming all this support into an elaborate and modern eye care system that has enough capacity to take care of all the eye care needs of Nepal. The achievements in reducing avoidable blindness in Nepal have been impressive, but the demographic changes of a fast growing and ageing population are catching up quickly and require a continuous increase in output and expansion of the eye care system. There are many places in Nepal where adequate eye care is not available or not affordable.

The objectives for the blindness control programme immediately after the NBS were:

- achievement of national self-reliance in eye health care
- a 90% reduction in the incidence of preventable blindness
- a 90% reduction in the prevalence of curable blindness

In principle Nepal has achieved self-reliance in eye health care. The capacity of the existing eye care services is in principal enough to take care of the current eye care needs of the Nepali population. Training of all cadres of ophthalmic manpower is now available at medical colleges in Nepal. Most eye hospitals are at present financially independent.

However, in practice the current eye care services are neither used fully nor effectively to eliminate avoidable blindness in Nepal. In 2009, 71% of all cataract operations are done on patients from India, while only few efforts are made to bring in more local patients for cataract surgery. The eye health system if almost fully NGO driven and operates in isolation. Referrals from and to government hospitals and clinics are difficult and uncommon. The eye care system is specialist-driven and has hardly any links with the national health system. “This has resulted in an eye care system which is world class in Kathmandu, and reasonably good (but not comprehensive) in most tertiary level institutions, weak at secondary level and virtually non-existent at the primary care level.” [21] Mid Term Review of VISION 2020: The Right to Sight, Nepal 2011, Ministry of Health & Population, Government of Nepal, Kathmandu 2011, page xvi

The financial sustainability is largely based upon the revenue generated by surgery on Indian patients. Without any support from the Government of Nepal this is a very fragile sustainability.

To assess whether the incidence of preventable blindness has been reduced is more complicated, if not impossible, because the incidence of preventable blindness is not known. Nutritional blindness, mainly as a result of vitamin A deficiency (VAD) has definitely reduced with the expansion of the EPI programme and with the high coverage of measles vaccination (86%) and the Vitamin A supplementation scheme (90%). Trachoma used to be endemic in many districts in Nepal and was a major cause of blindness. With the Trachoma intervention programme the incidence of blinding trachoma almost reduced to zero. But phthisis and non-trachomatous scarring due to trauma, infections and harmful practices still cause 4.1% of all bilateral blindness (PVA<6/60 in the better eye).

With the increase of the life expectancy and the proportion of elderly people, the incidence of blindness and visual impairment from glaucoma and diabetic retinopathy, which today can be prevented by regular control and timely intervention, also increases.

Finally, early cataract and refractive errors belong also in this group, because if these are corrected in time they will not don’t lead to blindness.

The third objective was to reduce the prevalence of curable blindness by 90%. In the NBS 80.2% (94,310) of the 117,623 persons with bilateral blindness were considered to be curable and 19.8% (23,313) permanent blind. If the number of curable blind would be reduced by 90% then 9,431 curable blind remain. Assuming that all treated patients regained sight then the new proportion of curable blindness would be 9,431 / (9,431 + 23,313) * 100 = 28.8%. This should then be visible in the proportion

of curable blindness (Table 36). The lowest proportions are seen in Bagmati (53%) and in Rapti zone (56%). These two zones also have the highest CSC and the lowest prevalence of bilateral blindness due to cataract. For Nepal the proportion curable blindness (PVA<3/60 in the better eye) in people aged 50+ is 66%, meaning that an estimated 40-50% of all curable blindness in Nepal was actually treated.

Nepal launched its VISION 2020 program in 1999 and a 20-year plan was presented in September 2001. The objectives of VISION 20202: The Right to Sight programme in Nepal are:

1. eliminate avoidable blindness by the year 2020
2. establish sustainable eye care systems integrated with the general health care system

The medium term goals are:

1. reduce the burden of disease for the major avoidable causes of blindness: cataract, trachoma, childhood blindness, refractive errors and low vision. In the current situation glaucoma and diabetic retinopathy should also be added.
2. Develop appropriate and adequate human resources
3. Develop adequate infrastructure and technology
4. Promote advocacy, policy and resource mobilisation

It is difficult to assess how much of the above objectives and goals were achieved. The eye care system continued its expansion between 2001 and 2011 in human resources and infrastructure, as well as in output (see Table 51). But the data on the disease burden from RAABs and custom surveys were mainly collected between 2006 and 2011. These can only be compared with data from the NBS in 1981.

