Chapter 4
The cataract situation in Suriname

Janna Minderhoud*
Jerrel C. Pawiroredjo*
Dennis R.A. Mans
Herman C.I. Themen
Anne-Marie T. Bueno de Mesquita-Voigt
Michael R. Siban
Cindy M. Forster-Pawiroredjo
Annette C. Moll
Ruth M.A. van Nispen
Hans Limburg

* contributed equally

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Abstract

Aims: To provide an overview of cataract data in Suriname and to describe and evaluate a programme to control cataract blindness in a developing country.

Design: Evaluation of hospital data and findings from a population-based cross-sectional survey.

Methods: The implementation of a new cataract surgical intervention programme was described and retrospectively evaluated by analysing the number of cataract operations and other related indicators at the Suriname Eye Centre (SEC) in the period 2006-2014. Findings of the recent Rapid Assessment of Avoidable Blindness (2013-2014) survey were used to evaluate the national cataract situation in Suriname in people aged ≥50 years (N=2,998), including prevalence of cataract blindness, outcome and cataract surgical rate (CSR).

Results. Since the implementation of a new cataract intervention programme, the number of cataract operations at the SEC has increased from 1,150 in 2006 to 4,538 in 2014, leading to an estimated national CSR of 9,103 per one million inhabitants. The prevalence of bilateral cataract blindness in Suriname was 0.8% (95% CI 0.2-1.3%) in individuals aged ≥50 years. The proportion of eyes with a post-operative visual acuity <6/60 (poor outcome) was lowest in eyes operated at the SEC (8.5%) and highest in surgeries performed by foreign humanitarian ophthalmic missions.

Conclusions. The cataract situation in Suriname is well under control since the implementation of the new intervention programme. Important factors contributing to this success were the introduction of phacoemulsification, intensive training, and improvement in the affordability and accessibility of cataract surgery. The proportion of poor outcomes was still >5%.

Introduction

Cataract is the main cause of blindness globally, accounting for 51% of reported cases of blindness and one-third of those of visual impairment (VI) in many parts of the world.[1] Improving cataract surgical quality and quantity continues to be a major challenge with many obstacles, which holds particularly true for the rapidly aging population in developing countries where over 90% of the world's visually impaired live.[2] This is largely attributable to the lack of health care and surgical teams, and often results in considerable disability, loss of productivity, psychosocial implications, and excess mortality.[3,4]

South and Latin America are generally regarded among the regions in the world with the highest number of epidemiologic studies of blindness and VI since 1999.[1] Impressive strides have been made to increase cataract services[1], with remarkable results in a number of these countries. Data from a recent Rapid Assessment of Avoidable blindness (RAAB) survey in the Republic of Suriname (South America) reported a relatively high cataract surgical coverage (CSC) for all visual acuity (VA) levels when compared to other South American and developing countries.[5] Suriname is an upper-middle-income country with an average annual per-capita income of US$ 9,370[6], and is located on the north-east coast of South America.[7] The country belongs to the Caribbean, is part of the World Health Organization (WHO) Americas-B (AMR-B) sub-region, and is a member of the South American and Pan American Health Organization (PAHO) that represents the WHO in the region.[8] The Suriname Eye Centre (SEC), a division of the government-owned Academic Hospital Paramaribo (AZP) in the country's capital city Paramaribo, is the main institution providing specialized ophthalmic care in Suriname. Since 2005, improving cataract surgical care in Suriname has been one of the principal goals of the SEC. For this purpose, a cataract surgical screening and intervention programme was implemented since 2006. The programme focused on the training of ophthalmologists and paramedical surgical staff in using modern phacoemulsification techniques, but also on the improvement of the infrastructure of cataract surgical services, including the systematic inclusion of distant rural areas and the creation of a cataract Ambulatory Surgical
Centre as well as the acquisition of modern and in part transportable equipment. The result has been a substantial increase in the annual number of cataract surgeries performed and a relatively high CSC of 94.3% in bilaterally blind persons older than 50 years, with results coming close to the standards of the WHO. [5,9]

This paper provides a detailed evaluation of the cataract situation in Suriname since the implementation of the new cataract surgical intervention programme in 2006. The effectiveness and safety of the programme as well as the current national cataract situation are discussed in terms of number of cataract operations performed per year by the SEC, average number of surgeries performed per ophthalmologist per year versus weighted mean number of ophthalmologists per one million individuals, prevalence data of cataract in individuals ≥50 years, current estimated national cataract surgical rate (CSR) and location and outcome of cataract surgery.

