Epidemiology, Aetiology and Care of Eye Disease in Suriname

JANNA MINDERHOUD

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Janna Minderhoud

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Voor Jan Pameijer,

mijn lieve vriend,
mijn mentor
mijn inspirator,
mijn opleider,
mijn paranimf.

Contents

Preface

In November 2010, the last week of my internship Ophthalmology at the Suriname Eye Centre of the Academic Hospital Paramaribo, I was invited to join an ophthalmic surgical mission to the interior of Suriname. The mission's aim was to operate bilaterally blind people for cataract in that part of the country, where regular ophthalmologic services are absent. This experience literally opened the eyes of many patients, ophthalmologists, policy makers, and the Surinamese community alike. Particularly moving was the reaction of a ninety-year-old patient who had been blind for many years but was not able to visit the capital city Paramaribo for cataract surgery, and who cried when she saw the faces of her grand children for the first time. Her tears and emotions expressed the detrimental impact of a visual impairment on her quality of life. But this experience also led to the realization that her condition was treatable, avoidable, and unnecessary. This moment motivated me to become an ophthalmologist and to start epidemiological research projects in the Amazon rain forest and later in the rest of Suriname, the beauty of which succeeded to capture my heart.

The results of my research are reported in this thesis, and have mainly focused on providing population-based data on the occurrence of eye disease in Suriname. Hopefully, these findings will help develop preventive and therapeutic eye care programmes to reduce the burden of avoidable blindness in Suriname.

The conclusion of this thesis would not have been possible without the full collaboration of all participants of the studies and the co-workers of the Suriname Eye Centre and the Medical Mission. I gratefully acknowledge their help and support. Without question, the information they provided will enable Surinamese ophthalmologists to improve ophthalmic care in Suriname.

- Janna Minderhoud -

Chapter 1

General Introduction

Prevention of blindness and visual impairment

Visual impairment (VI) and blindness are associated with considerable disability, loss of productivity, psychosocial problems, and excess mortality.[1–3] Therefore, prevention of blindness and VI receive a high priority in health programmes of many countries throughout the world. In the year 2010, the global number of visually impaired individuals was estimated at 285 million, 39 million of whom were blind.[4] The most recent global estimates suggest numbers of 3.2 million blind and 26.6 million visually impaired people in the Americas.[4] This is the reason for the World Health Organization (WHO) and the International Agency for the Prevention of Blindness (IAPB) to initiate the VISION 2020 programme, which aims to reduce the burden of avoidable blindness by the year 2020. In order to achieve this goal, regular population-based surveys are crucial to provide an updated characterization of the visual problems, establish local eye care programmes, and initiate future eye care planning.[4] So far, no standardized population-based surveys on the prevalence and causes of blindness and VI have been conducted in Suriname. This makes it difficult to estimate the extent of preventive or therapeutic eye care needed in the country and to design and conduct effective programmes that address these issues.

Ophthalmic care in the Republic of Suriname

The Republic of Suriname, an independent state situated on the northeast coast of South America, is an example of a developing country where avoidable and treatable blindness remains an important public health problem. The population size of Suriname for 2014 had been estimated at 573,311.[5] Around 90% of the population lives in the capital city Paramaribo and in other cities located in the narrow coastal zone in the northern part of the country.[6] The remaining 10% inhabits the interior, which comprises more than three-quarters of Suriname's land surface and consists largely of tropical rain forest.[6] Suriname has an annual gross national income *per capita* of US$ 9,370 and is an upper middle-income country according to World Bank criteria.[7] The country belongs to the Caribbean, is part of the 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 ten ophthalmologists of the Suriname Eye Centre (SEC) at the Academic Hospital Paramaribo (AZP) mainly provide specialized ophthalmic care in Suriname. Ophthalmology in Suriname has considerably advanced in the past years and the SEC has been accepted as an associate member of the World Association of Eye Hospitals (WAEH).[9] Each ophthalmologist performs cataract surgery and most have their own sub-specialization including glaucoma surgery, vitreoretinal surgery, cornea, and paediatric ophthalmology. Currently, a Surinamese resident is trained in oculoplastic and orbital surgery. The SEC itself provides training and education of medical and paramedical staff, and this is combined with a residency in The Netherlands at the Rotterdam Eye Hospital.

Since ophthalmic care is centralized in Paramaribo, decentralization of eye care represents an important problem in Suriname. For this reason, eye care for the interior and the rural districts is provided by regular visits (Eye Bus) and cataract surgical missions, both organized by the SEC. Nevertheless, every day new patients from the city as well as the surrounding districts present at the SEC with severe and sometimes end-stage eye disease. Obviously, treatment possibilities for such patients are limited. Particularly older individuals from rural parts of Suriname are not always able to reach the SEC. As a result, a high burden of avoidable blindness can be expected in these vulnerable populations. Unfortunately, data on the prevalence of blindness and VI for Latin America and the Caribbean between 1980 and 2012 are limited to only six nationally representative studies[10] and even non-existent for Suriname. This makes it difficult for the country to determine whether or not the goals of Vision 2020 - to reduce the burden of avoidable blindness - are achieved.

Potential causes of visual impairment and blindness in Suriname

Cataract

Cataract is the main cause of blindness globally, accounting for 51% of reported cases of blindness and one-third of those of VI in many parts of the world.[11] Improving cataract surgical care continues to be a road 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.[12] This is for an important part attributable to the lack of, and inequity of access to modern diagnostic and treatment facilities in these countries.[1,2]

Improvements in the infrastructure of cataract surgery are mandatory to reduce avoidable blindness. This requires the set-up of more regional eye care and training centres in order to reach remote areas and unaware communities.[11] Furthermore, regular population-based studies should be carried out in order to obtain data on the impact of such intervention programmes, related trends, and surgical outcome.[1] Notably, these data can help motivate other countries to improve cataract surgical care.[1] For these purposes, cataract surgical coverage (CSC) can serve as a reliable parameter of cataract status and the impact of cataract intervention programmes in a specific area.[1]

Impressive strides have been made to increase cataract services in South and Latin America.[11] Since 2005, improving cataract surgical care has also been one of the principal goals of the SEC. For this purpose, the SEC implemented a cataract surgical screening and intervention programme in 2006. The programme focused on the training of ophthalmologists and paramedical surgical staff in using modern phacoemulsification techniques; improvement of the infrastructure of cataract surgical care 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 (unpublished data medical office SEC). So far, no other information on the cataract situation in Suriname is available. However, data on the CSC in Suriname and the effectiveness and safety of the current cataract surgical programme are needed to evaluate the current cataract surgical care programme in Suriname and make adjustments based on future needs.

Diabetic retinopathy

It is estimated that in the year 2014 387 million individuals throughout the world suffered from diabetes mellitus (DM), and that this number will increase to 438 million by the year 2030.[13] Since nearly 80% of all diabetics live in low- and middle income countries[14], this increase will largely occur in developing countries including those in South and Latin America.[15] Diabetic retinopathy (DR), a severe eye complication of DM, is responsible for 1.0% of blindness and VI worldwide.[4] Even in high-income countries it is the leading cause of blindness in the working-age population.[14] Although the number of visually impaired individuals are likely to decrease due to Vision 2020 programmes, that of blind people due to posterior segment disease including DR, is anticipated to increase.[14] Population-based surveys on DM and DR are scant but necessary to provide an up-to-date assessment of the problem, improve awareness, and develop effective intervention programmes.

In Suriname, the prevalence of DM is estimated at 20% in individuals of 50 years and older.[13] Despite high-quality ophthalmic care including laser therapy and vitreoretinal surgery, DR seems to be a major problem in Suriname (expert opinion Jerrel Pawiroredjo, vitreoretinal surgeon SEC). More detailed data on the prevalence of DM and DR in Suriname are lacking but urgently needed for appropriate planning of DR services. Since Suriname is renowned for its multicultural composition[6], its population also offers the possibility to identify ethnic (genetic) differences related to the prevalence of DM and DR.

Glaucoma

Glaucoma seems to be another major health problem in Suriname (expert opinion of ophthalmologists at the SEC), an inclination that could be attributable to the relatively high proportion of the Surinamese population being of African descent (37.4% Maroon and Creole, 12.5% mixed).[6] This has also been reported for several other Caribbean and South American countries including Cuba, where the proportion of blindness due to glaucoma even amounts to 26.2%.[8] Many patients with glaucoma present at a late stage when treatment possibilities are limited. The consequence may be massive loss of visual field which is often seen in patients from distant, rural areas.[16] This is unnecessary when considering the wide range of effective medical and surgical interventions that are available. Therefore, awareness of glaucoma in families at risk could decrease patient delay and prevent people from becoming blind. Together, these considerations indicate the need of population data on the prevalence of blindness and VI due to glaucoma in order to develop preventive glaucoma programmes.

Uveitis

Uveitis is a common form of inflammatory eye disease and represents an important cause of VI and blindness worldwide.[17] It comprises a large group of diverse diseases that affect not only the uvea but also retina, optic nerve, and vitreous.[18] The aetiology of uveitis includes infectious causes such as toxoplasmosis and herpes as well as associations with various non-infectious systemic disorders such as sarcoidosis. If not diagnosed and treated early, uveitis may cause complications that can lead to permanent VI.

In Suriname, no data are available on the prevalence of the various forms of uveitis and on the prevalence of related systemic disorders. The same holds true for standardized diagnostic and treatment protocols for patients with uveitis, and this often results in delay of diagnosis and efficacious forms of treatment. Thus, data on the aetiology of uveitis in Suriname are necessary for the development of a targeted screening programme to optimize ophthalmic care for uveitis patients in Suriname.

Causes of visual impairment and blindness in childhood

Although blindness in children is relatively uncommon, it is a priority of Vision 2020 for several reasons. These include the detrimental psychological impact on patients and the substantial socio-economic consequences for both patients and the community in terms of productivity loss and medical care, including rehabilitation services.[19] The prevalence of blindness in children varies between approximately 0.3/1,000 children in industrialized countries and 1.5/1,000 in developing countries.[20] Causes range from corneal scarring secondary to vitamin A deficiency and measles in low-income countries to retinopathy of the prematurity (ROP) and cataract in middle-income countries.[21] Still, many causes of blindness in children are treatable and avoidable.[22]

The first data on childhood blindness in school-aged children in Suriname became available in 2013.[23] In that study, childhood cataract and ROP were identified as the major causes of bilateral blindness and severe visual impairment (SVI), and more than one third of cases was avoidable.[23] Although not published, trauma was the major cause in 20% of children with unilateral blindness (visual acuity (VA) <3/60)). Since an estimated 90% of particularly in childhood ocular trauma can be prevented [24–26], data on the epidemiology and aetiology of childhood ocular trauma could help increase awareness of, and reduce blindness in Surinamese children.

Collection of epidemiological data

Rapid Assessment of Avoidable Blindness

The Rapid Assessment of Avoidable Blindness (RAAB) survey is a rapid, simple, and inexpensive standardized methodology to assess the prevalence and causes of blindness in people aged 50 years and older in a specific geographic area.[27] The RAAB focuses primarily on the prevalence of avoidable causes of blindness such as cataract, refractive errors, and corneal scarring [27] So far, the RAAB has been successfully undertaken in more than sixty countries worldwide.[28]

Due to its standardized methodology, results from different countries can reliably be compared with each other. Furthermore, the findings from a specific country can be used to prioritize the specific needs for ophthalmic care of the communities in that country. Importantly, the RAAB can be used to assess the achievements of intervention programmes over time and make adjustments where necessary.[27] Longitudinal studies have already been carried out in Cuba (Havana, 2004 and 2012), Mexico (Nuévo Léon state, 2005 and 2014), and several districts in Vietnam, with encouraging results in most of these areas.[28]

Increasing awareness of the burden of DR worldwide has led to the development of a new method to estimate the prevalence of this condition. This new method has been incorporated in various RAAB surveys and proved successful in eleven countries including Mexico, Moldova, Saudi Arabia, and Jordan.[15,29–31] This method has also been standardized so that DR data from certain regions can also be compared to those from others. However, significant gaps still exist in reliable population-based DR data from many developing nations.[14]

Patients' records of the Suriname Eye Centre

As the SEC is the main eye care centre in Suriname, its ophthalmologists are consulted by all other hospitals in the country. This also holds true for, for instance, cases of multi-system disease and eye disease in remote rural areas. For these reasons, the records of the SEC contain information about the majority of eye patients in the country, which makes them useful for epidemiological studies. In addition to providing adult population-based RAAB data, the SEC records can be used to obtain information on childhood blindness and VI, eye disease and ophthalmic care in the interior of Suriname, and more detailed data on specific aetiologies of eye disease in Suriname.

Aims of this thesis

This thesis provides population-based data on the occurrence of eye disease in the Republic of Suriname. These data not only give an indication of the current situation in the country, but also are required for the development of targeted intervention programmes to reduce the burden of avoidable blindness in the country. The studies have specifically focused on preventable and treatable causes in high-risk and/or socio-economic important groups, *i.e.,* individuals aged 50 years and older, diabetics, the interior population, and children. Furthermore, data have been collected on the aetiology of uveitis in Suriname in order to develop a targeted screening and therapeutic programme on this eye condition.

A RAAB survey has been carried out to assess the prevalence and causes of blindness and VI as well as the prevalence of DM and DR in the Surinamese population of 50 years and older. These data also gave detailed insight into the current cataract situation in Suriname, including the cataract surgical coverage, cataract surgical outcome, and the main barriers to cataract surgery. The cataract surgical care of the SEC has been assessed by evaluating the cataract surgical output, the average number of surgeries performed per ophthalmologist per year, and the weighted mean number of ophthalmologists per one million individuals in the period between 2006 and 2014, after the implementation of the new cataract surgical intervention programme.

The experiences of the SEC with, and the outcome of outreach cataract services - phacoemulsification under topical anaesthesia in remote rural areas - are not covered by the RAAB and have separately been described. The same applies to the specific causes of blindness and VI in the Maroon population in Suriname's interior.

The records of the SEC also provided data on avoidable childhood blindness and VI in Suriname. Using this information, all school-aged children (8-15 years old) who had attended the SEC have been assessed for VI and/or (severe) eye injury. This analysis helped to identify the frequency and causes of childhood ocular trauma.

Finally, a prospective hospital-based study has been performed to assess the causes of uveitis in Suriname. As mentioned above, these data are needed for the development of a targeted diagnostic and therapeutic programme on uveitis in the country.

Outline of this thesis

The prevalence and causes of blindness and VI in people aged 50 years and older in Suriname are reported in Chapter 2. The population-based data have been obtained using the RAAB methodology and also include CSC, cataract surgical outcomes, and the barriers to undergo cataract surgery.

Chapter 3 describes the causes of blindness and VI in the Maroon population in the interior of Suriname. Data from this study can be used for the development of targeted eye care programmes in this group.

Chapter 4 provides a detailed evaluation of the cataract situation in Suriname since the implementation of the new cataract surgical intervention programme in 2006. The efficacy and safety of the programme has been discussed in terms of cataract surgical output, average number of surgeries performed per ophthalmologist per year *versus* weighted mean number of ophthalmologists per one million individuals, prevalence of cataract in individuals older than 50 years, and location and outcome of cataract surgery.

Chapter 5 describes experiences with phacoemulsification under topical anaesthesia in the interior of Suriname. The logistic and technical details provided clarify the feasibility to perform state-of-the-art phacoemulsification under topical anaesthesia in the Amazon rain forest.

Information on the prevalence of DR in Suriname, including the number of diabetics on regular ophthalmic monitoring, has been obtained using the RAAB+DR method and is given in Chapter 6. Since Suriname comprises a multicultural society, estimates on ethnic differences in the prevalence of DM and DR are also provided.

Chapter 7 deals with the aetiology of uveitis in Suriname. In a prospective cohort study, 100 consecutive cases of uveitis have been classified according to ethnic background, age, and gender, as well as anatomical and aetiological diagnosis using Standardization of Uveitis Nomenclature Working Group (SUN) criteria.

Chapter 8 gives details on the epidemiology and aetiology of childhood ocular trauma in Suriname. Using a hospital-based retrospective approach, all cases of children who were school-aged at the time of the survey and had visited the SEC because of ocular trauma, have been evaluated.

The general discussion in Chapter 9 summarizes and discusses the results of this thesis, evaluates the current ophthalmic care system in Suriname, and concludes with recommendations for further eye care programmes and research in the country.

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Chapter 2

Blindness and Visual Impairment in the Republic of Suriname

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Abstract

Objective: To assess the prevalence and causes of blindness and visual impairment (VI) in older adults in Suriname.

Design: Population-based cross-sectional survey.

Participants: A total of 2,998 non-institutional residents aged ≥50 years.

Methods: Fifty clusters of 60 people were randomly selected with a probability proportional to the size of the population unit. Eligible persons were randomly selected through compact segment sampling and examined in their own house using the standard Rapid Assessment of Avoidable Blindness (RAAB) protocol. Presenting distance visual acuity (PVA) was tested and the primary cause of blindness and VI was assessed by an ophthalmologist in people with a visual acuity (VA) <20/60 in either eye.

Main Outcome Measures: Prevalence and causes of blindness (PVA <3/60), severe VI (SVI: PVA <6/60 – 3/60), and moderate VI (MVI: PVA <6/18 – 6/60) were assessed. Cataract surgical coverage (CSC), main barriers to the uptake of cataract surgery, and outcomes after cataract surgery were evaluated.

Results: A total of 2,806 individuals were examined (response 93.6%). The standardized prevalence of blindness was 1.9% (95% CI: 1.0-2.8). Prevalence's of SVI and MVI were 1.1% (95% CI: 0.6-1.6) and 5.6% (95% CI: 4.1-7.0), respectively. Untreated cataract was the most common cause of bilateral blindness (54.0%), followed by glaucoma (23.8%). Cataract also accounted for most cases of bilateral SVI (57.9%). The main causes of MVI were uncorrected refractive errors (48.6%) and untreated cataract (33.7%). The CSC for VA <3/60 was 88.1% when calculated by eye and 94.3% by individual. 'Cannot access treatment' was the most common barrier (28.9%) for cataract surgery. Of the eyes that received surgery, 80.5% had a good outcome (PVA >6/18) and 9.8% had a poor outcome (< 6/60).

Conclusions: The prevalence of blindness in Suriname is comparable to other South American and Caribbean countries. Of all bilaterally blind cases, 87.3% is considered avoidable. Although the CSC is already high for all VA levels, the main intervention strategies to reduce avoidable blindness are cataract surgery, followed by the development of optical and special glaucoma services, as these are the most cost-effective interventions.