As mentioned above, avoidable blindness has not been eradicated. This will be very difficult because there will always be patients who refuse treatment for various reasons. Even if patients agree to be treated there will always be some time delay between taking the decision to seek medical help and the actual operation.

The establishment of a sustainable system for eye care with the general health care system of Nepal is the most difficult, but at the same time the most crucial task in Nepal.

The reduction of the disease burden has been fairly successful in Nepal. But so far it has mainly been focussing on patients who came directly to the eye hospitals with a request for help. That the majority of these patients came from India did not matter much as long as they brought in easy revenue to bring financial sustainability to the hospital. There are hardly any systems in place to actively reaching out to more remote areas to identify and mobilise Nepali patients with eye problems to come to the eye clinics.

Nepal has become self-sufficient in training of ophthalmic professionals. Although they don't meet the required numbers yet according to the WHO standards the capacity at present is sufficient to cater for the needs for eye care of the people from Nepal. What is lacking, however, are human resources to provide primary eye care in the remotest places and refer patients to facilities that can provide the necessary eye care. Large numbers of ophthalmic assistants are needed to provide basic eye care at secondary level institutions. Also, large numbers of optometrists are needed to build an adequate system of optical services throughout Nepal.

While in some zones the reduction of blindness has been impressive, other zones are still lagging behind.

Recommendations:

1. Develop cooperation and collaboration with general health programmes at district and zonal level. This is the most challenging issue which has a lot of political implications as well. However, it is the most essential requirement to achieve the objectives and goals of VISION 2020 in Nepal. With this collaboration there should be provision of basic eye care service at community level.

2. The eye care programme of Nepal should focus on the elimination of avoidable blindness in Nepal. This requires a full integration in the general health services of the country, from tertiary institutions up to the primary health care level in the remotest villages. The Government has to define the framework within which the private and NGO have to perform. That could start with prioritisation of interventions according to the eye care needs of the Nepali population. The GoN may consider to establish public-private partnerships or to provide subsidies to private and NGO hospitals to provide eye care to Nepali's in remote rural areas.

3. Decentralise the eye care programme to the zones. There are great differences between the zones in the availability and use of the eye care services, in disease burden. Some zones have done very well in reducing avoidable blindness (Bagmati, Rapti, Karnali, while others are lagging behind (Narayani, Gandaki, Mechi, Janakpur, Bheri). The strategies to increase the output and the impact of the eye care services may differ by zone as well. Zones with poor performance may learn from their colleagues in zones with excellent performance.

4. Develop VISION 2020 action plans for each zone. Usually local professionals know best what the constraints are and how to overcome these. This knowledge and experience should be tapped and translated in the zonal action plans. Data from this report can be very useful in the development of such plans. This allows each zone to address its own needs and to make optimal use of all the available resources in the zone, from the public, private and NGO sector. It is essential that all stakeholders in the zone participate in this process and fully commit themselves. Eye hospitals often feel they are in competition with their colleagues in other hospitals, making cooperation and collaboration impossible. However, the burden of eye diseases is too large to be solved by one hospital alone and the only solution is cooperation and sharing the tasks and responsibilities in the zone.

Special attention at this stage has to go to those zones where the total visual impairment (PVA<6/18 in the better eye) is higher than 15%. These are Narayani (42%), Janakpur (22%), Kosi (21%), Mechi (20%) and Bheri (18%). Also the zones and districts without any eye care infrastructure need special attention. The action plan should include clear targets and goals.

5. Increase the number of cataract operations on Nepali citizens. The number of cataract operations per year has to increase each year by at least 15% in order to keep pace with the increased demands due to the demographic trend and economic development. The prevalence of cataract in women is higher and the CSC in women is lower in most zones, indicating that more activities are needed to increase the number of cataract operations in women. The quality of cataract surgery in general is fair, but further improvement is possible by using routine outcome monitoring and identification of the causes of poor outcome.

6. Develop adequate infrastructure to provide refraction and optical services throughout Nepal. Uncorrected refractive errors are the second cause of visual impairment in Nepal. The average spectacle coverage is 45% but an many zones it is much lower. An adequate system to provide optical correction at an affordable price is the most cost-effective intervention to reduce avoidable visual impairment and to increase productivity.