Methods

Patient and population data
This study assessed the cataract situation in Suriname in people aged ≥50 years after an 8-year period following the implementation of the new cataract surgical intervention programme in 2006. Figure 1 shows the population growth of Suriname (2000-2030) and the proportion of people aged ≥50 years. The growth in this segment of the population will lead to an increase in the annual incidence of cataract and the need for cataract surgical services.

Cataract surgical care of the Suriname Eye Centre
Details about cataract surgical care of the SEC, including information about the absolute number of cataract operations performed, as well as the average number of surgeries performed per ophthalmologist per year and the weighted mean number of local ophthalmologists per one million individuals in Suriname in the period 2006-2014, were retrospectively obtained from the medical records of the SEC. Approximations of the yearly population size of Suriname in this period were obtained from the US Census Database.[7]

Population-based cataract data
To provide an overview of the current national cataract situation in Suriname, data on the prevalence of cataract in individuals ≥50 years, cataract surgical outcome, and information on their future needs were derived from the recent prospective population-based RAAB survey (N=2,998), which was carried out in 2013-2014 and adhered to the principles of the Declaration of Helsinki.[5] Cataract-operated individuals were asked about details of their former surgical procedure, including location and year of surgery. The current national CSR for Suriname was not known because not all cataract operations are recorded centrally. However, the national CSR for 2014 was estimated from the absolute number of cataract surgeries performed by the SEC in 2014 and the percentage of cataract operations conducted by the SEC (87%) as derived from the RAAB survey (the calculation was n / 87% divided by the population in millions in 2014). Written or thumb-printed informed consent was obtained from all participants. The Ministry of Health of Suriname gave approval for the study.

Data processing
The CSR was calculated and expressed as the total number of cataract surgeries performed.
per one million inhabitants per year. The number of surgeries per ophthalmologist and the weighted mean number of ophthalmologist were calculated and expressed per one million inhabitants per year, respectively.

Statistics
Automated analyses included in the RAAB software package were used to analyse the sample and age- and sex-adjusted prevalence of cataract-induced blindness, severe VI (SVI), and moderate VI (MVI) (95% confidence intervals (CI)).[10] The cluster sampling design was taken into account when CIs were calculated. P values <0.05 were taken to indicate statistical significance. Descriptive statistics regarding CSR, number of ophthalmologists per one million inhabitants, number of surgeries performed per ophthalmologist, and outcomes of cataract surgery were reported.

Results
Cataract surgical care of the Suriname Eye Centre
The absolute number of cataract operations performed per year by the SEC has increased from 1,150 to 4,538 surgeries in the period between 2006 and 2014, i.e., by a factor 3.5 in the 8 years covered by the current study (Table 1). The average yearly number of surgeries performed per SEC ophthalmologist in that period increased from 192 to 454, and the weighted mean number of local ophthalmologists increased from 12 per one million individuals in 2006 to 18 per one million individuals in 2014 (Table 1).

Population-based cataract data
Cataract prevalence in individuals older than 50 years
Table 2 shows the adjusted results for cataract and blindness, SVI, and MVI in individuals older than 50 years (2013-2014). The age- and sex-adjusted prevalence of bilateral blindness due to cataract was 0.8% (95% CI 0.2-1.3). Bilateral SVI (best corrected VA (BCVA) <6/60-3/60 in better eye) due to cataract occurred in 0.5% (0.2-0.7) and bilateral MVI (BCVA <6/18–6/60 in better eye) due to cataract in 1.9% (1.4-2.3) of this population. Blindness due to cataract was 1.5 times more common in women than men (0.9% versus 0.6% respectively).