Introduction

Prevention of blindness and visual impairment (VI) receives a high priority in health programmes of many countries throughout the world. In the year 2010, the global number of visually impaired individuals was estimated at 285 million, 39 million of whom were blind.[1] The most recent global estimates suggest numbers of 3.2 million blind and 26.6 million visually impaired people in the Americas.[1] In order to achieve the goals of VISION 2020 (initiated by the World Health Organization (WHO) and the International Agency for the Prevention of Blindness (IAPB)), national assessments of the magnitude and causes of VI are essential.[1] Regular population-based surveys are crucial to provide an updated characterization of the visual problems, establish local eye care programmes, and initiate future eye care planning.[1]

The Rapid Assessment of Avoidable Blindness (RAAB) survey is a rapid, simple, and inexpensive standardized methodology to assess the prevalence and causes of blindness in people aged 50 years and older in a specific geographic area.[2] RAAB focuses primarily on the prevalence of avoidable causes of blindness such as cataract, refractive errors, and corneal scarring.[2] So far, RAAB has been successfully undertaken in more than 60 countries worldwide.[3] Due to its standardized methodology, results between countries can reliably be compared. Furthermore, the findings from a specific country can be used to prioritize the specific needs for ophthalmic care of the communities in that country. Importantly, after the intervention programs, RAAB can be used to assess achievements over time and make adjustments where necessary.[2] The majority of RAAB surveys have shown that cataract was the most important cause of blindness.[3] This indicates that improvements in the infrastructure of cataract surgery are important interventions for reducing avoidable blindness. Indeed, cataract surgical coverage (CSC) can serve as a reliable parameter of cataract status and the impact of cataract intervention programmes in a specific area.[4]

The Republic of Suriname, an independent state situated on the north-east coast of South America, is an example of a developing country where avoidable and treatable blindness remains an important public health problem.[5] The population size of Suriname for 2014 is estimated at 573,311.[6] Around 90% of the population lives in the capital city Paramaribo and in other cities located in the narrow coastal zone in the northern part of the country.[7] The remaining 10% inhabits the interior, which comprises more than three-quarters of Suriname's land surface and consists largely of tropical rain forest.[7] Suriname has a gross national income *per capita* of US$ 9,370 and is an upper middle-income country according to World Bank criteria.[8] The country belongs to the Caribbean, is part of the 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.[9] Specialized ophthalmic care in Suriname is mainly provided by the Suriname Eye Centre (SEC) at the Academic Hospital Paramaribo (AZP). Eye care in the interior and in the rural districts is provided by regular visits (Eye Bus) and cataract surgical missions by ophthalmologists from the SEC.[5,10] Nevertheless, every day new patients from the city as well as the surrounding districts arrive at the SEC with severe, sometimes end-stage eye disease. Obviously, treatment possibilities for such patients are limited despite the high-quality eye care offered by the local ophthalmologists. Particularly older individuals from rural parts of Suriname are not always able to reach the SEC. As a result, a high burden of avoidable blindness can be expected in these populations.[5]

Between 1980 and 2012, only six nationally representative studies on the prevalence of blindness and VI were available for Latin America and the Caribbean and so far, no nationally representative data have been reported for Suriname.[11] This makes it difficult to estimate the extent of preventive or therapeutic eye care needed, or how it should be designed and conducted within the SEC or throughout the country. For this reason, we decided to investigate the prevalence and causes of blindness and VI in Suriname by using the RAAB methodology, and to assess CSC, cataract surgical outcomes, and the barriers to undergo cataract surgery.

Patients and methods

The RAAB was conducted by a collaborative partnership between the SEC in Paramaribo, Suriname, and the VU University Medical Centre in Amsterdam, the Netherlands. Ethical approval for the study was obtained from the Ministry of Health of Suriname. The survey was carried out between August 2013 and November 2014 in accordance with the codes of conduct of the Declaration of Helsinki. All subjects were examined and diagnosed during door-to-door visits, and all were asked for written informed or thumb-printed consent. Individuals who required further ophthalmic examination, medical attention, or treatment were referred accordingly to the SEC. People were assured that not participating in the study would have no consequences for current or future treatment.

Sampling

The RAAB only includes individuals aged 50 years and older as that age group has the highest prevalence of blindness.[2] The expected prevalence of blindness in Suriname was estimated on the basis of survey findings in neighbouring countries with a similar population composition, socio-economic situation, and health care facilities, and was estimated at 2.3%.[3] Based on data from the most recent national census (2011), the population size of Suriname during the period of the study could be approximated at 540,000 [7], with 18.7% aged 50 years and older [6], giving a target population of 101,000. For Suriname, a sample size of 3,000 would provide sufficient power to assess an expected blindness prevalence of 2.3% among people aged ≥50 years, with a precision of 32.5%, at 95% confidence, a design effect of 1.6 and 7% non-response. In total, 50 clusters of 60 residents aged 50 years and older were included in the study.

Population and census data from the latest national census (2011) [7] were obtained from the local policy station Bureau of Statistics. Using the RAAB software, 50 clusters were selected within census enumeration areas (EA) from a sampling frame consisting of the complete list of EAs and their inhabitants with a probability proportional to the size of the population.[2] Within each selected EA, eligible persons were selected through compact segment sampling to minimize selection bias.[2] The selected EA and its boundaries could easily be located with the special EA maps provided by the General Bureau of Statistics in Paramaribo. The survey team conducted door-to-door visits to all households in each EA until 60 subjects were identified. Residents who were not available for examination at the time of visit were examined on another day. If fewer than 60 subjects were present in a specific population unit, the 'next nearest EA' was selected to complete the cluster.

Ophthalmic examination

Systemic ophthalmic examination was performed using the Standard Rapid Assessment of Avoidable Blindness Protocol.[2] Training and inter-observer agreement tests were performed before the start of the survey at the AZP and were coordinated by a certified RAAB trainer. Sixty new patients of the SEC were recruited for free screening. Five different survey teams examined all these patients and findings were compared and discussed with the most experienced examiner.

Each survey team included an ophthalmologist, paramedical staff (one per team), and a survey coordinator or local guide. All eligible individuals were interviewed and examined in their own house where the assessment form was completed. In the most isolated areas, the communities were informed in advance about the date, time, and purpose of the survey.

The presenting distance visual acuity (VA) was evaluated using a Snellen tumbling E chart in full daylight. Reflection of blinding sunlight was avoided. Each eye was separately tested with available correction. In case of a VA of less than 20/60, a pinhole VA test was performed. Blindness was defined following WHO criteria as presenting visual acuity (PVA) <3/60 in the better eye with available correction, severe visual impairment (SVI) as PVA <6/60 to ≥3/60, moderate visual impairment (MVI) as PVA<6/18 to ≥6/60, and normal vision as VA≥6/18.[12] The lens was examined by an ophthalmologist using a handheld slit lamp in a shaded area. In subjects with a PVA <6/18, including those who had undergone cataract surgery, the primary cause of VI was assessed with an indirect ophthalmoscope after dilation of the pupil with 2% homatropine and 10% phenylephrine eye drops unless there was a very shallow anterior chamber. If there was significant corneal opacity, obvious severe cataract, or pupillary occlusion, dilation was not necessary for diagnosis. When there were two or more concurrent causes for the visual impairment and it was unclear which of these was the primary cause, the WHO/PBL eye examination record recommends the major cause as the disorder most amenable to treatment or prevention.[13] Participants with VI due to cataract in one or both eyes were asked why cataract surgery had not yet been performed. Cataract-operated individuals were asked about details of their former surgical procedure.

Data processing and statistical analysis

Two trained computer operators independently entered the data from the RAAB survey forms into the RAAB software after completion of the clusters. Consistency checks in the software highlighted any inconsistencies or possible errors, and the ophthalmologist immediately corrected these when possible. Automated analyses included in the RAAB software package were used to analyse the sample and age- and sex-standardized prevalence of blindness, SVI, and MVI (95% confidence intervals CI). The cluster sampling design was taken into account when CIs were calculated. P values <0.05 were considered statistically significant. In addition, the principal causes of VI were analysed. The reasons for non-response (absence at the time of the survey, refusal to participate, or inability to respond adequately to the examination) were also calculated.

Cataract surgical coverage was calculated for all VA levels and was defined as the proportion of individuals or eyes that had undergone cataract surgery.[4] Descriptive statistics regarding barriers to cataract surgery and outcomes of cataract surgery were reported. Because there was no information about VA before surgery, these calculations were done assuming that only patients with VA levels worse than 6/18 had undergone cataract surgery. Causes of avoidable blindness were classified as treatable (cataract, aphakia and uncorrected refractive errors (URE)), preventable by primary eye care services (corneal opacity, phthisis and pterygium) or preventable by specialized ophthalmic care (such as cataract surgical complications, glaucoma, and diabetic retinopathy (DR)).

Results

A total of 2,998 subjects aged ≥50 years were approached for the survey. Two thousand eight hundred and six (93.6%) of these were actually examined, 134 persons (4.5%) were not available, 30 (1.0%) declined and 28 (0.9%) could not be examined. Two isolated clusters in the interior could not be reached and were replaced by the next nearest EAs. Compared with census data, both for males and females, the older age groups were slightly over-represented (Table 1).

Blindness and visual impairment

The sample prevalence of bilateral blindness was 2.3% (95% CI: 1.4-3.2; Table 2). The sample prevalence of bilateral SVI and MVI in the examined population was 1.4% (0.8-1.9) and 6.5% (5.0-7.9), respectively (Table 3). Age- and sex- standardized prevalence of blindness, SVI, and MVI were 1.9% (1.0-2.8), 1.1% (0.6-1.6), and 5.6% (4.1-7.0), respectively (Table 3). Differences between males and females were statistically not significant. The prevalence of VI and blindness increased rapidly with older age (*e.g.*, bilateral blindness, 0.5% in people aged between 50 and 59 years to 10.2% in 80 years and older; Fig. 1).

Table 1. Age and gender composition of Suriname and sample population

	Males		Females	
Age groups years	**Suriname N (% total 50+)**	**Sample n (% total 50+)**	**Suriname N (% total 50+)**	**Sample n (% total 50+)**
50 - 59	26,335 (54.8%)	532 (42.5%)	26,489 (49.7%)	661 (42.6%)
60 - 69	12,535 (26.1%)	389 (31.0%)	14,298 (26.8%)	449 (28.9%)
70 - 79	6,678 (13.9%)	241 (19.2%)	8,756 (16.4%)	307 (19.8%)
80+	2,470 (5.1%)	91 (7.3%)	3,760 (7.1%)	134 (8.9%)

Table 2. Sample prevalence of blindness, SVI and MVI in adults of 50 years and older

	Males		Females		Total	
Bilateral VA	**n**	**% (95%CI)**	**n**	**% (95%CI)**	**n**	**% (95%CI)**
Blindness (PVA < 3/60)	29	2.3 (1.3–3.3)	35	2.3 (1.1 - 3.5)	64	2.3 (1.4 - 3.2)
SVI (PVA < 6/60 – 3/60)	15	1.2 (0.6–1.8)	23	1.5 (0.8 - 2.2)	38	1.4 (0.8 - 1.9)
MVI (PVA < 6/18 – 6/60)	84	6.7 (5.0-8.4)	97	6.3 (4.3 - 8.2)	181	6.5 (5.0 - 7.9)

PVA: presenting visual acuity; SVI: severe visual impairment; MVI: moderate visual impairment

Table 3. Age and sex adjusted prevalence of blindness, SVI and MVI in adults aged 50 years and older

	Males		Females		Total	
Bilateral VA	**n**	**% (95%CI)**	**n**	**% (95%CI)**	**n**	**% (95%CI)**
Blindness (PVA < 3/60)	862	1.8 (0.8 - 2.8)	1,044	2.0 (0.8 - 3.2)	1,906	1.9 (1.0 - 2.8)
SVI (PVA < 6/60 – 3/60)	426	0.9 (0.3 - 1.5)	697	1.3 (0.6 - 2.0)	1,123	1.1 (0.6 - 1.6)
MVI (PVA < 6/18 – 6/60)	2,635	5.5 (3.8 - 7.2)	3,016	5.7 (3.7 - 7.6)	5,645	5.6 (4.1 - 7.0)

PVA: presenting visual acuity; SVI: severe visual impairment; MVI: moderate visual impairment

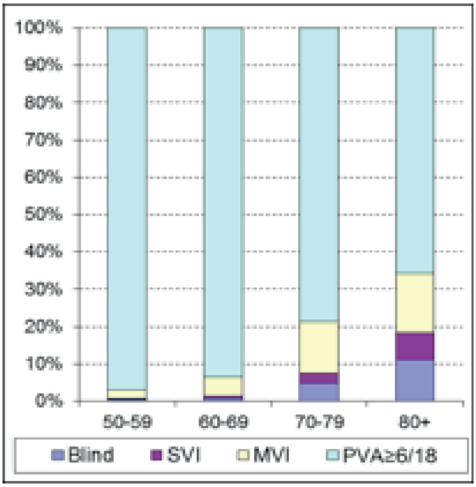

Figure 1. Age-specific prevalence of blindness, SVI, and MVI in Suriname in 2013

PVA: presenting visual acuity; SVI: severe visual impairment; MVI: moderate visual impairment

Table 4 shows the causes of visual impairment in people aged 50 years and older with bilateral blindness, SVI, and MVI. Untreated cataract was the most common cause of bilateral blindness, occurring in 54.0% of participants, followed by glaucoma (23.8%), other posterior segment disease (7.9%), diabetic retinopathy (3.2%), age-related macular degeneration (ARMD; 3.2%), and surgical complications (3.2%) including posterior capsule opacification (PCO). Overall, posterior segment disease was the cause in 38.1% of cases of blindness, *i.e.*, 55.2% in males and 23.5% in females ($p = 0.0486$). Blindness due to bilateral cataract seemed to occur more often in females (70.6%) than in males (34.5%; $p=0.052$), while blindness resulting from glaucoma seemed less common in females (8.8%) when compared to males (41.4%; $p=0.0124$). Cataract was also the main cause of SVI (57.9% of cases), followed by URE (10.5%), glaucoma and other posterior segment disease (both 7.9%), cataract surgical complications, and ARMD. The main causes of MVI were URE (48.6%) and untreated cataract (33.7%).

Cataract

The age- and sex-standardized prevalence of bilateral blindness due to cataract was 0.8% (0.2-1.3%) in the total population; 0.6% (0.0-1.2) in males and 0.9% (0.1-1.8) in females. The CSC was 88.1% for eyes with VA <3/60 (94.3% by individual), 84.2% for VA <6/60 (91.1% by individual), and 74.9% for VA <6/18 (81.2% by individual). Of the 1,003 eyes that had undergone cataract surgery, 97.2% were pseudophakic, and 2.8% were aphakic. Approximately 98 eyes (9.8%) had a poor outcome (VA <6/60), another 98 eyes had a borderline outcome (VA ≥6/60 and <6/18), and 807 eyes (80.5%) had a good outcome with available correction. Selection (comorbidity) was the main cause of poor outcome, followed by inadequate optical correction and surgical complications such as PCO. Eighty-seven percent of all cataract surgeries were conducted in a government hospital, 5.8% in a private hospital, 4.8% by other ophthalmic teams, and 2.4% in eye camps. There were no statistically significant differences between males and females in the use of these facilities. The proportion of eyes with a post-operative VA <6/60 (poor) with available correction was lowest in eyes operated in government hospitals (8.5%) and private hospitals (12.1%) when compared to other ophthalmic teams (18.8%) and eye camps (33.3%). The reasons that study participants with VA worse than 6/18 resulting from cataract did not attend surgery were ‘cannot

Table 4. Main causes of blindness, SVI, and MVI in Surinamese individuals aged 50 years and older

	Blindness		SVI		MVI	
	n	%	n	%	n	%
1. Refractive error	1	1.6%	4	10.5%	88	48.6%
2. Aphakia uncorrected	0	0.0%	1	2.6%	3	1.7%
3. Cataract untreated	34	54.0%	22	57.9%	61	33.7%
4. Cataract surgical complications	2	3.2%	2	5.3%	1	0.6%
5. Trachomatous corneal opacity	0	0.0%	0	0.0%	0	0.0%
6. Non Trachomatous corneal opacity	1	1.6%	1	2.6%	0	0.0%
7. Phthisis	0	0.0%	0	0.0%	0	0.0%
8. Pterygium	0	0.0%	0	0.0%	1	0.6%
9. Glaucoma	15	23.8%	3	7.9%	5	2.8%
10. Diabetic retinopathy	2	3.2%	0	0.0%	6	3.3%
11. ARMD	2	3.2%	2	5.3%	5	2.8%
12. Other posterior segment disease	5	7.9%	3	7.9%	6	3.3%
13. All other globe/CNS abnormalities	1	1.6%	0	0.0%	5	2.8%
Total	**63**	**100.0%**	**38**	**100.0%**	**181**	**100.0%**

CNS: Central Nervous System

access treatment' (28.9%), 'unawareness that treatment is possible' (23.7%), 'need not felt' (21.1%), 'fear' (13.2%), and 'treatment denied by provider' (13.2%).

Discussion

This is the first population-based survey on blindness and visual impairment in Suriname. The response rate was high (93.6%) and comparable to that in other recent RAAB surveys in South America.[14–17] The sample prevalence of blindness in adults aged 50 years and older was 2.3% (1.4-3.2) with an age- and sex- standardized prevalence of 1.9% (1.0-2.8). The findings of this survey provide an update on the status of eye care in Suriname, and provide base-line data for the development of a VISION 2020 action plan to improve eye care services and reduce the burden of blindness in the country.

The standardized prevalence of blindness in Suriname in the current study was comparable to estimates for nearby countries in the region with a similar health care infrastructure and socio-economic conditions.[17,18] In the Caribbean, the age-standardized prevalence of blindness in people aged 50+ years was 1.9% (1.4-2.4) [11], with the highest value in Haiti (4.8%; 2.6-7.7) and the lowest in Puerto Rico (1.1%; 95% CI not reported).[11] In South America, the prevalence of blindness was 3.0% in Panama (2.3-3.6%)[16], 2.0% (1.5-2.5%) in Peru[17], 1.1% (0.6-1.6) in Paraguay [15], and 0.9% (0.5-1.3) in Uruguay.[14] Results of the most recent RAAB survey in Argentina are not yet available. Overall, Suriname seemed to differ only marginally from other Caribbean and South American countries with respect to the prevalence of blindness.