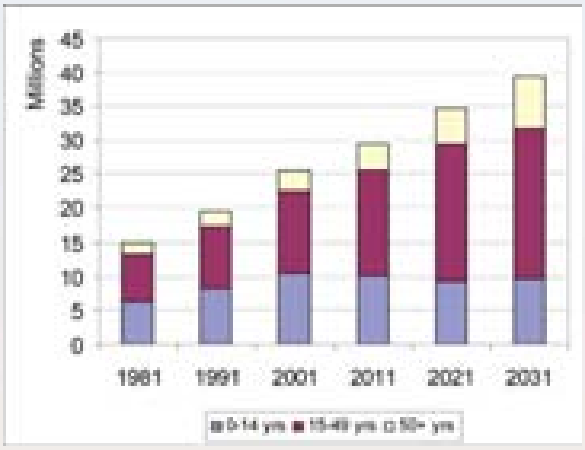
7. Special programmes to control blindness from Diabetic Retinopathy and Glaucoma. Also in Nepal the numbers of these patients are increasing. However, the ophthalmic infrastructure, equipment and human resources to examine and treat these patients are expensive. The cost-effectiveness to prevent visual impairment and blindness is much higher than for cataract surgery and correction of refractive errors. Small scale experiments in zones where cataract, refractive errors, trachoma and childhood blindness are well under control could be considered. In the other zones priority should be given to reorganise the eye care system and to implement the more cost-effective control of cataract and refractive errors.

Chapter 6. Prognoses

Like other countries in the region the population of Nepal is also 'ageing'. Birth rates are falling but due to the increasing life expectancy the population continues to grow, while the proportion of people aged 50+ increases.

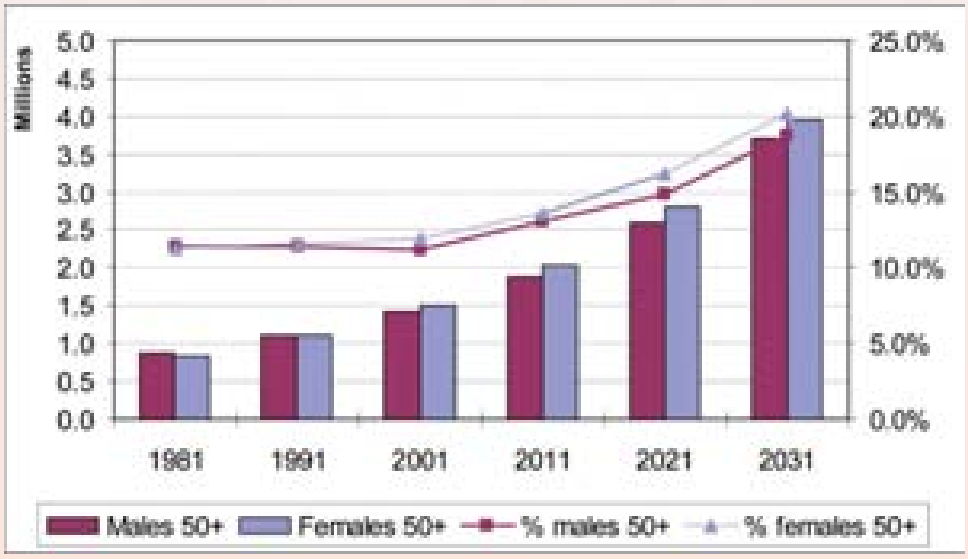
Figure 18 shows that the total population of Nepal is expected to continue to grow at more or less the same rate. The number of people aged 0-14 stabilises in 2001 and reduces even slightly thereafter. The population aged 15-49 continues to increase, as well as the number of people aged 50+, those most at risk of cataract and other age-related blinding diseases.

Figure 18. Population increase in Nepal (1981 – 2031)



Age is the main factor that determines the incidence of blindness. Figure 19 shows that the population aged 50+ in Nepal more than doubled from 1.7 million to 3.9 million in the 30 years between 1981 and 2011. It is expected to double again from 3.9 million to 7.6 million in the 20 years between 2011 and 2031. The number of females increases slightly faster than the number of males, but the difference is not significant.