Location, age and outcome of surgery
In total, 1,003 eyes in the sample were operated for cataract. Eighty-seven percent of the cataract operations were conducted at the SEC, 5.8% in a private hospital, 4.8% at the facilities of the Mission Milagros (the humanitarian surgical missions sponsored by Cuba) and 2.4% in foreign eye camps. Overall, the proportion of eyes with a poor outcome

<table>
<thead>
<tr>
<th>Year</th>
<th>Population size x 1000 inhabitants[7]</th>
<th>No. of ophthalmologists</th>
<th>No. of ophthalmologists per 1 million inhabitants</th>
<th>No. of cataract operations</th>
<th>Average No. of surgeries per ophthalmologist</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>512</td>
<td>6</td>
<td>12</td>
<td>1150</td>
<td>192</td>
</tr>
<tr>
<td>2007</td>
<td>521</td>
<td>7</td>
<td>13</td>
<td>1374</td>
<td>196</td>
</tr>
<tr>
<td>2008</td>
<td>530</td>
<td>7</td>
<td>13</td>
<td>2677</td>
<td>382</td>
</tr>
<tr>
<td>2009</td>
<td>538</td>
<td>7</td>
<td>13</td>
<td>2902</td>
<td>415</td>
</tr>
<tr>
<td>2010</td>
<td>546</td>
<td>8</td>
<td>15</td>
<td>3271</td>
<td>409</td>
</tr>
<tr>
<td>2011</td>
<td>553</td>
<td>8</td>
<td>15</td>
<td>3393</td>
<td>424</td>
</tr>
<tr>
<td>2012</td>
<td>560</td>
<td>9</td>
<td>16</td>
<td>3743</td>
<td>416</td>
</tr>
<tr>
<td>2013</td>
<td>567</td>
<td>10</td>
<td>18</td>
<td>3906</td>
<td>391</td>
</tr>
<tr>
<td>2014</td>
<td>573</td>
<td>10</td>
<td>18</td>
<td>4538</td>
<td>454</td>
</tr>
</tbody>
</table>
(post-operative VA < 6/60 with available correction) was significantly lower in eyes operated at the SEC (8.5%) when compared to those treated by foreign ophthalmic teams in eye camps (33.3%, based on a very small sample size of 24 surgeries, Table 3). When analysing national outcome by years after surgery, visual outcome of eyes operated during the last 3 years (85.4% good, 6.8% poor) was better than that in eyes operated 4 to 6, or 7 or more years ago (80.8% good, 8.7% poor; and 71.1% good, 16.1% poor, respectively) (Table 4).

Overall, selection (comorbidity) was the main cause of poor or borderline outcome (52%), followed by inadequate optical correction (30%) and surgical complications or posterior capsule opacification (11%). Following cataract surgery of 1,003 eyes, 97.2% were

### Table 2. Adjusted results for cataract and blindness, severe visual impairment and visual impairment (best corrected visual acuity)