The standardized prevalence of SMVI (severe/moderate visual impairment) in people of 50 years and older in Suriname was quite low (6.7%; 5.8-7.6) comparable to that estimated for other Caribbean or South American countries.[11,14–17] In the Caribbean, the aged-standardized prevalence for those aged 50 years and older was estimated at 11.0% (7.1-13.9).[11] Again, the highest estimate of SMVI in both genders was found in Haiti (21.9%; 8.9-33.9), while the country with the lowest age-standardized modelled prevalence of SMVI was Barbados (7.4%; 3.2-15.0).[11] In the most recent RAAB surveys in South America, the prevalence of SMVI ranged from 8.8% (7.9-9.7) in Uruguay to 11.5% (10.6-12.4) in Peru, 11.9% (10.7-13.1) in Paraguay and

13.1% (12.1-14.1) in Panama.[14–17] The low prevalence of SMVI in the current survey could be due to the lower prevalence of URE causing SMVI compared to other surveys.[14–17]This could be a result of the relatively good primary eye care service infrastructure in Suriname (expert opinion JP, AB, HT, MS). Still, URE remained an important cause of SMVI in Suriname and optical services should be improved to overcome this problem.

Although cataract was the most common cause of blindness and SVI in the entire study population, glaucoma was a major problem (23.8%) and was even the main cause of bilateral blindness in men. This propensity could be due to the high proportion of the Surinamese population being of African descent (37.4% Maroon and Creole, 12.5% mixed)[7] and has been reported before for several other Caribbean and South American countries including Cuba, where the proportion of blindness due to glaucoma even amounts to 26.2%.[9] We should take into consideration that central vision often remains intact in patients with glaucoma, even in advanced stages of the disease. This may imply that with so many patients who became blind from glaucoma, the number of patients in Suriname suffering from glaucoma may be even much higher. Unfortunately, these patients may have been overlooked in the current study, as the standard RAAB examination does not include an advanced screening method - such as visual field testing - for glaucoma. The higher prevalence of glaucoma among men was also reported in the Barbados Eye Study[19] and the Rotterdam Study[20] but multiple, large epidemiologic and population-based studies have been conducted around the world with conflicting results regarding the risk for glaucoma development between the genders.[21]

Of all cases of bilateral blindness in Suriname, 87.3% can be considered avoidable: 55.6% is treatable, 1.6% is manageable by primary eye care, and 30.2% is preventable by specialized ophthalmic care. These proportions are comparable to those from recent RAAB surveys in other parts of South America.[14–17] As in the current survey, cataract and glaucoma were the most common causes.[14–17] Barriers to seek treatment for cataract in Suriname were fairly similar for males and females, except for 'need not felt', which was more common in females. 'Cannot access treatment', the most common barrier, is a major and well-known problem because of difficulties to access the centralized centres for ophthalmic care. The population of the interior in particular is dependent on outreach projects where cataract surgical care is provided. This study shows that, in Suriname blindness was most prevalent in the (interior) Maroon population (6.3%) and more than 60% of blindness due to cataract occurred in this relatively isolated population. This suggests that cataract surgical services in the interior of Suriname have to be expanded. In other RAAB surveys cataract was also more common in relatively poor rural individuals whose access to eye care services was limited.[18] Fortunately, treatment costs did not represent a barrier for cataract surgery in Suriname, as most people of 60 years and older have health care insurance provided by the government.

Overall, compared to other countries, the cataract situation in Suriname is fairly well under control, although more women are blind or visually impaired due to this condition when compared to men. This gender inequity has been reported before for several other countries[22–24] and can probably be explained by the higher life expectancy of women when compared to men.[6] Also, many patients with SMVI due to cataract have undergone surgery. In fact, a CSC of 94.3% for people with VA <3/60 in Suriname is relatively high when compared to other South American and developing countries[25,26], and is even the highest in the region when calculated by individual for VA level <3/60 (ranging from 24% to 91% in Latin America).[25] This holds true for all VA levels and is equal for males and females. However, the proportion of the Surinamese population of 50 years and older is anticipated to grow from 13.2% in 2000 to 26.8% in 2030[6] while the prevalence of cataract in that age group is expected to rise exponentially, increasing the demand for cataract surgery. The current RAAB has assessed the situation approximately halfway through this period and has provided insight in the ways the eye care services in Suriname are dealing with the increased demand. For instance, in the last eight years, the SEC has significantly invested in further training of manpower and has purchased sophisticated and state-of-the art equipment. Still, detailed evaluation of the current cataract surgical services is necessary to identify possibilities to increase the cataract surgical rate by at least 10% and to compensate for the above-mentioned demographic trends.

Outcome of cataract surgery differed between different locations and offers room for improvement. On the positive side, visual outcome in the government and private hospitals, where most surgeries were performed (92.8%), usually met the standards from the WHO.[27] However, surgeries done by foreign ophthalmic teams had a poorer outcome in general. Accordingly, although 97.2% patients who had undergone surgery received an intraocular lens - which is relatively high when compared to other countries[18] - optimization of pre-operative selection procedures, refraction services, and surgical procedures are likely to considerably improve visual outcome.

This study had some limitations related to the selection of the sample. Although selection bias was minimized by compact segment sampling and revisiting people who were absent at the first visit, the older age groups were over-represented in our sample when compared with the most recent census data. This means that the sample prevalence for blindness is likely to be higher than the age- and sex- standardized prevalence, and that the standardized prevalence will be closest to the actual prevalence in the area under investigation. In addition to this, because of the 'no survey without service' statement and the selection of two unreachable clusters by the RAAB software (because of dangerous rapids in the river at the time of the survey and lack of housing for the medical teams) the most isolated areas in the interior of Suriname were not included in the study. These were replaced by the next nearest AEs, which were suitable to examine the participants and to perform cataract surgery in an eye camp setting if necessary.[10] It is possible that cataract prevalence had been underestimated by eliminating the most isolated rural areas where cataract surgical care has not yet been provided.

In summary, the percentage of avoidable blindness in Suriname among people aged 50 and older was relatively high with cataract being the major cause. Based on the high prevalence of glaucoma in Suriname, care should be taken to develop and expand the uptake of special services for glaucoma by active screening of family members and the expansion of health information on glaucoma and regular check-ups. Still, priority should be given to cataract surgery, followed by the development of optical services and Primary Health Care and Primary Eye Care services, as these are the most cost-effective interventions.

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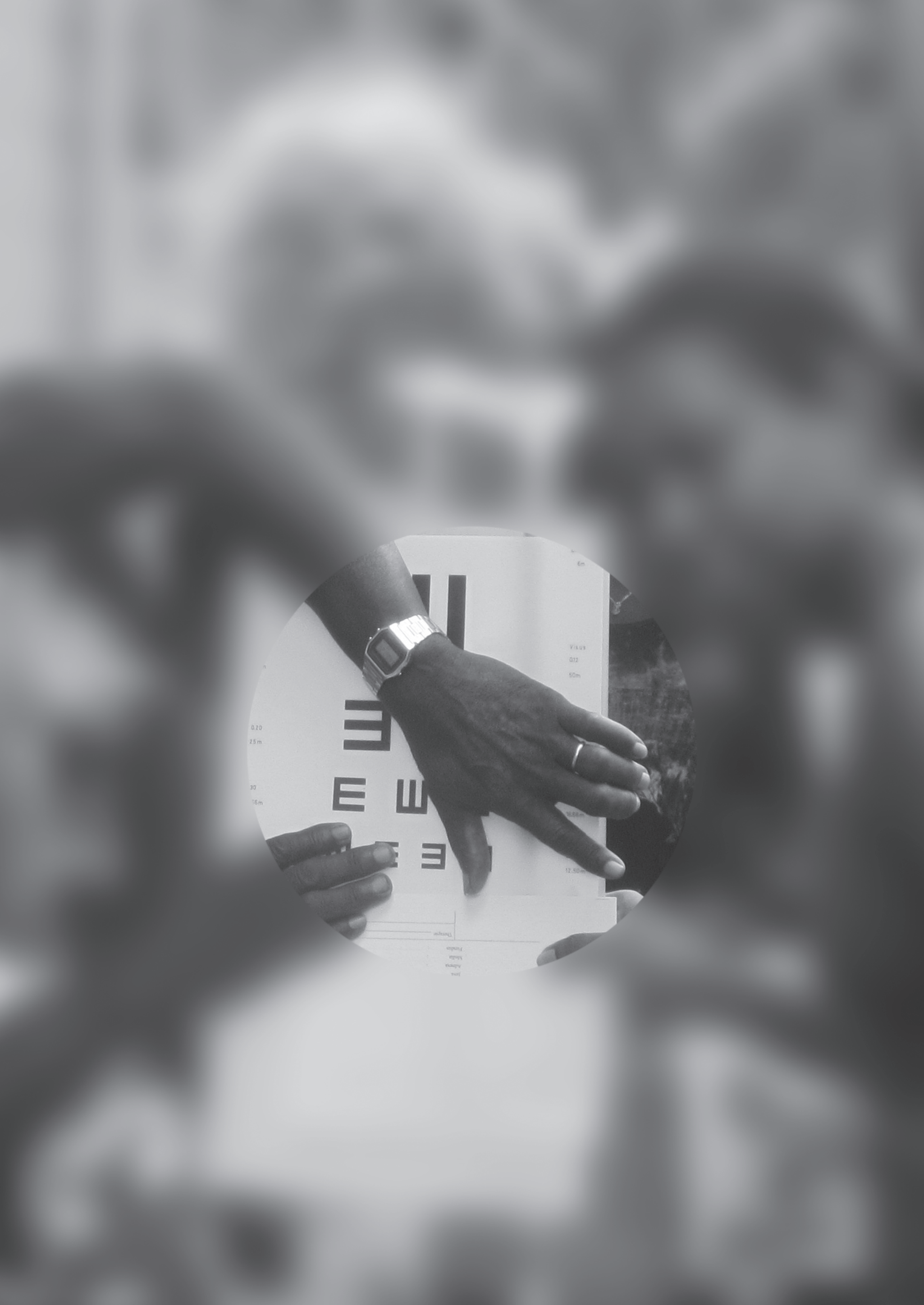
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Chapter 3

Causes of Blindness and Visual Impairment in the interior Maroon population in Suriname

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Abstract

Background/Aims: To assess the causes of blindness and visual impairment (VI) in the interior Maroon population living along the Upper Suriname River. The data obtained will be used to optimize preventive and therapeutic eye care programmes.

Methods: All of the approximately 23,000 inhabitants were invited for eye examination. Individuals expected to be blind or visually impaired were actively recruited. Data were collected on the basis of the World Health Organization Eye Examination Record version III (WHO/PBL).

Results: Thirty-eight (6%) of the 578 participants were either blind (visual acuity (VA) <3/60 in the better eye with available correction) or severely visually impaired (VA <6/60). The number of visually impaired patients (VA<6/18 and ≥6/60) was more than two-fold higher (102 (17.6%)). Cataract was the leading cause of blindness and severe visual impairment (SVI, 60%). Other major causes were glaucoma (16%) and idiopathic optic atrophy (10%). A few patients were blind due to phtysis bulbi, aphakia, corneal opacities, retinitis pigmentosa, and toxoplasmosis.

Conclusion: The number of visually impaired patients in the Upper Suriname River area was relatively high and most causes were avoidable. This indicates a need of blindness prevention programmes in these populations with emphasis on effective treatment of cataract and strategies for early detection and treatment of glaucoma.

Introduction

The Republic of Suriname, an independent state situated on the northeast coast of South America (Figure 1), is an example of a developing country where avoidable and treatable blindness remains an important public health problem. Suriname has a population of approximately 530,000. [1] Around 90% of the population lives in the capital city Paramaribo and in other cities located in the narrow coastal zone in the northern part of the country. [2] The remaining 10% inhabits the interior, which comprises more than three-quarters of Suriname's land surface and consists largely of tropical rain forest.[2] Specialized ophthalmic care in Suriname is mainly concentrated in the Suriname Eye Centre (SEC) in the Academic Hospital Paramaribo (AZP). Every day, new patients from the city and surrounding districts visit the SEC presenting with severe, sometimes end-stage eye disease. Unfortunately, the hinterland population is not always able to reach the SEC and little is known about the ophthalmic situation in these remote areas.

The hinterland population consists almost exclusively of Maroon and Indigenous (Amerindian) tribes. The Maroons are descendants from runaway slaves shipped from West Africa between the 16th and 19th century who have established a fairly large number of small communities along the Upper Suriname River. [3] They originated from the Gold Coast and the Slave Coast of West Africa, a region that now encompasses Ghana, Togo and Nigeria. [4] Unlike the Creoles in the urban areas of Suriname and other parts of the Caribbean, the interior Maroon population has hardly mixed with other ethnic groups. The Maroons live relatively isolated but are offered primary health care by the Medical Mission, a non-profit health care organization subsidized by the government. The Medical Mission has set up a system of rural clinics, dispensaries, and transport systems to urban hospitals, but does not provide secondary health care. This includes care for eye diseases. As a consequence, the burden of blindness and visual impairment (VI) is expected to be high among Maroons. When considering their African origin and the tropical environment they live in, it is likely that cataract and glaucoma will be identified as important causes of blindness and VI in the interior Maroon population.[5-7]

So far, no standardized surveys about the scale and causes of blindness and VI in this area have been conducted. The lack of information makes it difficult to plan preventive and other therapeutic eye care programmes. Therefore, the SEC initiated a population-based survey to assess the causes of blindness and VI in the Maroon population along the Upper Suriname River. The data obtained will be used to opti-

Figure 1. Map of the Republic of Suriname. Circle in top left: Suriname's location in South America. Circle in red: Upper Suriname River area.

mize preventive and therapeutic eye care programmes in these populations and to design national blindness programmes in Suriname and in other countries with predominantly populations of African descent.

Materials and methods

The survey was conducted in several villages along the Upper Suriname River (Figure 1) between December 2011 and June 2012. All off the approximately 23,000 inhabitants live in a rural setting and were invited for examination. There were no specific inclusion or exclusion criteria. To make sure that the majority of visually impaired patients were included, those suspected to be blind or visually impaired were actively recruited for eye examination by co-workers of the Medical Mission. Individuals who had previously been operated for cataract were also invited for follow-up.

The medical team consisted of two ophthalmologists, a medical doctor specifically trained in basic eye examination, and two trained eye nurses. The team was locally supported by co-workers of the Medical Mission who also functioned as interpreter (the majority of the elder Maroons are illiterate and speak only their native tribal language). Systematic ophthalmic examination was performed using the WHO Eye Examination Record version III developed for the Prevention of Blindness Programme (PBL).[8] The data per person were coded and systematically recorded.

Ophthalmic examination

Presenting distance visual acuity (VA) was tested using the Snellen E chart in full daylight by the assistants with the help of the local co-workers. Tests involving counting fingers, hand movements, and light perception were used for those unable to read the top line at half the test distance. Each eye was tested separately with available correction; in the case of a VA <6/18 a pinhole VA test was performed. Bilateral blindness was defined following WHO criteria as presenting VA <3/60 in the better eye with available correction, severe VI (SVI) as presenting VA <6/60 to ≥3/60, and VI (VI) as VA <6/18 to ≥6/60. Relative afferent pupil defect (RAPD) was examined using the swinging flashlight method. All subjects were examined by an ophthalmologist at the local medical post using a slit lamp, a(n) (in)direct ophthalmoscope, and a portable applanation tonometer (Icare, Finland Oy). In subjects with diabetes mellitus (DM), a presenting distance VA <6/18 or an intraocular pressure of 25 and higher, the pupil was dilated for diagnosis. In the case of patients presenting with a VA <6/18 in either eye, the WHO/PBL eye examination record recommends to consider the major cause as the disorder most amenable to treatment or prevention.[8] Automatic refraction (Retinomax K-plus, Righton) was only performed in visually impaired participants without other underlying eye disease.

Results

Five hundred seventy-eight of the 586 examined participants completed the protocol. Table 1 presents the age and sex distribution of the study population. The median age was 56 years (range 5-92 years) and the male-to-female ratio was approximately 1:4.

Table 1 Age and sex distribution of the sample

	Male	Female
Age (years)	**Number (%)**	**Number (%)**
0-39	22 (3.8)	88 (15.2)
40-49	24 (4.2)	94 (16.3)
50-59	14 (2.4)	81 (14.0)
60-69	28 (4.8)	94 (16.3)
70-79	22 (3.8)	62 (10.7)
≥80	15 (2.6)	34 (5.9)
Total	125 (21.6)	453 (78.4)

Presenting visual acuity

Table 2 presents the distribution of unilateral and bilateral blindness, SVI, and VI. Monocular blindness was more than twice as common as binocular blindness. The total number of blind and severely visually impaired patients in our study population increased with increasing age from 1 patient (0.2%) in the age group between 40 and 49 years, to 12 patients (2.1%) aged 80 years or older. The highest percentage of visual impairment was noted in the 60 to 69-age group (5.5%). Furthermore, 8.8% of the male population and 6.0% of the female population was blind or severely visually impaired. On the other hand, VI was more common in females than in males (11.2% versus 19.4%).

Table 2 Blindness and VI in one or both eyes according to WHO criteria and gender in the upper Suriname River area*

Categories of VI	Men N = 125 n (%)	Women N = 453 n (%)	Total N = 578 n (%)
Bilateral			
Blindness	6 (1.0)	20 (3.5)	26 (4.5)
SVI	5 (0.9)	7 (1.2)	12 (2.1)
VI	14 (2.4)	88 (15.2)	102 (17.6)
Unilateral			
Blindness	19 (3.3)	46 (8.0)	65 (11.2)
SVI	6 (1.0)	5 (0.9)	11 (1.9)
VI	17 (2.9)	40 (6.9)	57 (9.9)

*Blindness = VA <3/60; SVI = VA <6/60 to ≥3/60; VI = VA <6/18 to ≥6/60

Causes of blindness and VI

Cataract and glaucoma were the most important causes of blindness and SVI, responsible for more than 75% of cases (Figure 2). Idiopathic optic atrophy was the third most frequent single cause(s) of blindness and SVI, accounting for 10% of blind and severely visually impaired patients. The remaining 14% of patients was blind or severely visually impaired as a result of uncorrected aphakia, xerophthalmia, phthisis bulbi, retinitis pigmentosa, or toxoplasmosis.