Figure 19. Demographic trends males and females aged 50+.[22]



[22] *Source: International Data Base, US Census Bureau*
http://www.census.gov/population/international/data/idb/country.php

The lines in figure 19 indicate that the proportion of the population aged 50 years and older is expected to increase from 12% in 2001 to 20% in 2031. This is less than in other Asian countries where this demographic trend has started earlier, but it will cause an increase in the incidence of age related eye diseases, including blindness and visual impairment. Eye care services and their output throughout Nepal have to increase as well in order to balance this annual increase in incidence and to reduce the backlog further.

To cover the annual increase of the incidence of cataract, caused by the ageing trend, the number of cataract operations has to increase about 5% per year. Covering the earlier stages of cataract (Table 57) will require another 5% increase and finally, with the ongoing development in Nepal, the demand for good eyesight will also go up, good for another annual increase of 5% in cataract operations. All together the number of cataract operations on Nepali citizens has to increase each year by about 10-15% just to compensate for the demographic trends only.

Annex 1. RAAB survey form

RAPID ASSESSMENT FOR AVOIDABLE BLINDNESS

A. GENERAL INFORMATION

Survey area: _____ Cluster: ☐☐☐ Year - month: ☐☐☐☐ - ☐☐

Name: _____ Sex: Male: ○ (1) Female: ○ (2) Individual no.: ☐☐ Age (years): ☐☐

Optional 1: ☐☐ Optional 2: ☐☐

Examination status:
Examined: ○ (1) (go to B) Refused: ○ (3) (go to E)
Not available: ○ (2) (go to E) Not able to communicate: ○ (4) (go to E)

Always ask: "Did you ever have any problems with your eyes?"

B. VISION - presenting vision

Using distance glasses: No: ○ (1) Yes: ○ (2)

	Right eye	Left eye
Can see 6/18	○ (1)	○ (1)
Cannot see 6/18 but can see 6/60	○ (2)	○ (2)
Cannot see 6/60 but can see 3/60	○ (3)	○ (3)
Cannot see 3/60 but can see 1/60	○ (4)	○ (4)
Light perception (PL+)	○ (5)	○ (5)
No light perception (PL-)	○ (6)	○ (6)

VISION - with pinhole

	Right eye	Left eye
Can see 6/18	○ (1)	○ (1)
Cannot see 6/18 but can see 6/60	○ (2)	○ (2)
Cannot see 6/60 but can see 3/60	○ (3)	○ (3)
Cannot see 3/60 but can see 1/60	○ (4)	○ (4)
Light perception (PL+)	○ (5)	○ (5)
No light perception (PL-)	○ (6)	○ (6)

C. LENS EXAMINATION

	Right eye	Left eye
Normal lens / minimal lens opacity:	○ (1)	○ (1)
Obvious lens opacity:	○ (2)	○ (2)
Lens absent (aphakia):	○ (3)	○ (3)
Pseudophakia without PCO:	○ (4)	○ (4)
Pseudophakia with PCO:	○ (5)	○ (5)
No view of lens:	○ (6)	○ (6)

D. MAIN CAUSE OF PRESENTING VA<6/18

(Mark only one cause for each eye)

	Right eye	Left eye	Principal cause in person
Refractive error:	○ (1)	○ (1)	○ (1)
Cataract, untreated	○ (2)	○ (2)	○ (2) (F)
Aphakia, uncorrected:	○ (3)	○ (3)	○ (3)
Surgical complications:	○ (4)	○ (4)	○ (4)
Trachoma:	○ (5)	○ (5)	○ (5)
Phthisis:	○ (6)	○ (6)	○ (6)
Other corneal scar:	○ (7)	○ (7)	○ (7)
Globe abnormality:	○ (8)	○ (8)	○ (8)
Dilate pupil:			
Glaucoma:	○ (9)	○ (9)	○ (9)
Diabetic retinopathy:	○ (10)	○ (10)	○ (10)
ARMD:	○ (11)	○ (11)	○ (11)
Onchocerciasis:	○ (12)	○ (12)	○ (12)
Other post. segment / CNS:	○ (13)	○ (13)	○ (13)
Not examined (can see 6/18)	○ (14)	○ (14)	○ (14)

E. HISTORY, IF NOT EXAMINED

(From relative or neighbour)

Believed	Right eye	Left eye
not blind	○ (1)	○ (1)
blind due to cataract	○ (2)	○ (2)
blind due to other causes	○ (3)	○ (3)
operated for cataract	○ (4)	○ (4)