<table>
<thead>
<tr>
<th></th>
<th>Males</th>
<th></th>
<th>Females</th>
<th></th>
<th>Total</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>% (95%CI)</td>
<td>n</td>
<td>% (95%CI)</td>
<td>n</td>
<td>% (95%CI)</td>
</tr>
<tr>
<td>Cataract and blindness in better eye with best correction or pinhole</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unilateral cataract</td>
<td>306</td>
<td>0.6 (0.0-1.2)</td>
<td>493</td>
<td>0.9 (0.1-1.8)</td>
<td>799</td>
<td>0.8 (0.2-1.3)</td>
</tr>
<tr>
<td>Bilateral cataract</td>
<td>1,274</td>
<td>2.7 (1.6-3.7)</td>
<td>1,231</td>
<td>2.3 (1.2-3.4)</td>
<td>2,505</td>
<td>2.5 (1.6-3.4)</td>
</tr>
<tr>
<td>Cataract eyes</td>
<td>1,885</td>
<td>2.0 (1.1-2.9)</td>
<td>2,217</td>
<td>2.1 (0.9-3.2)</td>
<td>4,102</td>
<td>2.0 (1.2-2.9)</td>
</tr>
<tr>
<td>Cataract and SVI in better eye with best correction or pinhole</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unilateral cataract</td>
<td>110</td>
<td>0.2 (0.1-0.4)</td>
<td>375</td>
<td>0.7 (0.3-1.1)</td>
<td>485</td>
<td>0.5 (0.2-0.7)</td>
</tr>
<tr>
<td>Bilateral cataract</td>
<td>393</td>
<td>0.8 (0.0-1.6)</td>
<td>459</td>
<td>0.9 (0.3-1.4)</td>
<td>852</td>
<td>0.8 (0.3-1.4)</td>
</tr>
<tr>
<td>Cataract eyes</td>
<td>531</td>
<td>0.6 (0.1-1.0)</td>
<td>1,067</td>
<td>1.0 (0.5-1.5)</td>
<td>1,598</td>
<td>0.8 (0.4-1.2)</td>
</tr>
<tr>
<td>Cataract and MVI in better eye with best correction or pinhole</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unilateral cataract</td>
<td>769</td>
<td>1.6 (0.9-2.3)</td>
<td>1,107</td>
<td>2.1 (1.5-2.7)</td>
<td>1,876</td>
<td>1.9 (1.4-2.3)</td>
</tr>
<tr>
<td>Bilateral cataract</td>
<td>695</td>
<td>1.4 (0.6-2.3)</td>
<td>791</td>
<td>1.5 (0.6-2.4)</td>
<td>1,486</td>
<td>1.5 (0.8-2.1)</td>
</tr>
<tr>
<td>Cataract eyes</td>
<td>1,990</td>
<td>2.1 (1.3-2.8)</td>
<td>2,462</td>
<td>2.3 (1.4-3.2)</td>
<td>4,452</td>
<td>2.2 (1.6-2.8)</td>
</tr>
</tbody>
</table>

### Table 3. Post-op visual acuity with available correction by place of surgery

<table>
<thead>
<tr>
<th></th>
<th>WHO Eye Centre</th>
<th>Mission Milagros</th>
<th>Private hospital</th>
<th>Eye camp</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>norm Eyes %</td>
<td>Eyes %</td>
<td>Eyes %</td>
<td>Eyes %</td>
<td>Eyes %</td>
</tr>
<tr>
<td>Good: can see 6/18</td>
<td>&gt;80%</td>
<td>714 81.8</td>
<td>31 64.6</td>
<td>48 82.8</td>
<td>14 58.3</td>
</tr>
<tr>
<td>Borderline: can see 6/60</td>
<td>&lt;15%</td>
<td>85 9.7</td>
<td>8 16.7</td>
<td>3 5.2</td>
<td>2 8.3</td>
</tr>
<tr>
<td>Poor: cannot see 6/60</td>
<td>&lt;5%</td>
<td>74 8.5</td>
<td>9 18.8</td>
<td>7 12.1</td>
<td>8 33.3</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
<td>873 100.0</td>
<td>48 100.0</td>
<td>58 100.0</td>
<td>24 100.0</td>
</tr>
</tbody>
</table>

### Table 4. Visual acuity in operated eyes in sample by years after surgery

<table>
<thead>
<tr>
<th></th>
<th>3 years postop</th>
<th>4-6 years postop</th>
<th>7 years postop</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Eyes %</td>
<td>Eyes %</td>
<td>Eyes %</td>
<td>Eyes %</td>
</tr>
<tr>
<td>Good: can see 6/18</td>
<td>440 85.4</td>
<td>168 80.0</td>
<td>199 71.1</td>
<td>807 80.5</td>
</tr>
<tr>
<td>Borderline: can see 6/60</td>
<td>40 7.8</td>
<td>22 10.6</td>
<td>36 12.9</td>
<td>98 9.8</td>
</tr>
<tr>
<td>Poor: cannot see 6/60</td>
<td>36 6.8</td>
<td>18 8.7</td>
<td>45 16.1</td>
<td>98 9.8</td>
</tr>
<tr>
<td>Total</td>
<td>515 100.0</td>
<td>208 100.0</td>
<td>280 100.0</td>
<td>1,003 100.0</td>
</tr>
</tbody>
</table>


pseudophakic and 2.8% were aphakic. Eighty percent of individuals were aged 60-80 years at the time of the surgery.

National CSR
As the SEC performs a total of 87% of all cataract surgeries in the country, the national CSR for 2014 was estimated to be around 9,103 cataract surgeries performed per one million inhabitants per year.