Cataract was also the leading cause of VI, accounting for more than 60% of visually impaired patients (Figure 3). Refractive error was the second most common cause of VI (14%). Eight percent of visually impairment was due to optic atrophy (5%) or glaucoma (3%). Other posterior segment diseases (such as diabetic retinopathy (DR), toxoplasmosis, albinism, and retinitis pigmentosa) accounted for another 5% of cases. Extending pterygium caused three percent and the remaining 1% was due to posterior capsule opacification (PCO). In five patients no cause was identified. Sixty-five percent of blindness and SVI, and 82% of those of VI involved avoidable causes, including uncorrected and corrected cataracts, PCO, refractive error, corneal scars, extending pterygium, and phthisis/no globe caused by trauma.

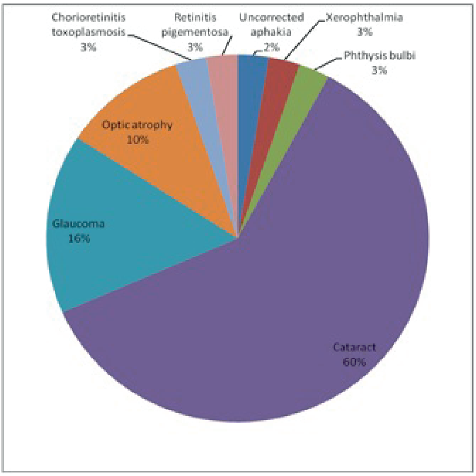

Figure 2. Primary causes of blindness and severe visual impairment (38 eyes from 38 patients with VA <6/60)

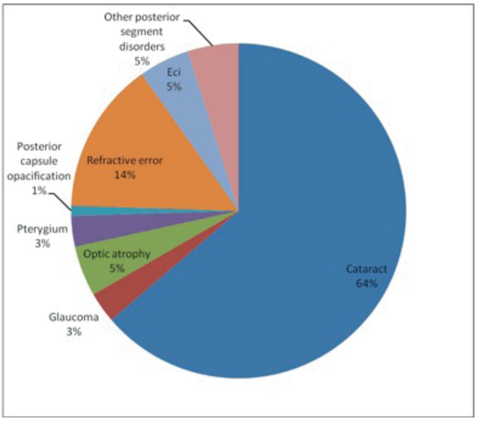

Figure 3. Primary causes of VI (102 eyes from 102 people with VA <6/18)

Discussion

This survey investigated the causes of visually impairing diseases in a Maroon population living along the Upper Suriname River in Suriname. We identified cataract and glaucoma as the most important causes of blindness and SVI. Both conditions were the leading causes of blindness in more than 75% of bilaterally blind and severely visually impaired patients. These results are in line with those from a population-based epidemiologic study in individuals of African descent in Barbados, indicating that cataract and glaucoma were responsible for the majority of bilaterally blind patients in that country.[7] Another important cause of blindness in both our survey and the Barbados Eye Study (BES) was idiopathic optic atrophy.[7] Notwithstanding differences in methodology and definitions, the similarity in target population speaks in favour of the consistency of our results with those of the BES. The frequent occurrence of cataract and glaucoma in Afro-Caribbeans may be of relevance to the planning and delivery of treatment and prevention programmes in the Maroon population of Suriname.

Cataract

Cataract is responsible for more than 90% of disability-adjusted life-years in low- and middle-income countries.[9] The burden of blindness and SVI caused by cataract could be substantially reduced by providing cataract surgery. Since 2007, the SEC has started cataract surgery missions to the Upper Suriname River area.[10] However, long-term outcomes after the first cataract surgical missions in the Maroon population might be relatively poor (unpublished data). This was due to pre-existing ocular pathologies and surgical complications such as PCO. The high number of cataract-operated eyes with PCO was partly related to the use of hydrophilic IOLs during the first cataract missions. In all, our data suggest that the SEC should dedicate increased efforts to provide high-quality cataract surgery and YAG laser posterior capsulotomy in the Upper Suriname River area. Hydrophobic IOLs are used since 2010 [10], and further improvement in cataract surgical outcome could be accomplished by excluding patients with severe pre-existing ocular pathology, implementing a monitoring system after surgery and post-operative refraction. [11]

Glaucoma

The high number of patients with glaucoma in our patient population is in agreement with the findings from surveys conducted in African countries and Caribbean populations with West African ancestry.[5; 7; 12-14] However, it is difficult to compare our data with those from other surveys because samples were not taken at random and a different definition of glaucoma was used. Furthermore, it remains challenging to diagnose glaucoma without computerized visual field testing.

Open angle glaucoma has an early onset and progresses rapidly. In most patients in developing countries, the disease leads to massive loss of visual field because of late diagnosis and lack of treatment possibilities.[12] Chronic treatment of glaucoma with medication is often unsuccessful in developing countries where individuals do not have easy access to secondary health care, as holds true for the Maroons. Medication is expensive, its availability is limited, and people have to travel long distances for follow-up examination.[12] In all, this leads to poor compliance. Argon laser therapy has a limited role because of unsatisfactory results as well as the performance of trabeculectomy, which is related to poor patient acceptance and difficulties in post-operative care.[12] Subjects diagnosed with glaucoma during our survey were advised to visit the AZP for evaluation. Unfortunately, many patients, including patients aged less than 30 years old, were already severely visually impaired. Our results again confirm the need of an efficient, cost-effective procedure to resolve the problem of glaucoma in comparable populations of African descent.[12; 15]

Diabetic retinopathy

Type II DM is more common in African-Americans than in whites and there is evidence to suggest that black people are more prone to develop DR because of underlying risk factors such as hypertension [16-18] and poor glycaemic control.[19-21] Based on this information, the absence of DR in Maroons living in Suriname's interior was remarkable, particularly when compared to Maroons living in villages closer to the urban areas in whom DR was (much) more common (expert opinion JP, unpublished data). As obesity was also more common in the latter less isolated and more westernized population, their higher DR prevalence may tentatively be attributed to (urban-rural) differences in lifestyle and dietary habits. Obviously, this supposition must be confirmed in future studies.

Optic atrophy

The high percentage of blindness caused by idiopathic optic atrophy was in agreement with the BES results but higher than that found in comparable population-based studies with black participants.[22-23] Between 1974 and 1977, a retrospective case record and field study was conducted about the occurrence, forms, and aetiology of optic atrophy in Suriname.[24] The results of this study showed that bilateral unexplained optic atrophy was more common in Creole than in Hindustani patients, and that the incidence was highest among males in the Para and Saramacca districts.[24] It was concluded that the Negroid population groups in Suriname might develop optic atrophy because of a hereditary predisposition combined with exogenous factors such as toxic influences.[24] Nutritional cyanide intake in various cassave products had been suggested as a possible intoxicator [24], but the exact cause is still unknown. Thus, more detailed studies should be carried out to understand the aetiology of optic atrophy in populations of African descent.

Strengths and limitations of the study

To reduce the time of the survey, refraction was not included in the ophthalmic examination. Instead, a pinhole and automatic refractive measurement was used as a proxy for best corrected VA and diagnosis of refraction error. Another limitation of the study was the self-created selection bias to make sure that all blind and visually impaired individuals were included. The sample was not taken at random, which is essential to get insight into the exact prevalence of diseases. Also, strikingly more women than men were included in the survey, probably due to the fact that the number of females living along the Upper Suriname River is higher than the number of males. Males are often absent because of work elsewhere.

On the other hand, patients were examined by a standardized methodology in which an indirect ophthalmoscope was used to identify the causes of posterior segment diseases. In most surveys, a direct ophthalmoscope is used to reduce the time and cost of the survey. A more detailed methodology to assess posterior segment disease becomes more important when the prevalence of cataract decreases.[25] In addition, the problem of presbyopia was assessed in the majority of individuals aged over 45 years (data not shown). Presbyopia does not lead to blindness, but can lead to substantial concerns. Still, this easily treatable condition is not included in the standardized methodology of several surveys [25] or in blindness prevention programmes. In our experience, the delivery of reading glasses was one of the most efficient and successful aspects of our screening mission.

Conclusion

This study reveals a relatively high burden of blindness and VI in the Maroon population along the Upper Suriname River. As the causes are most probably avoidable and treatable, the prevalence of these conditions can be reduced. This assessment of the prevalent ophthalmic diseases provides useful baseline information for the planning of preventive and therapeutic eye care programmes and indicates the necessity of a representative national blindness survey for the development of national blindness prevention programmes.

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Chapter 4

The cataract situation in Suriname

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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 U$ 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; 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

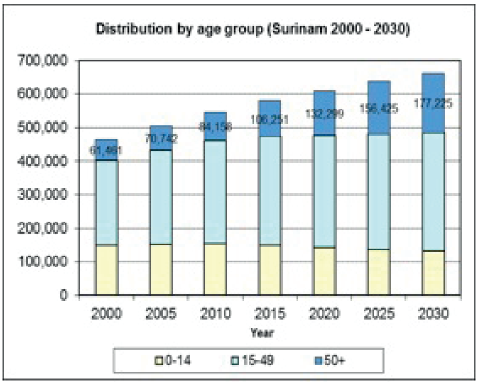

Figure 1. Population of Suriname by age group

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 bilateral cataract occurred in 0.5% (0.2-0.7) and bilateral MVI (BCVA <6/18–6/60 in better eye) due to bilateral 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 1. Number of cataract surgeons and cataract operations at the Suriname Eye Centre (SEC) in the period 2006-2014

Year	Population size x 1000 inhabitants[7]	No. of ophthalmologists	No. of ophthalmologists per 1 million inhabitants	No. of cataract operations	Average No. of surgeries per ophthalmologist
2006	512	6	12	1150	192
2007	521	7	13	1374	196
2008	530	7	13	2677	382
2009	538	7	13	2902	415
2010	546	8	15	3271	409
2011	553	8	15	3393	424
2012	560	9	16	3743	416
2013	567	10	18	3906	391
2014	573	10	18	4538	454

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

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

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

	WHO	**Suriname Eye Centre**		**Mission Milagros**		**Private hospital**		**Eye camp**		**Total**	
	norm	**Eyes**	**%**	**Eyes**	**%**	**Eyes**	**%**	**Eyes**	**%**	**Eyes**	**%**
Good: can see 6/18	>80%	714	81.8	31	64.6	48	82.8	14	58.3	807	80.5
Borderline: can see 6/60	<15%	85	9.7	8	16.7	3	5.2	2	8.3	98	9.8
Poor: cannot see 6/60	<5%	74	8.5	9	18.8	7	12.1	8	33.3	98	9.8
Total	100%	873	100.0	48	100.0	58	100.0	24	100.0	1,003	100.0

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

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

(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 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.

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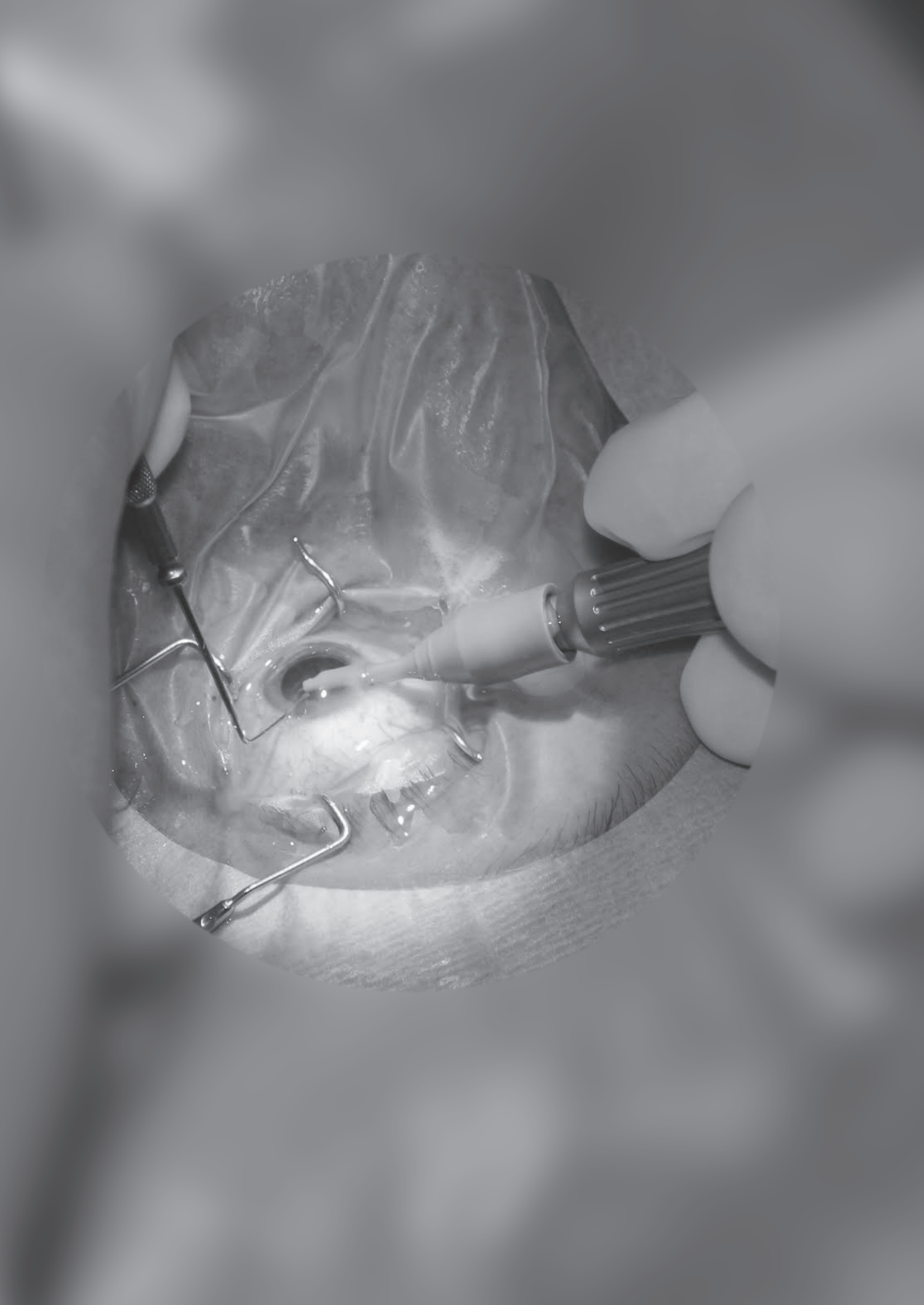

Chapter 5

Phacoemulsification under topical anaesthesia in remote areas

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Abstract

Purpose We report the use of high-quality cataract surgery in remote areas of the Amazon in Suriname.

Setting The Amazon rain forest of Suriname, South America.

Design Retrospective observational study.

Methods We describe our experiences with the use and the clinical outcomes of phacoemulsification with intraocular lens (IOL) implantation in 88 consecutive patients. All surgeries were performed in the field under topical anaesthesia. Outcomes were evaluated by comparing pre- and post-operative uncorrected visual acuity using World Health Organization (WHO) criteria, and assessing intra- and immediate post-operative complications by Oxford Cataract Treatment Evaluation Team (OCTET) definitions.

Results Before surgery, 54 eyes (61%) where either blind or severely visually impaired (visual acuity <6/60). Only 8 patients (9%) had a visual acuity ≥6/18. At the final post-operative visit, 61 patients (70%) had an uncorrected visual acuity ≥6/18 and 8 patients (9%) remained blind or severely visually impaired. Intra-operatively, 2 cases (2%) of posterior capsule rupture (OCTET III) occurred, involving one dropped nucleus (1%).

Conclusion High-quality cataract surgery can reliably be performed in remote areas of the Amazon rain forest with a good visual outcome and a low complication rate.

Introduction

Cataract is among the leading causes of blindness in many developing countries.[1] This condition is also responsible for more than 90% of disability-adjusted life-years in low- and middle-income countries.[2] As the world population is rapidly aging, cataract is anticipated to become a major health threat in the near future.[3] Not surprisingly, strategies aimed at the prevention and treatment of cataract-induced blindness is high on the list of public health concerns of many countries. Therefore, and in keeping with the goals of Vision 2020, the Global Initiative for the Elimination of Avoidable Blindness of the World Health Organization (WHO) and the International Agency for the Prevention of Blindness have made the treatment of cataract in developing countries one of their top priorities.[1]

The Republic of Suriname is situated on the northeast coast of South America (Figure 1) and has a population of approximately 525,000. Around 90% lives in the capital city of Paramaribo and in other cities located in the narrow coastal zone in the northern part of the country. The remaining 10% inhabits the hinterland, which comprises more than three-quarters of Suriname's land surface and consists largely of dense Amazon tropical rain forest. The hinterland population exists almost exclusively of Amerindians (the indigenous peoples of Suriname) and Maroons (descendants from runaway slaves shipped from Western African between the 16th and 19th century).[4-5] Many Amerindian tribes have settled in the southern district of Sipaliwini, while certain Maroons have established a fairly large number of small communities along the Suriname River. The majority of elder Amerindians and Maroons are illiterate and speak only their native tribal language.

The inhabitants of the hinterland are relatively isolated and are offered primary health care by the Medical Mission, a non-profit health care organization subsidized by the government. The Medical Mission has set up a system of rural clinics, dispensaries, and transport systems to urban medical posts, but does not provide secondary health care. Therefore, patients in Suriname's hinterland do not have easy access to specialized medical care, such as cataract surgery. As a consequence, this condition has become an important cause of visual impairment and blindness in elder Amerindians and Maroons.

With the aim to reduce the burden of cataract-induced blindness in Suriname, the Department of Ophthalmology of the Academic Hospital Paramaribo has started Ophthalmic Missions to these remote areas. The first screening mission was carried out in 2002, and since 2007 phacoemulsification under topical anaesthesia is being performed in the field. Notably, the medical team had to overcome not only the relatively primitive conditions (such as the lack of electricity, running water, and adequate medical facilities), but also the language barrier between them and the local population. In this paper, we describe our experiences with the use and the clinical outcome of phacoemulsification under topical anaesthesia (without sedation) in remote areas of the Amazon rain forest in Suriname. Although the use of phacoemulsification under topical anaesthesia in mobile eye camps has been described before[6], its use in the setting of the Amazon rain forest is unique.