F. WHY CATARACT OPERATION WAS NOT DONE

(Mark up to 2 responses, if VA<6/18, not improving pinhole, with visually impairing lens opacity in one or both eyes)

Unaware that treatment is possible	○ (1)
Believes it to be destiny / God's Will	○ (2)
Told to wait for cataract to mature	○ (3)
Surgical services not available or very far	○ (4)
Don't know how to get surgery	○ (5)
Cannot afford operation	○ (6)
No one to accompany	○ (7)
No time available / other priorities	○ (8)
Old age and need not felt	○ (9)
One eye adequate vision / need not felt	○ (10)
Fear of operation	○ (11)
Fear of loosing eye sight	○ (12)
Other disease contra-indicating operation	○ (13)

G. DETAILS ABOUT CATARACT OPERATION

	Right eye	Left eye
Age at operation (years)	☐☐	☐☐
Place of operation		
Government hospital	○ (1)	○ (1)
Voluntary / charitable hospital	○ (2)	○ (2)
Private hospital	○ (3)	○ (3)
Eye camp / improvised setting	○ (4)	○ (4)
Traditional setting	○ (5)	○ (5)
Type of surgery		
Non IOL	○ (1)	○ (1)
IOL implant	○ (2)	○ (2)
Couching	○ (3)	○ (3)
Cost of surgery		
Totally free	○ (1)	○ (1)
Partially free	○ (2)	○ (2)
Fully paid	○ (3)	○ (3)
Cause of VA<6/18 after cataract surgery		
Ocular comorbidity (Selection)	○ (1)	○ (1)
Operative complications (Surgery)	○ (2)	○ (2)
Refractive error (Spectacles)	○ (3)	○ (3)
Longterm complications (Sequelae)	○ (4)	○ (4)
Does not apply - can see 6/18	○ (5)	○ (5)
Are you satisfied with results of cataract surgery?		
Very satisfied	○ (1)	○ (1)
Partially satisfied	○ (2)	○ (2)
Indifferent	○ (3)	○ (3)
Partially dissatisfied	○ (4)	○ (4)
Very dissatisfied	○ (5)	○ (5)

Annex 2. Survey form used in Gandaki, Lumbini and Narayani survey

Cataract Program Evaluation in Gandaki Zone Nepal

Eye Examination Record — Form 3

Name: _____ Where Examined (Site=S; House=H)

A. Cluster | HH | Per | QA = 1 | Age | Sex | Mon | Date | Year = 2000

Ophthalmic Assistant ID

R L

B. Vision:

Presenting Vision

Wearing glass (1 = No ; 2 = Yes)

If Yes, unaided vision

VA couldn't be determined, reason:

and estimated vision status

Believed Blind = 1

Believed Not Blind = 2

Undetermined = 3

C. Cataract Surgery History:

Did you have Cataract Surgery (1 = No ; 2 = Yes)

If yes, Month & Year

Where (1= Govt.Hospital; 2= Pvt./NGO; Free 3= Pvt./NGO;Paying; 4= Eye camp)

Name of Hospital/Camp Place

RE .....

LE .....

D. Refraction with Retinoscopy:

(If presenting VA< 6/19 in either eye or cataract operated)

Ophthalmic Assistant ID

	Sph	Cyl	Axis	VA
Right Eye				
Left Eye				

Ophthalmologist ID

R L

E. Basic Eye Examination:

Mark as applicable (1=not present; 2=present; 9=undetermined)

Eyelid: Defective closure; Inturned margins/trichiasis

Globe: Phthisical/disorganised; Absent; Conjunctivitis; Central corneal opacity; Corneal ulcer; Pterygium (corneal)

Others (specify) RE .....

LE .....

Pupillary reflex:

(1=Reactive; 2=Sluggish; 3=Non-reactive; 9=Undetermined)

Can't be examined, reason: .....

F. Intraocular Pressure: (as indicated)

Was IOP done (1 = No; 2 = Yes)

If yes Reading

G. Anterior Chamber: AC depth

(1=Normal; 2=Shallow; 3=Deep; 9=Undetermined)

H. Pupil dilation: (as indicated)

Were pupil dilated (1=No; 2=Yes)

Was it dilated to 2.6mm (1=No; 2=Yes)

I. Lens status:

Normal .1

Cataract - some red reflex .2

Cataract - no red reflex .3

Aphakia .4

Aphakia with PCO .5

Pseudophakia .6

Pseudophakia with PCO .7

RE ..... Others (specify) .8

LE .....