Discussion
This paper retrospectively evaluates the impact of a new cataract surgical intervention programme on the cataract situation in Suriname. Since the implementation of the programme in 2006, the absolute number of cataract operations performed at the SEC per year had increased with a factor 3.5. Furthermore, the weighted mean number of local ophthalmologists increased from 12 per one million individuals in 2006 to 18 per one million individuals in 2014. Each ophthalmologist performed in 2014 on average 454 surgeries, which was 2.4 times more than in 2006. The total number of cataract surgeries at the SEC represented a coverage of 87.0% of all cataract surgeries in Suriname. Although the SEC is a tertiary hospital, its surgical outcome came close to the WHO standard.[9] The results indicate that the cataract situation in Suriname is well under control.

The current average number of 18 ophthalmic surgeons per one million inhabitants in Suriname is among the lowest in Latin America and the Caribbean, where it ranges from 8 in Honduras to 162 in Cuba.[11] For this reason, ophthalmic care in Suriname is also periodically provided on a small scale by visiting foreign ophthalmologist from the Netherlands and the United States, while under a government cooperation agreement the Cuban Mission Milagros was active between 2005 and 2010. The Surinamese ophthalmologists at the SEC performed together 1,150 cataract surgeries in 2006 and succeeded to increase this number to 4,538 in 2014. The resulting 3.5 fold increase in the number of cataract surgeries per year adds up to a national CSR of 9,103.

When measured up to other Latin American and Caribbean countries, only Argentina shows comparable data with a CSR of 6,878.[data 2013, 10] In the other countries in these parts of the world, the CSR ranged from 545 in Bolivia to 3,277 in Brazil.[data 2013, 10] The average number of surgeries per ophthalmologist of 454 in 2014 is also the highest in the region, with average numbers ranging from less than 20 per ophthalmologist per year in Cuba to about 112 per ophthalmologist per year in Costa Rica.[data 2012, 1]

The success of the new cataract programme is particularly reflected by the reported relatively high CSC (for all VA levels) of 90% in bilaterally blind or visually impaired individuals older than 50 years.[5] This is higher than that found by previous surveys in Latin America which reported a CSC (for all VA levels) between 15% in El Salvador and 83% in Argentina.[1,12] Furthermore, analyses of available records on CSC consistently showed a remarkably high CSC in Suriname when compared to many countries throughout the world. [2,5] All these data indicate that the cataract situation in Suriname is well under control and that many patients with SVI and MVI due to cataract in the country have already received surgery, underscoring the accomplishments of the intervention programme.

Essential elements of the programme include an intensive phacoemulsification training programme in 2005 and 2006 and the transition from conventional extracapsular cataract extraction (ECCE) with implant of a standard 21 dioptre IOL under general anaesthesia to phacoemulsification with foldable well calculated IOL implant (Optical Biometry IOL Master 500, Carl Zeiss Meditec) under retrobulbar anaesthesia, and since 2011 under topical anaesthesia. In 2005 the decision was made by the SEC to introduce the phacoemulsification technique as standard for cataract surgery in Suriname. As the per capita income increased, the government and all health insurance companies agreed to fully cover phacoemulsification cataract surgery in all basic health insurance packages as this technique became affordable for the country.
Compared to ECCE, phacoemulsification causes less astigmatism \[13,14\], less postop inflammation[15] and patients were needed to be seen less frequently after surgery, with a mean follow-up of 1 month after phacoemulsification versus 3 months after ECCE. Faster recovery, lower morbidity and good outcome have popularized phaco surgery in the country and have significantly reduced fear for cataract surgery. In a small community such as Suriname, information by word of mouth contributed to a lower threshold for others to seek earlier medical attention. Regular and systematic information to the community by the media also resulted in better-informed patients. As the doctors became more experienced and developed better surgical skills, they became more efficient as their average time per procedure decreased, leading to higher volumes. The implementation of the Ambulatory Cataract Surgical Centre, periodical and systematic screening and surgical missions to distant districts and the isolated interior of Suriname further improved the cataract situation in Suriname. An important factor in further strengthening of ophthalmic services at the SEC has been the recruitment of optometrists and training of technical ophthalmic assistants. However, the proportion of the Surinamese population aged ≥50 years is projected to increase from 13.2% in the year 2000 to 26.8% in 2030[7] and the average life expectancy is expected to rise from 68 years in 2000 to 76 in 2030, causing more people to be at risk of developing cataract. This implies that the output of cataract operations still has to increase yearly in order to avoid recurrence of the backlog in surgeries and the increase in the prevalence of cataract. It is therefore mandatory to continue the training of manpower and the acquisition of state-of-the art equipment; expand local and nation-wide health campaigns; reduce the costs of cataract surgery; increase governmental health expenditures; intensify case finding; and improve efficiency in the referral system for cataract surgery.