Patients and methods

This was a retrospective descriptive study that included consecutive patients with cataract who had undergone phacoemulsification and intraocular lens (IOL) implantation under topical anaesthesia in Laduani and Kwamalasamutu between November 2011 en December 2012 (Figure 1).

Inclusion and exclusion criteria

The pre-selection of candidates was done by health workers of the Medical Mission, and was mainly based on older age and the presence of visual complaints. Patients arrived on foot, by boot or were carried in a barrow from as far as 100 km for eye examination and treatment. Individuals eligible for cataract surgery had clinically significant lens opacity, satisfactory light perception and projection of light, and had agreed to undergo surgery. Patients who needed retrobulbar anaesthesia because of a high degree of anxiety at the time of surgery or who needed extracapsular cataract extraction because of hard or mature cataracts were excluded from the study.

Data retrieval

The data retrieved from the clinical notes included gender, age at the time of surgery, surgical details and post-operative complications, as well as pre-operative and post-operative visual acuity. The post-operative uncorrected

Figure 1. Map of the Republic of Suriname. Circle in top left: Suriname's location in South America. Circles in red: locations of the Laduani and Kwamalasamutu mobile eye camps.

visual acuity was taken at the final visit at least one week after surgery. Snellen's acuity (E chart) was categorized using WHO guidelines. [7] When visual outcome was poor (<6/60) the cause was recorded. The classification of intra-operative and immediate post-operative complications followed the Oxford Cataract Treatment Evaluation Team (OCTET) classification of cataract surgery-related complications.[8]

Surgical set-up and phacoemulsification

Equipment for the mobile eye unit was transported to the area by airplane. The operation theatre was set up in a room of a local home or medical post and the phacoemulsification system was installed. The four participating surgeons (JP, AB, HT, JHP) were all skilled in performing phacoemulsification and each had more than four years experience with the technique. Prior to the intervention, local translators gave the patients meticulous instructions in their own language. However, during the procedure, the surgeons communicated directly with the patients after having mastered the essential native expressions specifically for this purpose.

A trained ophthalmic assistant carried out biometric IOL measurements. Two hours prior to surgery, the pupil of the affected eye was dilated with topical homatropin (20 mg/mL) and phenylephrine (100 mg/mL). Topical anaesthesia with lidocaine (40 mg/mL) was administered immediately before disinfecting the conjunctiva and eyelids with povidone-iodine (50 mg/mL). For phacoemulsification, a 2.75 mm corneo-scleral tunnel incision and a separate stab incision for the second instrument were made. When necessary, the anterior capsule was stained with trypan blue (Vision Blue®, 0.6 mg/mL). Anterior capsulorhexis was created using a bent 27-gauge needle followed by hydro dissection. Phacoemulsification was performed using a Laureate (Alcon) or Legacy (Alcon) phacoemulsification system applying the divide-and-conquer technique (0.5 mL of gentamicin (40 mg/mL) and 0.5 mL of adrenaline (1 mg/mL) was added to each bottle of balanced salt solution). The remaining cortex was removed with the co-axial irrigation/aspiration hand piece or with the bimanual technique. Hydroxypropyl methylcellulose (20 mg/mL) was used as visco-elastic. A calculated hydrophobic foldable acrylic IOL (SN60WF; Alcon) was implanted in the capsular bag.

Post-operative management

Most patients returned to their homes immediately after surgery. Those who came from far spent the night in hammocks near the clinic waiting for their first post-operative examination. Routine post-operative care included the application three times a day of a topical dexamethason-tobramycine (Tobradex®) combination (1/3 mg/mL) for three weeks, and the administration of acetazolamide (Diamox®) tablets (250 mg) to surgeon's preference to patients who had a high palpatory intra-ocular pressure 1-day post-operatively or significant corneal oedema. All patients were reviewed within twenty-four hours and subsequent visits were determined according to clinical need.

Results

Patient characteristics

A total of 92 patients had undergone surgery for cataract at the Laduani and Kwamalasamutu mobile eye camps. Four patients were selected for surgery under retrobulbar anaesthesia, two of which underwent planned extracapsular cataract extraction. In total, 88 eyes of 88 patients were included. Twenty-seven (31%) patients were male. The mean (range) age of the patients was 73 (52-88 years) years.

Uncorrected visual acuity before surgery and visual outcome at follow-up

Eighty-seven of the 88 operated eyes (99%) were examined at the final visit. Before surgery, 61% of the operated eyes were either blind (less than WHO category 3/60; Table 1) or severely visually impaired (less than WHO category 6/60; Table 1). Only 9% had satisfactory vision (WHO category 6/18 or better; Table 1). At the final post-operative visit, poor visual outcome (less than WHO category 6/60) was noted in 9% of the eyes, while good vision (WHO category 6/18 or better) was found in 70% of the eyes that had undergone phaco-emulsification with IOL implantation (Table 2). When considering that 67 of the 87 patients had better vision after surgery according to the WHO classification, it can be concluded that the procedure had improved vision in more than 77% of this patient population.

Causes of poor visual outcome

Seven of the 8 eyes with acuity <WHO category 6/60 at follow-up had pre-existing ocular pathology including end-stage glaucoma, branch retinal vein occlusion, idiopathic optic atrophy, or extending pterygium. The poor outcome of one eye was caused by corneal decompensation.

Complications

Two intra-operative complications occurred in two eyes (2.3%) (Table 3). Both cases involved posterior capsule rupture of OCTET grade III. One case required anterior vitrectomy with IOL implantation in the sulcus. The other case involved a dropped nucleus and was transported by air to the Academic Hospital Paramaribo for pars plana vitrectomy.

In all, 44 patients (50%) did not have any immediate post-operative complications (Table 4). The remaining 44 patients (50%) had 45 complications comprising OCTET grade I complications in 43 patients (49%) and OCTET grade II complications in 2 of them (2.3%). The latter two patients needed an extra stitch because of wound leakage. Acetazolamide (Diamox®) tablets were administered to 40

Table 1. Distribution of uncorrected visual acuity before surgery

WHO category	Level of visual acuity	Number of patients (%)
Blind	less than 3/60 – PL	31 (35.2)
Severe visual impairment	less than 6/60 to 3/60	23 (26.1)
Visual impairment	less than 6/18 to 6/60	26 (29.5)
No impairment	6/18 or better	8 (9.1)
Total		88 (100)

PL= perception of light

Table 2. Distribution of uncorrected visual acuity after surgery

Level of visual acuity	Number of patients (%)
6/18 or better	61 (70.1)
6/24 - 6/60 (borderline)	18 (20.7)
Less than 6/60 (poor)	8 (9.2)
Total	87 (100.0) †

† One patient was lost to follow-up

Table 3. Distribution of intra-operative complications

Complication	OCTET grading*	Number of patients (%)
None		86 (97.7)
Posterior capsule rupture (with only vitreous loss)	III	1 (1.1)
Posterior capsule rupture (with dropped nucleus)	III	1 (1.1)
Total		88 (100)

* Grade I: trivial complications that may need medical therapy but are not likely to result in a marked drop in visual acuity; grade II: intermediate complications that need medical therapy and will result in a marked drop in visual acuity if left untreated; grade III: serious complications that need immediate medical or surgical intervention to prevent gross visual loss.

Table 4. Distribution of post-operative complications

Complication	**OCTET grading***	**Number of patients (%)**
None		44 (50.0)
Transient corneal oedema	I	26 (29.5)
Transient corneal oedema + descemet membrane folds	I	17 (19.3)
Wound leakage	II	2 (2.3)
Total		88 (101.1)*

*Grade I: trivial complications that may need medical therapy but are not likely to result in a marked drop in visual acuity; grade II: intermediate complications that need medical therapy and will result in a marked drop in visual acuity if left untreated; grade III: serious complications that need immediate medical or surgical intervention to prevent gross visual loss.
*One patient had two post-operative complications

patients (45%) to lower intra-ocular pressure and/or to reduce corneal oedema. It is worth mentioning that raised intra-ocular pressure could not, by definition, be attributed to the procedure itself and was therefore not considered a complication.

Discussion

Cataract is the leading cause of blindness in many developing countries.[1] One of the accepted ways to increase usage of cataract services is by extending ophthalmic care facilities to rural areas through mobile eye units, thereby bringing cataract surgical services more close to affected individuals.[9] However, results of camp surgery can be poor, mainly because of low-quality pre-operative examination and limited availability of sophisticated equipment. For these reasons, the quality and safety of surgery in eye camps is often questioned and high-quality cataract surgery would only be possible in adequately equipped facilities.

An alternative concept is to screen patients in the field and transport them for surgery to a base hospital. Unfortunately, this concept is associated with high costs and a lower response rate, leaving eye camps the most effective way for people in remote rural areas to provide access to cataract surgery. In this article, we report that high-quality cataract surgery in the field is possible, even under primitive circumstances. We showed that skilled surgeons and a good organization make it feasible to perform phacoemulsification with topical anaesthesia with good visual outcome and low complication rate in the middle of the Amazon rain forest.

The surgical missions were set up to provide ophthalmic care to isolated Maroon and Amerindian tribes in the hinterland of Suriname. As in other developing countries, our medical team had to deal with dense and mature cataracts.[10] The only patient selection criteria for cataract surgery were visual acuity in relation to bio-microscopy findings. Although most patients were unfamiliar with any surgical procedure, no sedation was used. Particularly the language barrier between the surgeons and the patients imposed a major challenge, particularly in patients presenting with comorbidities such as pseudo-exfoliation, corneal scars, and extending pterygia. Despite these obstacles, results were good, showing improved uncorrected visual acuity in the majority of patients. The number of posterior capsular ruptures was also within the range of complications reported in the literature [11-12] and no cases of endophthalmitis occurred.

Cataract surgery is among the most cost-effective interventions in ophthalmology [13], and has evolved from intra capsular cataract extraction to phacoemulsification surgery. While phacoemulsification is currently the standard surgical technique for cataract surgery in most western countries, it is not widely used in developing countries.[1] It requires costly equipment and consumables and has a learning curve for the surgeons.[1; 14-16] Instead, manual small incision cataract surgery (MSICS) is gaining popularity in many developing countries.[17] This technique is less efficacious than phacoemulsification and theoretically carries a greater risk of inflammation, cystoid macular oedema, and astigmatism.[1] However, it is faster, less technology-dependent, and less costly [1], and thus better attuned to the generally limited resources in developing countries. Yet, clinical trials have shown that phacoemulsification accomplishes better uncorrected visual acuity than MCICS.[1-18] Obviously, this is a major advantage in remote (tropical Amazon) areas were obtaining a reliable subjective refraction is complicated and time consuming because of illiteracy and a language barrier.

We prefer the use of topical anaesthesia since it does not subject patients to the potential complications of retro- or peribulbar injections such as globe perforation[19], retinal detachment with retinal vascular occlusion [20], optic nerve injury [21], brainstem anaesthesia [22] and cardiopulmonary arrest.[23] Generally for phacoemulsification, topical anaesthesia provides comparable relief of pain and avoids all the complications associated with injections. In the field, the use of topical anaesthesia is even more practical because the surgeons can easily perform it; it is also safe (no need for patient monitoring by an anaesthesiologist), effective [6], less time consuming (fast patient turnover), and less costly than the use of injections. Some concerns have been expressed regarding an increased risk of intra-operative complications of topical anaesthesia due to unrestricted eye movements and insufficient pain control. [24] However, studies have shown that phacoemulsification under topical anaesthesia in random patient populations and without sedation may serve well in routine cataract surgery.[6-12] In addition to these results, we report that phacoemulsification under topical anaesthesia is safe and feasible, even in the middle of the tropical rain forest and under the circumstances of a language barrier.

In conclusion, this report confirms the feasibility of high-quality cataract surgery in remote areas in the Amazon. Future prospective studies with a larger patient population should include a more complete ophthalmic examination (*i.e.*, refraction, intra- ocular pressure measurement, and cataract grading) to better assess the quality of cataract services, as well as assessments of the gains in quality of life. It is clear that that bringing high quality surgery to the hinterland anywhere on the globe will significantly contribute to the achievement of the Vision 2020 goal to eliminate cataract as a cause of blindness in these areas.

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Chapter 6

Diabetes and diabetic retinopathy in people aged 50 years and older in the Republic of Suriname

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Abstract

Background/Aims: Population based surveys on diabetes and diabetic retinopathy (DR) are necessary to increase awareness and develop screening and therapeutic programmes. The aim was to estimate the prevalence of DR in older adults of different ethnical backgrounds in Suriname.

Methods: Fifty clusters of 60 people aged ≥ 50 years were randomly selected with a probability proportional to the size of the population unit. Eligible persons were randomly selected through compact segment sampling and examined using the Rapid Assessment of Avoidable Blindness plus Diabetic Retinopathy (RAAB + DR) protocol. Participants were classified as having diabetes if they: were previously diagnosed with diabetes; were receiving treatment for glucose control; had a random blood glucose level > 200 mg/dL. These participants were dilated for funduscopy, assessed for DR following the Scottish DR grading protocol and evaluated for ethnicity and DR ophthalmic screening frequencies.

Results: A total of 2,806 individuals were examined (response 93.6%). The prevalence of diabetes was 24.6%. In these patients any type of diabetic retinopathy and/or maculopathy occurred in 21.6% and sight threatening DR in 8.0%. Of the known diabetics, 34.2% never had an eye examination for DR and in 13.0% the last examination was >24 months ago. The prevalence of diabetes was significantly higher in Hindustani people compared to other major ethnic groups.

Conclusions: The prevalence of diabetes and diabetics without regular DR control in people aged ≥ 50 years in Suriname was higher than expected. The uptake for special services for DR has to be expanded to decrease patient delay and DR induced blindness.

Introduction

It is estimated that in 2014, there were 387 million people with diabetes and that by 2030, this number will increase to 438 million people globally.[1] Since nearly 80% of all persons with diabetes live in low- and middle income countries[2], this increase will largely occur in developing countries, including those in South and Latin America.[3] Diabetic retinopathy (DR), a severe eye complication of diabetes, is responsible for 1.0% of blindness and visual impairment (VI) worldwide.[4] Even in high-income countries it is the leading cause of blindness in the working-age population.[2] As other causes of blindness are likely to decrease due to Vision 2020 programmes, the number of blind people due to posterior segment disease, including DR, will increase.[2] Population based surveys on diabetes and DR are scarce but necessary to provide an up to date assessment of the problem, to improve awareness and to develop effective intervention programmes.

The Rapid Assessment of Avoidable blindness (RAAB) survey method is a simple methodology to assess the prevalence and causes of blindness in people aged ≥ 50 years in a specific geographic area.[5] RAAB was developed to focus primarily on the prevalence of avoidable causes of VI and blindness such as cataract, refractive errors and corneal scarring.[5] Due to awareness of the increasing burden of DR worldwide, a new method has been developed to estimate the prevalence of DR within the RAAB survey. So far, the inclusion of DR in RAAB has been successfully undertaken in 11 countries, with available data from Mexico, Moldova, Saudi Arabia and Jordan.[3,6–8] In contrast to earlier studies using different study methodologies, the use of this standardized method makes it possible to compare data from different countries. However, significant gaps still exist in reliable population-based DR data from developing nations.[2]

In Suriname, the prevalence of diabetes is expected to be around 20% in patients aged ≥ 50 years.[1] Recently, data were reported on the prevalence and causes of blindness and VI in people aged ≥ 50 years in Suriname.[9] The sample prevalence of bilateral blindness was estimated at 2.3% with cataract as the most frequent cause (54%), followed by glaucoma (23.8%) and other posterior segment disease (7.9%).[9] Despite high quality ophthalmic care including laser therapy and vitreoretinal surgery, DR was shown to be the fourth most frequent cause of bilateral blindness (3.2%) and VI (3.3%).[9] More detailed data on the prevalence of diabetes and DR in Suriname are lacking and urgently needed for appropriate planning of DR services.

The following study aimed to identify the prevalence of DR in Suriname including the number of diabetics on regular ophthalmic controls, using the RAAB+DR method. Since the population composition of Suriname consists of a multicultural society [10], ethnical differences in diabetes and DR prevalence were also investigated. The data obtained will be used for the development of preventive and therapeutic diabetes and DR programmes, to prevent patient delay and to reduce the burden of DR induced blindness in Suriname.

Materials and methods

RAAB

The RAAB + DR survey was carried out between August 2013 and November 2014 in accordance with the codes of conduct of the Declaration of Helsinki. Ethical approval for the study was obtained from the Surinamese Ministry of Health. The RAAB only includes individuals aged ≥ 50 years as this age group has the highest prevalence of blindness.[5] Giving a target population of 101,000 (census 2011), the sample size calculation module of the RAAB software indicated that a sample size of 3,000 subjects would provide enough power to estimate an expected prevalence of blindness of 2.3%, with a variation of 32.5%, a design effect of 1.6 for a cluster size of 60, and taking a non-response of 7% into account.[9] Based on an expected prevalence of diabetes of 20% in people aged ≥ 50 years and 25% prevalence of DR among diabetics, the required sample size for DR was 2,300, which would be achieved in this sample. Fifty census enumeration areas were randomly selected with a probability proportional to the population in the area. Within each selected enumeration area 60 residents aged ≥ 50 years were randomly selected through compact segment sampling and examined in their own house using the standard RAAB protocol.[5] Informed written or thumb-printed consent was obtained from all participants. Presenting distance visual acuity (VA) was tested using a Snellen tumbling E chart in full daylight. The primary cause of blindness and VI was assessed by an ophthalmologist in people with VA <6/18 in either eye. Care was taken that all people examined during the survey who required medical attention were provided with medical care.

Diabetes and DR Assessment[3]

Participants were classified as having diabetes if they were previously diagnosed with diabetes (known diabetics), if they were receiving treatment for glucose control (known diabetics) and if they were not earlier diagnosed with diabetes but had a random blood glucose level of > 200 mg/dl (11.1 mmol/l, random blood glucose test (Bayer)).[3] Known diabetics were asked about age at diagnosis, treatment type and whether they had any eye examination because of their diabetes. All participants classified as having diabetes were dilated for indirect funduscopy by a trained ophthalmologist. Findings were graded during examination using the Scottish diabetic retinopathy grading system for which teams were specially trained.[11]

Statistical analysis

Automated analyses included in the RAAB software package were used to analyse the data. Non-respondents were excluded from statistical analyses.[9] The cluster sampling design was taken into account when confidence intervals (CIs) were calculated for sample prevalence of diabetes and DR. P-values < 0.05 were considered statistically significant.