Undetermined .9

J. Cataract Surgery details: (If operated for cataract)

	R	L
Type of Cataract Surgery: ICCE .1	☐	☐
ICCE - IOL .2		
ECCE .3		
Phaco/SICS - IOL .4		
ECCE - IOL .5		
Others (specify) RE. 6		
LE.		
Undetermined .9		
Incision: Corneal .1	☐	☐
Corneoscleral/limbal .2		
Scleral .3		
Undetermined .9		
Indectomy: Peripheral .1	☐	☐
Sectoral .2		
None .3		
Undetermined .9		

Cataract Surgical Complications:
(1=Not present; 2=Present; 9=Undetermined)

Iris Prolapse	☐	☐
Vitreous in AC/Wound	☐	☐
Corneal decompensation	☐	☐
Pupillary capture by IOL	☐	☐
Subluxated/Dislocated IOL	☐	☐
CME	☐	☐
Postoperative Glaucoma	☐	☐
Infection/Uveitis	☐	☐
Others (specify)	☐	☐

RE. . . . . .

LE. . . . . .

Can't be examined, reason: . . . . . .

K. Fundus: (1=Not present; 2=Present; 9=Undetermined)

	R	L
Congenital anomaly	☐	☐
Glaucomatous cupping	☐	☐
Other optic atrophy	☐	☐
Maculopathy	☐	☐
ARMD	☐	☐
High myopia	☐	☐
Chorioretinitis	☐	☐
Vascular retinopathy	☐	☐
Diabetic retinopathy	☐	☐
Retinitis pigmentosa	☐	☐
Retinal detachment	☐	☐
Significant Vitreous opacities	☐	☐
Other posterior segment anomaly	☐	☐

(specify): RE . . . . . .

LE . . . . . .

L. Cause for Low Vision or Blindness:
(For each eye with presenting vision <6/19)

Enter only one principal cause

	RE	LE
Refractive error .01	☐☐	☐☐
Cataract .02		
Neglected Cataract/ Sec. Glaucoma .04		
PCO/After cataract .05		
Corneal opacity .06		
Surgical complication .11		
Phthisical / disorganised Globe .12		
Absent Globe .13		
Glaucoma .14		
Optic atrophy .15		
Vascular Retinopathy .16		
Macular degeneration .17		
Amblyopia .18		
Retinal detachment .19		
Others (specify) .20		

(eg. subluxated IOL)

Did a surgical complication contribute to the above? (1=No; 2=yes) ☐ ☐

M. Current Action needed: (1=No; 2=Yes)

Cataract Surgery	☐	☐
Eyelid Surgery	☐	☐
Glaucoma Surgery	☐	☐
Yag Laser for PCO	☐	☐
Spectacles prescribed	☐	☐
Medication	☐	☐
Others (specify) RE	☐	☐
LE		

N. Interview for Barriers Questionnaire ☐

(1=No; 2=Yes)

(All persons with presenting VA<6/60 in one or both eyes due to cataract should be interviewed)

O. Remarks

Annex 3. Survey Team

1. Mechi Zone:
Dr Purushottam Joshi - Ophthalmologist
Dr Kiran Shakya - Ophthalmologist
Mr Tulsi Dahal – Ophthalmic Assistant

2. Sagarmatha Zone:
Dr Nishant Singh - Ophthalmologist
Dr Lila Raj Puri – Ophthalmologist
Mr Hari Har Shrestha- Ophthalmic Assistant
Mr Samit Kumar Chaudhary – Ophthalmic Assistant
Mr Tirtha Singh - Ophthalmic Assistant
Mr Ramananda Biswokarma - Ophthalmic Assistant
Mr Dipesh Ram- Ophthalmic Assistant
Mr Surat Lal Mahato – Eye Health Worker
Mr Bidhyanand Chaudhary- Eye Health worker
Mr Raj Kumar Yadav- Eye Health worker

3. Koshi Zone:
Dr Sanjay Singh – Ophthalmologist
Mr Dipendra Chaudhary - Ophthalmic Assistant
Mr Sunil Chaudhary - Ophthalmic Assistant
Mr Roshan Thakur - Ophthalmic Assistant