Although the CSC was equal for males and females in Suriname, more women were blind or visually impaired due to cataract when compared to men. This gender inequity has been reported before for several other countries[16–18] and can probably be explained by the higher life expectancy of women when compared to men.[7] In the total Surinamese population aged ≥50 years, the prevalence of cataract induced blindness and VI was average compared to other countries in the region.[19]

An important limitation of this study is that cataract outcome registration is not routinely done in the SEC. Therefore the individual outcomes of all surgeries performed between 2006 and 2014 are not available. However, the RAAB survey methodology still can be used as a tool to measure outcome after cataract surgery. In the Suriname RAAB sample 1003 people had undergone cataract surgery. This sample, as well as the outcomes, is assumed to be representative for the total number of cataract surgeries performed in Suriname. Most cataract surgeries (92.8%) were performed at the SEC and in private hospitals, and led to a visual outcome that came close to the WHO standard.[9] Notably, 97.2% of patients who had undergone surgery received an intraocular lens, and this proportion is relatively high when compared to other countries.

[1] Although based on a very small sample size, the substantial differences in surgical outcome among the locations of treatment (only 8.5% with a poor outcome at the SEC, but 33.3% with a poor outcome at eye camps) offer room for improvement. This may be achieved by optimizing pre-operative selection procedures, refraction services, and surgical procedures, and perhaps also by regulating and limiting access of less experienced foreign ophthalmic teams to eye camps where 50% of poor outcome was caused by intraoperative complications.[20] In general, monitoring the outcome of cataract surgery can sensitise surgeons to quality control, which can lead to a decrease in complication rates and improved visual outcome.[21] Several tools are developed for eye surgeons to monitor their own results.[21–26]

Taking into account the high cataract surgical output at the SEC, particularly this institution should play a major role in decreasing...
the proportion of poor outcomes below the WHO threshold of 5%. However, this may not be realistic when considering the tertiary patient population of the SEC. These individuals have in general an unfavourable prognosis due to pre-existent comorbidities (71% of poor outcome), such as advanced glaucoma, diabetic retinopathy, macular disease and corneal opacities, and surgery only slightly improves VA. Still, the overall quality of cataract surgery in Suriname was relatively good when compared to other countries in the region. Only Argentina (82% good, 8.8% borderline and 9.2% poor outcomes) and Paraguay (77% good, 15.3% borderline and 7.7% poor outcomes) showed comparable results.[1,12,27] The better national visual outcomes of eyes operated during the last 3 years when compared to those operated 4 to 6 years and 7 or more years ago could be anticipated, as surgeon skills, surgical facilities, and thus surgical outcome, continued to improve (expert opinion JP). The same holds true for the increasing risk of contracting other sight-threatening eye diseases with older age and as more time passes since the last operation.[24]

In summary, the SEC in Suriname has been able to achieve a remarkable increase in cataract surgical output in Suriname in the period 2006-2014. The Suriname programme has shown that it is possible to reduce the burden of cataract blindness in a developing country when all aspects of the cataract problem are systematically addressed (availability, accessibility and affordability). Free government health insurance for the elderly with full cataract surgery coverage proved to be essential, as well as, proper surgical training, implementation of modern surgical techniques, outreach programmes to distant districts and villages, well organized logistics and acquisition of modern equipment. Clearly, the success of the programme depended on considerable investments while such financial resources are often beyond the reach of many developing countries. Still, the programme presented in the current study may serve as an example for other (developing) countries how to reduce the burden of cataract-induced blindness.
References