Logistic regression analyses were performed in SPSS 22 (IBM SPSS statistics) to estimate the age- and sex standardized odds ratios (OR) for diabetes or DR prevalence. To compare diabetes and DR prevalence between ethnic groups, logistic regression analyses were performed in R (version 3.2.0) and quasi-standard errors were used to calculate 95%CI intervals.[12]

Table 1. Age and gender composition of Suriname and sample population

	Males		Females	
Age groups (years)	**Census N (% total 50+)**	**Sample n (% total 50+)**	**Census N (% total 50+)**	**Sample n (% total 50+)**
50 - 59	26,335 (54.8%)	532 (42.5%)	26,489 (49.7%)	661 (42.6%)
60 - 69	12,535 (26.1%)	389 (31.0%)	14,298 (26.8%)	449 (28.9%)
70 - 79	6,678 (13.9%)	241 (19.2%)	8,756 (16.4%)	307 (19.8%)
80+	2,470 (5.1%)	91 (7.3%)	3,760 (7.1%)	134 (8.9%)

Table 2. Prevalence of diabetes by age group and by gender

	Males		Females		Known diabetics		New cases		Full sample	
	N	**% (95% CI)**	**n**	**% (95%CI)**	**n**	**% (95%CI)**	**n**	**% (95%CI)**	**n**	**% (95% CI)**
50-59	123	23.1% (19.3-27.0)	168	25.4% (21.4-29.5)	249	85.6% (81.2-89)	42	14.4% (11.0-18.8)	291	24.4% (21.7-27.7)
60-69	92	23.7% (19.5-27.8)	143	31.8% (26.0-37.7)	219	93.2% (89.1-95.8)	16	6.8% (4.2-10.9)	235	28.0% (23.9-32.2)
70-79	49	20.3% (14.8-25.8)	88	28.7% (22.6-34.7)	125	91.2% (86.0-94.6)	12	8.8% (5.4-14.0)	137	25.0% (20.3-29.7)
80+	10	11.0% (5.1-16.9)	16	11.9% (6.7-17.2)	24	92.3% (72.5-98.2)	2	7.7% (1.8-27.5)	26	11.6% (7.8-15.3)
All ages	274	21.9% (19.1-24.7)	415	26.8% (23.3-30.2)	617	89.6 (87.0-91.7)	72	10.4% (8.3-13.0)	689	24.6% (21.8-27.3)

Results

A total of 2,998 subjects aged ≥ 50 years was numerated in the survey, of whom 2,806 (93.0%) took part in the RAAB (Table 1).[9] Of the 2,806 included RAAB participants, 2,738 (97.6%) completed the DR module.

Diabetes and DR

Overall, 689 (24.6%; 95%CI: 21.8-27.3; Table 2) people had diabetes according to the predefined criteria. Diabetes prevalence was lower among those ≥ 80 years (11.6%; 7.8-15.3) compared with other age groups (range 24.4 - 28.0%; Table 2). There was no significant difference in diabetes prevalence by gender. Of all newly diagnosed diabetic patients, 58.3% was found among people aged 50-59 years (Table 2).

Hindustani people were significantly more likely to have diabetes compared with other major ethnic groups (Figure 1). Diabetes prevalence was higher in urban compared with rural areas (OR 4.69; 2.9-7.5, p <0.001). The estimated prevalence of any DR in the full survey population (including nondiabetic subjects) was 5.3% (4.4–6.3), whereas 0.9% (0.5–1.3) had proliferative DR and 1.4% (0.9–1.9) had referable diabetic maculopathy (Table 3). The prevalence of blindness and VI among diabetics was 1.9% (0.8-2.9) and 4.4% (2.6-6.1) respectively, versus 2.4% (1.3-3.5) and 7.1% (5.5-8.8) in persons without diabetes.

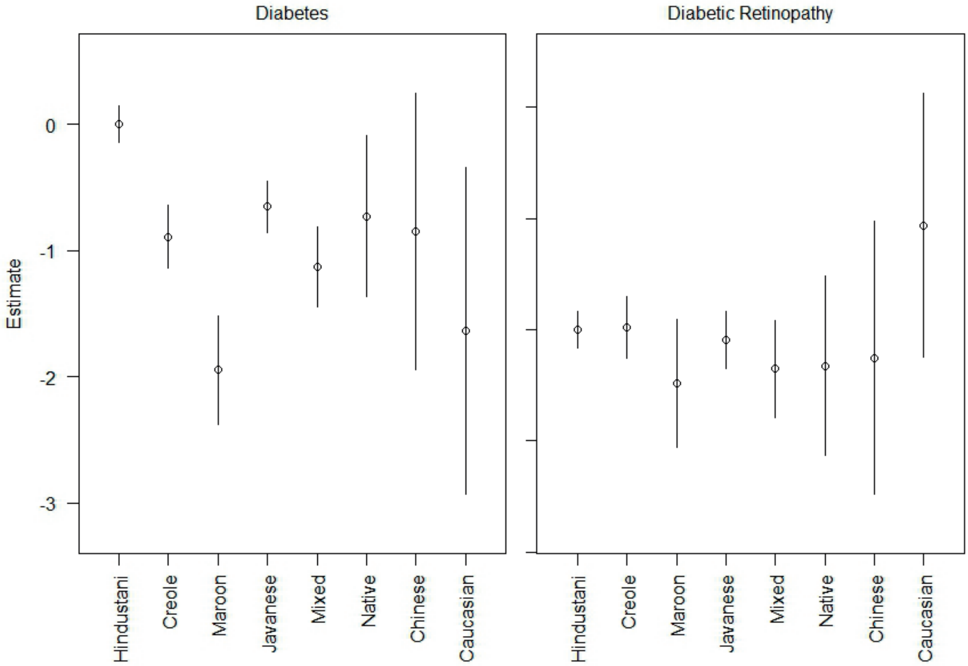

Figure 1. Comparison of diabetes and DR prevalence between different ethnic groups.
The plot shows estimates and confidence intervals (based on quasi-standard errors) to compare diabetes and DR prevalence between different ethnic groups. Odds ratios against the reference group (Hindustani, estimate set at zero) can be calculated per ethnicity by taking the exponential of the estimates.

Among people with diabetes, 617 (89.6%) were previously diagnosed. The mean duration of diabetes was 12.3 years (SD 11.1 years). Of these, 211 (34.2%) never had an eye examination, 248 (40.2%) had an eye examination < 1 year ago, 78 (12.6%) between 1 and 2 years earlier and 80 (13.0%) > 2 years ago. Seventy-two persons (10.4%) were assessed as 'new cases' (random blood sugar > 200mg/dl). Of the 'known diabetics', > 40% had a random blood glucose of > 200 mg/dl and only 58.5% was considered to be well controlled (random blood sugar < 200mg/dl). About 77.3% of diabetics were only using tablets to control the disease, 15.6% were using insulin and 6.9% were not using any medical treatment. Diabetes in females was significantly better controlled compared to males (mean 191mg/dl versus 212 mg/dl; $p < 0.001$).

Of the 689 people classified as having diabetes, 49 (7.1%) declined to undergo pupillary dilation. Of the 640 (92.9%) examined people, 21.6% had any sign of diabetic retinopathy (and/or maculopathy), 12.3% had any sign of maculopathy and 8% had sight-threatening DR (STDR, Table 3). The prevalence of diabetic retinopathy and/or maculopathy was not significantly related to age (Table 4) but considerably higher among known compared to new cases (OR 4.65; 1.7–13.0, $p = 0.003$; Table 3).

Diabetes duration (OR 1.06; 1.0-1.1, $p < 0.001$) and use of insulin (OR 4.82; 3.0-7.7, $p < 0.001$) were also significantly associated with diagnosis of DR. Prevalence of DR was not significantly related to ethnicity (Figure 1) or blood sugar level (OR 1.0, $p = 0.080$).

Discussion

This was the first survey on blindness, VI and DR in the Republic of Suriname and, to the best of the authors' knowledge, the first RAAB survey in South America that included the DR

Table 3. Prevalence of DR in diabetics and in the entire sample using the Scottish diabetic retinopathy grading system

	Among diabetics		Full sample	Among known diabetics		Among new cases	
	N	p (95% CI)	p (95% CI)	N	p (95% CI)	N	p (95% CI)
Retinopathy grade							
No retinopathy (R0)	502	72.9% (69.4-76.3)	17.9% (15.7-20.1)	450	72.9% (69.1-76.5)	52	72.2% (59.4-82.2)
Background DR - mild (R1)[a]	54	7.8% (6.0-9.7)	1.9% (1.4-2.4)	53	53 8.6% (6.8-10.8)	1	1.4% (0.2-10.0)
Background DR – observable (R2)[b]	20	2.9% (1.6-4.2)	0.7% (0.4-1.0)	17	17 2.8% (8.1-25.9)	3	4.2% (1.3-12.2)
Background DR – referable (R3)[c]	31	4.5% (2.7-6.3)	1.1% (0.6-1.6)	31	31 5.0% (3.3-7.5)	-	
Proliferative DR (R4)[d]	26	3.8% (2.2-5.3)	0.9% (0.5-1.3)	26	4.2% (2.8-6.3)	-	
Ungradable DR (R6)[e]	7	1.0% (0.0-2.0)	0.2% (0.0-0.5)	7	1.1% (0.4-3.1)	-	
Any DR	138	20.0% (17.1-23.0)	4.9% (4.0-5.9)	134	21.7% (18.8-25.0)	4	5.6% (2.1-14.1)
Diabetic maculopathy grade							
No maculopathy (M0)[f]	555	80.6% (77.7-83.4)	19.8% (17.4-22.1)	502	81.4% (78.3-84.1)	53	73.6% (61.0-83.3)
Maculopathy - observable (M1)[g]	24	3.5% (2.2-4.8)	0.9% (0.5-1.2)	23	3.7% (2.5-5.5)	1	1.4% (0.2-9.7)
Maculopathy – referable (M2)[h]	40	5.8% (4.0-7.6)	1.4% (0.9-1.9)	39	6.3% (4.6-8.6)	1	1.4% (0.2-10.0)
Any maculopathy	85	12.3% (9.6-15.0)	3.0% (2.3-3.8)	82	13.3% (10.7-16.4)	3	4.2% (1.3-12.8)
Any retinopathy and/or maculopathy	149	21.6% (18.9-24.4)	5.3% (4.4-6.3)	144	23.3% (20.7-26.2)	5	6.9% (2.8-16.0)
Sight threatening DR (R4 and/or M2)	55	8.0% (5.7-10.2)	2.0% (1.3-2.6)	54	8.8% (6.5-11.7)	1	1.4% (0.2-10.0)
Any laser scars	70	10.2% (7.9-12.5)	2.5% (1.8-3.1)	68	11% (8.8-13.7)	2	2.8% (0.7-10.8)

a. The presence of at least one dot/blot/superficial/flame shaped haemorrhage, microaneurysm, hard exudate or cotton wool spot
b. Four or more blot haemorrhages in one hemi-field only
c. Four or more blot haemorrhages in both inferior and superior hemi-fields, or venous beading, or intra retinal micro-vascular abnormalities (IRMA)
d. Active new vessels or vitreous haemorrhage
e. Retina not sufficiently visible for assessment
f. No features ≤2 disc diameters from the centre of the fovea
g. Lesions within a radius of >1 but ≤2 disc diameters of the centre of the fovea, any hard exudates
h. Lesions within a radius of ≤1 disc diameter of the centre of the fovea, any blot haemorrhages and/or any hard exudates

Table 4. Prevalence of diabetic retinopathy and/or maculopathy by age and by gender

	Males		Females		Total	
	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)
50-59	19	15.4% (8.1-22.8)	36	21.4% (16.3-26.6)	55	18.9% (15.0-22.8)
60-69	23	25.0% (16.3-33.7)	26	31.8% (26.0-37.7)	49	20.9% (15.8-25.9)
70-79	10	20.4% (8.3-32.5)	12	11.9% (6.7-17.2)	22	11.6% (7.8-15.3)
80+	4	40.0% (9.3-70.7)	4	11.9% (6.7-17.2)	8	30.8% (12.4-49.2)
All ages	56	20.4% (15.0-25.9)	78	18.8% (15.7-21.9)	134	19.4% (16.7-22.2)

module. Overall, the prevalence of diabetes was 24.6% among which 21.6% had any sign of diabetic retinopathy or maculopathy. Eight percent of people with diabetes had STDR and more than one third never had any eye examination.

The prevalence of diabetes was slightly higher than expected. This could be explained by the fact that the hypothesised prevalence was based on the prevalence of diabetes in the total population[1] since no specific data were available for the population aged ≥ 50 years. Diabetes prevalence was average compared to earlier RAAB + DR surveys performed in other countries. In these surveys diabetes prevalence ranged from 11.4% (10.4 - 12.4) in the Republic of Moldova to 29.7% (28.1 - 31.4) in Tiaf, Saudi Arabia.[6–8] In Chiapas, Mexico, the geographically closest country having RAAB + DR data available, the prevalence of diabetes was 21.0% (19.5 - 23.1).[3]

In Suriname, diabetes prevalence varied between different ethnic and different age groups. The population in Suriname is different from other countries in South America. It has a more multicultural society consisting of Hindustanis (27%), Creoles (16%), Javanese (14%), Maroons (22%), as well as mixed (13%), Chinese (1%) and various other minorities.[10] In the current survey, diabetes was most prevalent in the Hindustani and least prevalent in the (rural) Maroon population. Diabetes prevalence was also higher in the urban and coastal areas compared with the rural population. The higher prevalence of diabetes in Hindustani people is consistent with a population-based study performed among Surinamese participants in The Netherlands showing Hindustani origin to be one of the most important predictors for diabetes.[13] Although a different genetic profile may, in part, explain these differences, environmental and modifiable factors related to diet and lifestyle may also play an important role.[14,15] In people aged ≥ 80 years, diabetes prevalence was low which could be due to a higher mortality rate in complicated diabetic patients due to cardiovascular diseases at younger age. Since more than 50% of newly diagnosed diabetic patients was found in people aged 50 - 59 years, screening for diabetes could be effective in this specific age group.

The prevalence of DR among diabetics in Suriname was quite low compared to other countries. In 1999, the prevalence of DR in Latin America was estimated to be 40.2%.[16] Furthermore, in an overview of the global pattern of DR, prevalence estimates ranged from 10% to 61% in known diabetics and from 1.5% to 31% in new cases.[2] In the same overview DR prevalence was shown to be higher in developing countries.[2] Unfortunately, both studies included people of different age categories and different screening methods were used which makes it difficult to compare. However, the estimated prevalence of DR and STDR in Suriname was still lower compared to the reported prevalence in other RAAB + DR surveys, ranging from 36.8% (17.5% STDR) in Tiaf, Saudi Arabia to 55.9% (14.6% STDR) in the Republic of Moldova.[3,6–8] Apart from differences in eye care organization, these differences could be due to population (ethnicity) and socio economic differences.[2] Furthermore, the prevalence of DR in Suriname may be underestimated compared to RAAB + DR surveys where a fundus camera was used, which was found to be a more sensitive diagnostic tool for evaluation of DR than clinical examination in the field.[3]

In Suriname, several factors were associated with a higher prevalence of DR. Although DR prevalence was not significantly related to ethnicity, it was estimated to be highest among Hindustani and Creole diabetics and lowest among Maroons. In general, it is suggested that differences in ethnicity may play a role in DR prevalence, although relatively few studies have investigated this.[2] Available data from other multi-ethnic populations showed prevalence of DR to be the highest in Africans/Afro-Caribbeans compared to South Asians or white Europeans.[17] Since most population groups in Suriname have the same access to ophthalmic care, genetic susceptibility could play a role. On the other hand, the interior Maroons have the same West-African origin as the urbanized Creole population but no DR was found in the interior population. These findings suggest additional environmental influences on the risk of developing DR.

In our survey, the use of insulin and long duration of diabetes were both significantly associated with a higher risk of developing DR. Although not shown in our survey, in general, good control of blood sugar level is the most important factor in reducing incidence and progression of DR.[2,18,19] For Suriname, the number of poorly controlled diabetics was high, but lower when compared to other RAAB + DR surveys.[3,6,7] Over 40% of known diabetics in Suriname had a random blood sugar > 200 mg/dl and required a better adjustment of their diabetes. It was remarkable that diabetes in women was significantly better controlled than in men, which could be explained by the fact that women in Suriname are more self-sufficient. While duration of diabetes was significantly related to DR, age was not, which was most likely due to the small sample size or survival of diabetic patients without comorbidity.

Another critical point of concern is the number of diabetic patients who were never examined by an ophthalmologist. Regular ophthalmic screening is important in preventing or moderating the visual consequences of DR. Suriname already offers a great range of screening and treatment possibilities for DR. These include fluorescence angiography, optical coherence tomography, laser therapy, intravitreal injections and vitreoretinal surgery, needed for an optimal DR screening and treatment programme.[16] Reducing delay in diagnosis and treatment of DR could tremendously reduce the risk of becoming blind.[16] Overall, the relatively low prevalence of DR, STDR, poor controlled diabetics and newly diagnosed diabetics in our survey compared to other RAAB + DR surveys may suggest relatively good diagnostic and treatment services for DR and diabetes in Suriname. Still, optimization of diabetic (eye) care could improve these numbers even more. In the current survey, all newly diagnosed diabetics and those diagnosed with DR were provided with a full ophthalmic examination and follow up in the SEC.

This study had some limitations related to the selection of the sample. The older age groups were over-represented in our sample, which may have caused a slight under-estimation of the prevalence of diabetes. Estimates of diabetes prevalence may also have been influenced by the rapid methods required in the RAAB + DR protocol to test glucose levels: only one measurement of non-fasting glucose levels was performed. Oral glucose tolerance test, fasting glucose or repeated measurements may have provided more reliable data. Furthermore, only people aged ≥ 50 years were examined and our survey offers no data about the prevalence of diabetes in younger age groups.

In conclusion, the estimated prevalence of diabetes in people aged ≥ 50 years in Suriname is higher than expected with unacceptably high proportions of uncontrolled diabetics and patients who never had an ophthalmological examination. To decrease the prevalence of STDR and DR induced blindness, the uptake of special services for DR has to be expanded by increasing the coverage of regular DR controls and the proportion of patients with a well-adjusted blood sugar level.