4. Janakpur Zone:
Dr Hem Chandra Jha – Ophthalmologist
Dr Ben Limbu – Ophthalmologist
Mr Mohan Krishna Shrestha – Survey Supervisor
Mr Rudal Prasad Shah - Ophthalmic Assistant
Mr Gyanendra Prasad Bimal - Ophthalmic Assistant

5. Bagmati Zone:
Dr Reeta Gurung – Ophthalmologist
Dr Govinda Paudyal – Ophthalmologist
Dr Benu Limbu – Ophthalmologist
Dr Prativa Lama Joshi – Ophthlamologist
Mr Nabin Kumar Rai – Survey Supervisor
Mr Mohan Krishna Shrestha – Survey Supervisor
Mr Khim Gurung – Survey Supervisor
Mr Bikrama Dahal – Ophthalmic Assistant
Ms Dilasha Shrestha – Ophthalmic Assistant
Ms Jaya Shrestha – Ophthalmic Assistant
Mr Radha Krishna Suwal – Ophthalmic Assistant
Mr Pradeep Banjara - Ophthalmic Assistant
Mr Pralhad Pyakurel – Ophthalmic Assistant
Mr Abhisek Shrestha - Ophthalmic Assistant
Mr Rajan Shrestha - Ophthalmic Assistant
Mr Yuva Raj Thapa - Ophthalmic Assistant
Mr Sushil Singh - Ophthalmic Assistant
Mr Rabindra Khadka - Ophthalmic Assistant

6. Narayani Zone:
Dr Kamal Bahadur Khadka- Ophthalmologist
Dr Subodh Chandra Das - Ophthlamologist
Mr Mohan Sunuwar - Investigator
YD Sapkota- Survey Supervisor
Ms Beena Basnet – Ophthalmic Assistant
Ms Asmita Karki – Ophthalmic Assistant
Mr Shambhu Kuswaha – Ophthalmic Assistant

7. Lumbini Zone:
Dr Anil Sherchan – Ophthalmologist
Mr Ram Prasad Kandel – Investigator
Mr Y D Sapkota – Survey Supervisor
Mr Tulsi Parajuli – Ophthalmic Assistant
Mr Ramchandra Shrestha – Ophthalmic Assistant

8. Dhaulagiri Zone
Dr Indra Man Maharjan – Ophthalmologist
Dr Eliya Shrestha – Ophthalmologist
Dr Srijana Karmacharya – Ophthalmologist
Mr Bhoj Raj Gautam – Ophthalmic Assistant
Mr Govinda Badhu – Ophthalmic Assistant
Mr YD Sapkota – Survey Supervisor

9. Gandaki Zone:
Dr Raghunandan Byanju – Ophthalmologist
Dr Sudhansu Shekhar – Ophthalmologist
Dr Indra Man Maharjan – Ophthalmologist
Mr YD Sapkota – Suevey Supervisor
Mr Janak Bahadur Chanda – Ophthalmic Assistant
Mr Govinda Sharma Pokhrel – Ophthalmic Assistant

10. Rapti Zone:
Dr Su Laxmi Katuwal – Ophthalmologist
Mr Salik Ram Gautam – Ophthalmic Assistant
Mr YD Sapkota – Survey Supervisor

11. Bheri Zone:
Dr Basu Adhikari – Ophthalmologist
Dr Indu Prasad Dhungel – Ophthalamologist
Mr Badri Shrestha – Ophthalmic Assistant
Mr Ram KC – Ophthalmic Assistant
Mr Y D Sapkota – Survey Supervisor

12. Karnali Zone:
Dr Sunu Dulal – Ophthalmologist
Mr Y D Sapkota – Survey Supervisor
Mr Janak Bahadur Chand – Ophthalmic Assistant
Mr Govinda Natha Yogi – Ophthalmic Assistant

13. Mahakali and Seti Zone:
Dr Bidya Prasad Pant – Ophthalmologist
Dr Suresh Raj Pant – Ophthalmologist
Mr Ramesh Chandra Bhatta – Survey Supervisor
Mr Suresh Raj Awasthi – Optometrist
Mr Dev raj Paneru – Ophthalmic Assistant
Ms Manju Gurung – Ophthalmic Assistant
Mr Bir Singh Dhami – Ophthalmic Assistant
Ms Batti Gurung – Ophthalmic Assistant