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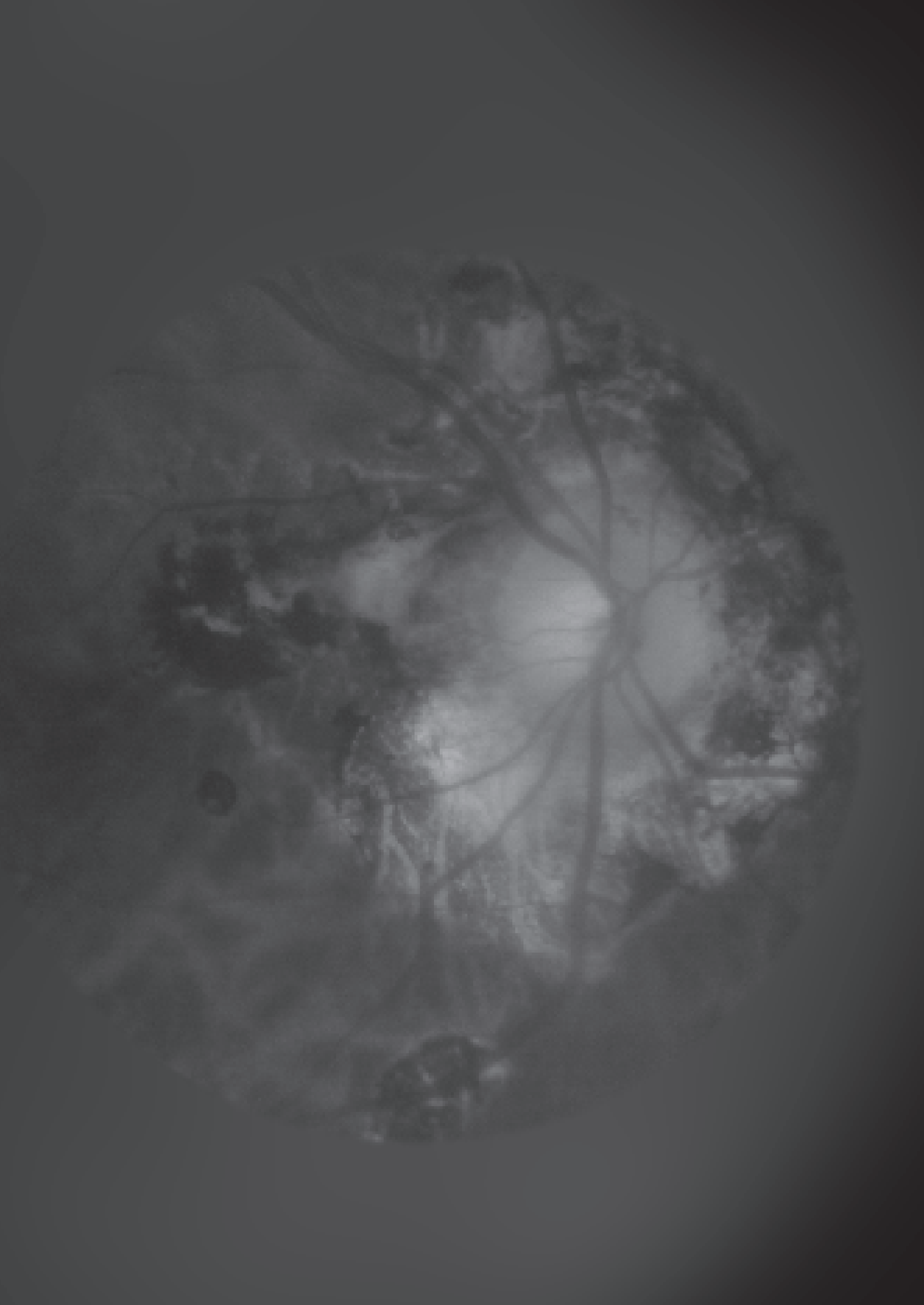

Chapter 7

The aetiology of Uveitis in Suriname

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Abstract

Background/Aims: To report on the spectrum of uveitis in the multi-ethnic population of Suriname.

Methods: A prospective cohort study of 100 consecutive uveitis cases was performed between July 2014 and January 2015. All patients underwent medical history screening using a specific uveitis screening questionnaire as well as a standard laboratory screening protocol. Subsequently, all patients were classified according to their age, gender, and ethnicity, as well as their anatomical and aetiological diagnosis using the Standardization of Uveitis Nomenclature Working Group (SUN) criteria.

Results: Anterior uveitis (AU) was the most common location (64%), followed by panuveitis (panU) in 19%, posterior uveitis (PU) in 15%, and intermediate uveitis (IU) in 2% of patients. Infectious uveitis was diagnosed in 34% of patients, 71% of who had toxoplasmosis. Two of the latter group were also HIV positive. Furthermore, 12% of the patients with infectious uveitis had latent tuberculosis, 9% had ocular syphilis, and 9%herpetic uveitis. Uveitis associated with systemic non-infectious disease was diagnosed or suspected in 7% of patients (rheumatoid arthritis in 3, Crohn's disease in 1, psoriasis in 1, ankylosing spondylitis in 1, and sarcoidosis in 1 patient, respectively). Fifty-nine percent of the patients remained of undetermined origin.

Conclusion: This study is the first to report on the clinical manifestations and causes of uveitis in Suriname, and suggests that infectious uveitis may occur in 34% of uveitis patients in this country. A relatively small number of HIV-positive cases, but no patients with active tuberculosis were identified.

Introduction

Uveitis is a multifactorial inflammatory eye disease and represents an important cause of visual impairment (VI) and blindness worldwide.[1,2] The aetiology of uveitis includes infectious causes and associations with diverse non-infectious systemic disorders, and its complications can cause permanent visual loss if not diagnosed and treated early in the course of the disease.

A combination of geographical, environmental, nutritional, socioeconomic, ethnic, and genetic factors influences the causes and prevalence of uveitis throughout the world. [2] The patterns of uveitis observed in South America differ distinctly from the patterns encountered in Europe and the United States of America.[1-2] However, large differences among South American countries are also encountered including differences in prevalence of tuberculosis, toxoplasmosis, onchocerciasis, leprosy, leptospirosis, and other (parasitic) infections.[3-13]

In Suriname, one of the Guiana's in South America, the prevalence data of different uveitis entities and associated systemic disorders are entirely lacking. Suriname is a relatively small developing country with 573.311 inhabitants and has a tropical climate.[13] Due to trans-continental migration during colonial times, the population of Suriname consists of many ethnic backgrounds. The majority of which includes Creole, Javanese, Maroon, and Hindustani people.[14] A smaller proportion consists of Indigenous, Chinese, and mixed population groups.[14] Primary, secondary, and tertiary eye care in Suriname is mainly concentrated in the Suriname Eye Centre (SEC) at the Academic Hospital Paramaribo (AZP), which is the only tertiary referral centre for uveitis patients in Suriname.

In this prospective study, we determined the specific diagnoses in 100 consecutive patients with active uveitis who visited the SEC.

Patients and methods

Sample and ethical considerations

Hundred consecutive (not necessarily new) juvenile and adult patients who visited the SEC between the 15th of July 2014 and the 29th of January 2015 for examination and treatment of the ocular inflammation process associated with any type of active uveitis were included in the study. Patients having no signs of inflammatory activity, those who were not able to adhere to the examination protocol, and those with a history of ocular trauma or ocular surgery were excluded. The same held true for patients with exogenous endophthalmitis, surgery-related, post-traumatic, and toxic uveitis. The study was approved by the Ethics Committee of the Surinamese Ministry of Health and followed the tenets of the Declaration of Helsinki. All patients signed a written informed consent form.

Anatomical classification

Ophthalmic examination included visual acuity (VA) measurement, slit-lamp bio microscopy, tonometry, and indirect ophthalmoscopy. The presence of anterior chamber reaction or an inflammation process of the vitreous, retina, or choroid defined disease activity. Clinical ocular evaluation and anatomical classification of uveitis were recorded according to the Standardization of Uveitis Nomenclature Working Group (SUN) criteria.[15]

Aetiological classification

Relevant patient history and additional patient characteristics were analysed using a standard uveitis screening questionnaire form. Standard laboratory screening for all patients included erythrocyte sedimentation rate (ESR), red and white blood cell counts and differentiation, kidney function, and C-reactive protein (CRP) levels. Serology included testing for antibodies against the human immunodeficiency virus (HIV), *Toxoplasma* and *Treponema pallidum* antibody (TPHA), cytomegalovirus (CMV) in HIV-positive patients, and a Venereal Disease Research Laboratory (VDRL) test in TPHA-positive cases. The quantiferon®-TB Goldtest (Cellestis GmbH, Germany) was performed in all participants. This test was used instead of the tuberculin skin test because the results are not influenced by previous vaccination with Bacille-Calmette Guerin (BCG).[16,17]

Immunological screening included evaluation for rheumatoid factor (RF) in patients with a suspected history of rheumatoid arthritis, and assessment of anti-nuclear antibody (ANA) in children. All patients underwent a radiological chest examination. If the chest X-ray showed any abnormal signs, the patients were referred to a pulmonary internal medicine specialist. HLA-B27 typing was not available. However, all patients with uveitis and suspected underlying systemic arthritic disease based on questionnaire results or laboratory screening were evaluated by a rheumatologist to rule out any associated systemic disease.

Definition of diagnosis

Diagnosis of toxoplasma chorioretinitis was based on clinical presentation of focal active chorioretinitis in association with typical hyperpigmented atrophic scars. In all suspected cases Immunoglobulin G (IgG) and Immunoglobulin M (IgM) toxoplasmosis titres were evaluated to confirm the clinical diagnosis. Tuberculosis-related uveitis was diagnosed in patients with evidence of active systemic tuberculosis (TB) with uveitis of otherwise unknown origin. The diagnosis of herpetic anterior uveitis (AU) was based on clinical presentation in patients with unilateral uveitis, sectorial iris paralysis or atrophy, and elevated intraocular pressure with or without a history of herpes corneal infection in the affected eye. The diagnosis of sarcoidosis was performed using the chest X-ray and systemic examination by a pulmonary specialist. Serum angiotensin-converting enzyme (ACE) analysis was not available. Vogt-Koyanagi-Harada disease and Behcet's disease were diagnosed using the current guidelines.[18]

Statistical analysis

Statistical analyses were performed using SPSS 21 for Windows. The general, clinical, and laboratory data were recorded, and a P value <0.05 was considered statistically significant. Continuous variables were expressed as means ± SDs (range for age), while categorical data were presented as frequencies. Relationships between categorical variables were assessed using Fisher's exact test.

Results

Patient characteristics

Table 1 gives the general characteristics of the 100 consecutive patients with uveitis who had been included in the study. There were 41 new cases while the remaining 59 patients

Table 1 General characteristics of 100 consecutive patients with uveitis in Suriname

	Total, N=100	New uveitis patients N=41	Chronic or recurrent uveitis patients N=59	P value
Mean age, years (range); std	42.9 (4-75); std15.72	39.2 (4-75); std 16.6	45.4 (12-71); std 14.7	P=0.06
Male/female ratio	40/60	13/28	27/32	P=0.21
Uni/bilateral ratio	59/41	27/14	32/27	P=0.30
Ethnic background				P=0.07*
Hindustani	44	17	27	
Creole	24	8	16	
Javanese	10	6	4	
Maroon	12	8	4	
Indigenous	1	1	0	
Chinese	0	0	0	
Mixed	9	1	8	
Anterior uveitis N (%)	64 (64%)	24 (24%)	40 (40%)	P=0.34
Intermediate N (%)	2 (2%)	1 (1%)	1 (3%)	P=0.79
Posterior uveitis N (%)	15 (15%)	8 (8%)	7 (7%)	P=0.29
Pan Uveitis N (%)	19 (19%)	8 (8%)	11 (11%)	P=0.91

* this P value represents the distribution of all ethnicities in the two groups (new and chronic uveitis patients)

presented with a relapse of active uveitis. The mean age was 42.9 years (range 4-75 years) and the male-to-female ratio was 40/60.

Anatomical classification

Ocular characteristics are presented in Table 1. Anterior uveitis was the most common anatomical type of uveitis (occurring in 64% of cases), followed by panuveitis (panU) in 19%, posterior uveitis (PU) in 15%, and intermediate uveitis (IU) in 2% of patients. Unilateral uveitis (59/100) was more common than bilateral uveitis (41/100, P=0.30).

Results of diagnostic tests

The results of diagnostic tests are shown in Table 2 and classification of patients according to the cause or association with systemic disorders in Table 3.

Infectious uveitis was diagnosed in 34% of patients and association with non-infectious systemic diseases in 7%. Fifty-nine percent of patients remained of undetermined origin.

Positive antibodies for *Toxoplasma gondii* were found in 48 patients. A positive IgM titre was found in 3 patients. The diagnosis of ocular toxoplasmosis with typical fundus lesions was made in 24 patients including 2 HIV-positive patients. Additionally, 24/48 patients with positive toxoplasma antibodies were diagnosed with only AU; in these cases, the underlying aetiology remained unknown. Of these 24 cases, 7 patients with AU without other identified cause of uveitis had a high IgG titre (>122 IU/mL), possibly associated with active disease. [19] These 7 patients were IgM negative.

Three out of 100 patients were HIV positive; 2 (1 PU, 1 panU) were diagnosed with toxoplasmosis (based on clinical features of focal chorioretinitis, positive serologic results along with a good response to therapy for toxoplasmosis). The remaining HIV-positive patient had an AU and had a positive serum toxoplasmosis serology (IgM positive) without any other features of ocular toxoplasmosis. A positive Quantiferon®-TB Goldtest was found in 7/100 patients, 6 of whom were diagnosed with AU (non-granulomatous, 4 patients with chronic unilateral AU and 2 patients with bilateral AU) and 1 patient with a PU. In the latter patient, the diagnosis of toxoplasmosis was already made based on a typical chorioretinal

Table 2 Anatomical classification of uveitis and results of screening in 100 consecutive patients with uveitis

Examination	Total	Anterior Uveitis	Intermediate Uveitis	Posterior Uveitis	Pan Uveitis
Rheumatoid factor positive	4/100	4/4	0/4	0/4	0/4
HIV positive	3/100	1/3	0/3	1/3	1/3
VDRL positive	3/100	0/3	0/3	1/3	2/3
Toxoplasma					
IgG positive*	48/100	24/48	1/48	10/48	13/48
IgM positive**	3/100	2/3	0/3	0/3	1/3
Quantiferon Test***	7/100	6/7	0/7	1/7	0/7
Chest X-ray abnormalities	13/100	10/13	0/13	2/13	1/13

* $P < 0.05$
** IgM positive cases were also IgG positive
*** in 14 patients we were not able to perform a Quantiferon test.

Table 3 Specific diagnoses of 100 patients with uveitis in Suriname

Diagnosis	N
Infectious cause, total	34
Toxoplasma chorioretinitis	24
Syphilis	3
Miscellaneous*	7
Associated with non-infectious systemic disease**	7
Unknown***	59

* includes 3 patients with herpetic uveitis, 4 with latent tuberculosis
** includes 3 patients with rheumatoid arthritis, 1 with Crohn's disease, 1 with psoriasis and arthralgia's, 1 with ankylosing spondylitis and 1 with sarcoidosis.
*** includes 7 patients with anterior uveitis of undetermined cause but with high IgG serum toxoplasma titres (> 122 IU/mL)

scar and a good response to cotrimoxazole (Bactrimel®). Five other patients with a positive Quantiferon®-TB Goldtest showed chest X-ray abnormalities of which 2 had an enlarged mediastinum, 1 showed apical cavitation, 1 had reticulonodular densities, and 1 showed interstitial enhancement. These patients were referred to a pulmonologist for further evaluation. Four of these 5 referred patients were diagnosed with latent pulmonary tuberculosis, but none of them fulfilled the guidelines of Gupta et al [20] for the diagnosis of ocular tuberculosis. None of the patients was diagnosed with active pulmonary tuberculosis. One patient with chest X-ray abnormalities was diagnosed with sarcoidosis. The remaining 7/13 patients with X-ray abnormalities were non-specific.

Herpetic anterior uveitis was suspected in 3/100 patients who had an unilateral anterior uveitis in combination with elevated intraocular pressure. However, no sectorial iris paralysis or atrophy was seen, and there was no history of herpes keratitis. A total of 3/100 cases had a positive TPHA test together with high VDRL levels and were diagnosed with ocular syphilis.

Rheumatoid factor was positive in 4/100 patients, and 3 patients were diagnosed with sclerouveitis associated with rheumatoid arthritis. The remaining patient with positive rheumatoid factor was diagnosed with Crohn's disease. All these patients were referred to a rheumatologist for confirmation of the diagnosis and for further evaluation and treatment.

Children

In children aged younger than 18 years (N=9), PU was the most common anatomical location (5/9, 56%). All PU cases in children were caused by toxoplasmosis. The cause of AU (2/9) and panU (2/9) remained undetermined.

Discussion

This study on uveitis in Suriname is the first to present data on the aetiology of this ocular disease in the country. The results show that 64% of uveitis patients in Suriname had an AU, which is within the range reported by large surveys on uveitis in other parts of the world.[21] Toxoplasma chorioretinitis was the most common cause of uveitis, but no underlying cause was identified in the majority of cases (59%).

These findings are consistent with those of most studies conducted in Western countries where UA was also found to be the most common location of uveitis with frequencies ranging from 25% to 91% of cases.[8] In Brazil, AU was diagnosed in 70.1% of patients followed by PU and panU, whereas IU was rare.[3] In contrast, AU is less prevalent in other developing countries, especially in areas with a high number of HIV-positive patients. This is probably due to the fact that HIV causes an increase in opportunistic infections which are more frequently associated with PU.

Most cases of AU were idiopathic which is consistent with studies from neighbouring countries.[3,6] Similarly to the current study, the most frequent diagnosis in PU and panU patients throughout South America was toxoplasma chorioretinitis (24%, 24/100 patients). Similar results were found in North America, Europe, and Africa.[1,22] Remarkably, 7 patients with AU of undetermined origin had high IgG anti-toxoplasma titres (but negative IgM titres), which could be associated with active systemic infection.[19] Temporary AU has been reported in many systemic infections and an association between systemic toxoplasmosis and AU has previously been noted.[23]

The underlying cause of uveitis in the three HIV-positive patients in the current study was toxoplasmosis. Results in other developing countries demonstrated a high burden of infectious CMV retinitis in HIV-positive patients which was not encountered in the present series.[24] The low prevalence of HIV among patients with uveitis also reflects the relatively low estimates reported by the National AIDS Programme (NAP) in Suriname, which indicates that the prevalence of HIV infection in the Surinamese population is 1.1% (0.9%-1.3%).[25]

Other infectious cases found in the current study were latent tuberculosis (4%) and syphilis (3%). Since it was not possible to perform all diagnostic tests for the identification of infectious causes such as the aqueous assessment, the real number of patients with infectious uveitis might have been even higher than the 34% found in this study.

Several other aetiologies of uveitis observed in industrialized countries – including presumed ocular histoplasmosis, birdshot chorioretinopathy, Fuchs' uveitis, Posner-Schlossman syndrome, Eales disease, serpiginous chorioretinopathy, and other less common entities - were not observed in the current series. In addition, low numbers of patients with uveitis and associated non-infectious diseases were diagnosed. This may, in part, be due to the relatively low number of patients enrolled in the current study, the limited availability of diagnostic tools, and a presumably low prevalence of these entities of uveitis in Suriname.

In conclusion, the current study is, to our knowledge, the first to assess the spectrum of uveitis in the Surinamese population and suggests that at least 34% of uveitis cases are of infectious origins with toxoplasmosis being the most common cause. Furthermore, both tuberculosis- and HIV-associated uveitis seems uncommon. Despite the relatively small sample size and lack of diagnostic tools, the findings of this study can be used for the development of a targeted screening programme for uveitis patients in Suriname, which is essential for optimal management of affected patients.

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Chapter 8

Epidemiology and aetiology of Childhood Ocular Trauma in the Republic of Suriname

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Abstract

Purpose: To describe the epidemiology and aetiology of ocular trauma in school-aged children who previously visited the Suriname Eye Centre (SEC) of the Academic Hospital Paramaribo.

Methods: In a hospital-based retrospective study, all cases of children who were school-aged (8-15 years) at the time of the survey and previously underwent evaluation and/or treatment at the SEC because of ocular trauma were analysed. Demographic and ophthalmologic data were taken out of patient records; eye injuries were classified using the Birmingham Eye Trauma Terminology classification system. Main outcome measures were type of injury, mechanism/cause of injury, final visual acuity (VA), hospitalisation, patient delay, and patient compliance.

Results: Five hundred and thirty-eight records were analysed which included 35 (7%) open globe injuries (OGI), 458 (85%) closed globe injuries, 5 (1%) orbital fractures, and 40 (7%) eyelid injuries. The most frequent causes of trauma represented body parts (18%) and sticks or branches (13%) and resulted from poking (20%) or punching (13%) the eye. Final VA<6/60 was reported in 58% of registered OGI. Where living in rural areas ($p=0.007$), OGI ($p<0.0001$) and poor compliance to scheduled check-ups ($p<0.0001$) were statistically significantly related to an unfavourable outcome, patient delay was not. Patients having OGI were more often hospitalised than children with other injuries ($p<0.0001$).

Conclusion: This is the first study providing data on childhood ocular trauma in Suriname. Since the majority of childhood injuries were avoidable, new policies should aim at developing effective, targeted preventive strategies to promote awareness, parental supervision, immediate action, and compliance.

Introduction

Severe ocular trauma is the leading cause of monocular visual disability and non-congenital unilateral blindness in children in many parts of the world.[1,2] It can have a detrimental psychological impact on patients and substantial socio-economic consequences for both patients and public health in terms of productivity loss and medical care utilisation, including rehabilitation services.[3] However, an estimated 90% of ocular trauma can relatively be prevented, particularly in children.[1,4,5]

Although developing countries carry the heaviest burden of ocular injuries [3,6], data on the epidemiology of childhood ocular trauma in these parts of the world are scant.[7] However, these children may be more susceptible to eye injuries when compared to those from industrialised countries, among others, because of more violence, lack of seatbelt usage, no regulated use of fireworks, living in remote rural areas without adequate medical services, and poor supervision in neighbourhoods.[3] Lack of awareness of the need for immediate medical attention and inadequate medical infrastructure often contribute further to the relatively high frequency of associated complications and visual disability.[3]

The Republic of Suriname is a developing, upper middle-income country situated in South America (Data | The World Bank). 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 Pan American Health Organization (PAHO).[8] Avoidable and treatable blindness remains an important public health problem in both adults and children in Suriname.[9,10] In 2013, some data on childhood blindness in school-aged children in Suriname became available.[9] In that study, trauma was the major cause in 20% of children with unilateral blindness (visual acuity (VA) <3/60; unpublished data). Because no further information was provided, the aim of this study was to investigate the epidemiology and aetiology of childhood ocular trauma in school-aged children in Suriname.

Patients and methods

Patient population and data processing

Details about eye injuries that occurred between November 1995 and April 2011 in the lives of children (who were at time of the survey at school-age between 8-15 years) were obtained from the records of the Suriname Eye Centre (SEC), the only eye care centre in Suriname, and were anonymously entered into a password-protected database. Missing data were recorded as 'no registry'.

Socio-demographic information of the patients was also recorded, i.e., gender, age, place of residence (urban or rural), status of health care insurance, information about the time between injury and medical attendance (patient delay); mechanism, cause, location, and type of injury; VA after the injury; treatment approach; and follow-up.

The severity of eye trauma was classified using the Birmingham Eye Trauma Terminology classification system.[11,12] Open-globe injuries (OGI), defined as full thickness injuries of the cornea and/or sclera were categorised as rupture, penetrating (entrance wound), intraocular foreign body (IOFB), and perforating injuries (entrance and exit wounds). Closed-globe types of injury (CGI) were categorised as contusion (caused by direct delivery of energy by the object or from changes in the shape of the globe), lamellar laceration (partial thickness wound of the eyeball), and mixed injuries.[3,5] Since superficial injuries are not included in BETTs classification, one more category was added to CGIs that included corneal erosion, conjunctival laceration, superficial foreign body, and chemical ocular burn. Cases diagnosed as orbital fracture and eyelid wounds were separately recorded.

Statistics

Descriptive data were expressed as frequencies (95% confidence intervals, CI). Comparisons between subgroups were performed with the X^2-tests. Multivariable logistic regression analyses were performed for ordinal variables to identify age- and sex-adjusted predictors for hospitalisation and final VA. Multivariable linear regression analysis was performed to identify age- and sex-adjusted predictors for patient delay. Assumptions for linearity were checked and two outliers were removed from the database (delay>365 days in two patients). Because the dependent variable 'patient delay' was skewed, a square root transformation was performed.

Ethical considerations

The Ministry of Health of Suriname granted ethical approval for the study. The study adhered to provisions specified in the Declaration of Helsinki.

Results

Patient population

Between November 1995 and April 2011, 538 primary cases of paediatric ocular trauma were diagnosed. The age range of the patients was 0 months to 15 years and 6 months (Table 1).

Approximately two-thirds of traumas were in boys, and more than 80% of them had health insurance (Table 1). More than 90% of the patients lived in urban areas or related coastal regions of Suriname (Table 1). Trauma was most common in boys aged 3-11 years (Table 1). Eyelid injuries and orbital fractures were more frequently found in the younger age groups (0-2 years, 25% and 20% respectively,

Table 1. Demographic characteristics of children with ocular trauma

Characteristics	**Number (%)**	**95% confidence interval**
Age (years) when trauma occurred		
0-2	53 (9.9)	7.4 -12.4
3-5	117 (21.7)	18.2 - 25.2
6-8	169 (31.4)	27.5 - 35.3
9-11	139 (25.8)	22.1 – 29.5
12-15	50 (9.3)	6.8 - 11.8
No registry	10 (1.9)	0.7-3.1
Gender		
Boys	363 (67.5)	45.3-71.5
Girls	175 (32.5)	28.5-36.5
Health insurance		
Yes	439 (81.6)	78.3 – 84.9
No	65 (12.1)	9.3 - 14.9
No registry	34 (6.3)	4.2 – 8.4
Area of residence		
Urban and related districts	505 (93.9)	91.9 – 95.9
Rural districts	33 (6.1)	4.1 – 8.1

data not shown). Eleven cases (2%) involved bilateral injuries (data not shown).

Mechanism, cause, and location of injury

As shown in Table 2, most injuries were due to poking or accidently self-poking (20%; 16.2-22.8), followed by being punched in the eye (13%; 9.7-15.3), a particle or object that flew into the eye (12%; 9.5-15.1), and falling onto or running into an object (12%; 9.2-14.6).

The injuries were most frequently caused by body parts (18%; 14.5-20.9), sticks or branches (13%; 9.7-15.3), fireworks (6%; 4.1-8.1), and stones (6%; 3.9-7.9). Other important causes included toy guns, catapults, and air rifles (4%; .9-5.1) (Table 3).

Most injuries occurred on the street or at the playground, followed by injuries at home or around the house (almost one-third and one-fifth, respectively; Table 4). The most common causes of eye injuries around the house were chemical or hot substances (24%; including the herbicide paraquat and incense, but also detergent, talcum powder, chlorine, paint, hairspray, and glue) and body parts (16%). The most frequent causes of injury in children playing outside the house were sticks (32%), stones (16%), fireworks (18%), and toys, including catapults and bullet guns (or air rifles) (9%). These injuries were related to unfavourable outcomes. Seven ocular injuries (all contusions including three eyes with traumatic uveitis) were reported as a result of child abuse. The odds of hospitalisation were significantly higher in patients living in the interior of Suriname compared to patients from the urban areas (OR 3.3, 1.4-8.1, p=0.01, logistic regression), however, this effect was not independent from the type of injury.

Table 2. Mechanism of Injury by gender

	Number (%) of Children†		
Cause of injury	**Boys**	**Girls**	**Total**
Poked in the eye	63 (17.4)	42 (24.0)	**105** (19.5)
Punched in the eye	38 (10.5)	29 (16.6)	**67** (12.5)
Particle/object flew into the eye	48 (13.2)	18 (10.3)	**66** (12.3)
Fell/ran onto object	45 (12.4)	19 (10.9)	**64** (11.9)
Fireworks, explosion	27 (7.4)	6 (3.4)	**33** (6.2)
Object thrown at child	24 (6.6)	5 (2.9)	**29** (5.4)
Struck in the eye	21 (5.8)	7 (4.0)	**28** (5.2)
Chemical substance	15 (4.1)	4 (2.3)	**19** (3.5)
Motor vehicle accident	10 (2.8)	6 (3.4)	**16** (3.0)
Sport related	10 (2.8)	3 (1.7)	**13** (2.4)
Bullet gun	10 (2.8)	1 (0.6)	**11** (2.0)
Hot substance	3 (0.8)	5 (2.9)	**8** (1.5)
Child abuse	5 (1.4)	2 (1.1)	**7** (1.3)
Animal/insect	3 (0.8)	3 (1.7)	**6** (1.1)
Catapult	2 (0.6)	4 (2.3)	**6** (1.1)
Fragment of shattered glass	3 (0.8)	3 (1.7)	**6** (1.1)
Coconut fell out of tree	0 (0.0)	1 (0.6)	**1** (0.2)
No registry	36 (9.9)	17 (9.7)	**53** (9.9)
Total	**363** (100.0)	**175** (100.0)	**538** (100.0)

†Percentages have been rounded and may not total 100

Table 3. Causes of injury by gender

Cause of injury	Number (%) of Children†		
	Boys	Girls	Total
Body part	55 (15.2)	40 (22.9)	**95** (17.7)
Stick, branch	46 (12.7)	21 (12.0)	**67** (12.5)
Fireworks, explosion	27 (7.4)	6 (3.4)	**33** (6.1)
Stone	26 (7.2)	6 (3.4)	**32** (5.9)
Stationary	23 (6.3)	9 (5.1)	**32** (5.9)
Chemical, hot substance	23 (6.3)	7 (4.0)	**30** (5.6)
Metal (particle)	17 (4.7)	12 (6.9)	**29** (5.4)
BB pellet gun, catapult, toy	15 (4.1)	4 (2.3)	**19** (3.5)
Motor vehicle crash	9 (2.5)	6 (3.4)	**15** (2.8)
Knife	8 (2.2)	5 (2.9)	**13** (2.4)
Sand, dust or wood (particle)	11 (3.0)	2 (1.1)	**13** (2.4)
Fruits, nuts, plants	7 (1.9)	4 (2.3)	**11** (2.0)
Pen, pencil	6 (1.7)	5 (2.9)	**11** (2.0)
Animal, insect	3 (0.8)	4 (2.3)	**7** (1.3)
Ball	6 (1.7)	0 (0.0)	**6** (1.1)
Glass	3 (0.8)	3 (1.7)	**6** (1.1)
Belt	4 (1.1)	1 (0.6)	**5** (0.9)
Furniture	3 (0.8)	2 (1.1)	**5** (0.9)
Scissors	2 (0.6)	2 (1.1)	**4** (0.7)
Elastic	3 (0.8)	0 (0.0)	**3** (0.6)
Hewer	2 (0.6)	1 (0.6)	**3** (0.6)
Other	35 (9.6)	21 (12.0)	**56** (10.4)
No registry	29 (8.0)	14 (8.0)	**43** (8.0)
Total	**363** (100.0)	**175** (100.0)	**538** (100.0)

†Percentages have been rounded and may not total 100

Type of injury and course of treatment

Fived hundred and thirty-eight records were analysed which included 35 (7%; 95%CI: 4.8-9.2) OGI, 458 (85%; 82.0-88.0) CGI, 5 (1%, 0.16-1.8) orbital fractures, and 40 (7%, 4.8-9.2) eyelid injuries (36 lacerations, 1 abscess, 3 burns) (Table 5).

The majority of OGI (77%) were penetrating injuries (63.1-90.9; Table 5), while globe ruptures occurred in 3 of 35 cases (0.5-18.5; Table 5). One eye with a penetrating injury was complicated by an IOFB. Globe perforations occurred in four eyes, two of which were complicated by an IOFB from an airgun. Fireworks caused one globe perforation. All OGI required intensive medication and most eyes required primary wound closure (60%). The remaining, covered penetrating corneal injuries (10 cases, 29%) were treated with a protective shield, topical medication and close follow-up. Evisceration (primary) was performed in three eyes. Seven eyes required primary or secondary lensectomie or cataract extraction with or without an intraocular lens (IOL) implantation. Intraocular and intraorbital foreign bodies were removed from three eyes. In one of the latter cases an intraocular metal particle had perforated the lens and also led to endophthalmitis that was additionally treated with intravitreal (vancomycin 0.2mg/0.1mL, gentamicin 0.05mg/0.1mL) and oral antibiotics.

Table 4. Place of injury of paediatric ocular traumas

Place	Number (%)	95% confidence interval
Street or playground	177 (32.9)	28.9 -36.9
At home or around the house	98 (18.2)	14.0 - 21.5
Interior (remote rural areas)	33 (6.1)	4.1 – 8.1
Traffic	18 (3.3)	1.8 – 4.8
Work premises	17 (3.2)	1.7 – 4.7
Sports	14 (2.6)	1.3-3.9
School	13 (2.4)	1.1-3.7
No registry	168 (31.2)	27.3-35.1
Total	**538** (100.0)	

The odds of hospitalisation were significantly higher in OGI versus other injuries (OR 99.1, 36.8-267.3, $p<0.0001$).

CGI (n=458) were mainly caused by contusion (63%; 58.6-67.4) followed by superficial injuries (26%; 22.0-30.0; 6 chemical burns, 30 conjunctival lacerations, 38 superficial foreign bodies, and 53 corneal erosions), lamellar lacerations (8%; 5.5-10.5), or mixed (1%; 0.1-1.9) injuries (Table 5). Most CGI were topically treated with antibiotics, mydriatics and steroids in case of a traumatic uveitis. In 10% of eyes a hyphaema (anterior chamber haemorrhage) was reported at presentation in the clinical notes. None required evacuation of hyphaema. Five eyes, three of which secondary to (primary) hyphaema, developed a raised intraocular pressure and were treated with topical medication (steroids and mydriatic drops) and acetazolamide. No glaucoma surgery or vitreoretinal surgery was indicated. In 3% of CGI eyes the lens showed evidence of damage. Cataract extraction was performed in nine eyes with visually significant traumatic cataract. Two percent of conjunctival lacerations required surgical repair. In one case an intraorbital bullet from an air rifle was removed.

Imaging (X-orbit or CT-orbit) was performed in 5% of all injuries. Nine patients were diagnosed with an orbital fracture (4 secondary diagnosis). None of them required orbital surgery. Forty-five injuries involved eyelid lacerations, including 36 primary diagnosis of which 30% required immediate surgical repair. In one case also a lacrimal reconstruction was performed. Other primary and secondary eyelid injuries involved eyelid burns and eyelid abscesses (both 5 cases). The latter required incision, drainage, and oral antibiotics.

Patient delay and compliance

Almost three-quarters of patients did not present at the ophthalmologist immediately after the injury. The patient delay ranged from 1 day to one year after trauma (mean 6.3 days). For OGI, the delay ranged from 0 to 28 days (mean 4.4 days). Linear regression analysis indicated that living in the interior of Suriname was statistically significantly associated with patient delay ($p=0.001$). Health insurance status, final VA<6/12 or hospitalisation were not independently related to patient delay.

Almost one-third of patients (31%) showed poor compliance, i.e., did not appear for scheduled treatment or check-ups. Thirty-seven of these patients were prescribed medication, including steroids. Seven children (age range 5-10 years) did not appear for surgery after the diagnosis of traumatic cataract with indication for surgery. Other children did not return to the outpatient clinic while having active disease including uveitis, Berlins oedema, cataract, hyphaema, recently closed perforation, retinal or vitreous haemorrhage, macular oedema, ulcerating keratitis with hypopyon, and endophthalmitis.

Table 5. Globe Injuries classified according to the Birmingham Eye Trauma Terminology system*, primary diagnosis, and gender

Type of injury	Number (%) of Injuries		
Open-globe injuries	**Boys**	**Girls**	**Total**
Penetrating	20 (5.5)	7 (4.0)	**27** (5.0)
Perforating	4 (1.1)	0 (0.0)	**4** (0.7)
Rupture	3 (0.8)	0 (0.0)	**3** (0.6)
Intraocular foreign body	1 (0.3)	0 (0.0)	**1** (0.2)
Closed-globe injuries			
Contusion	197 (54.3)	93 (53.1)	**290** (54.0)
Lamellar laceration	22 (6.1)	14 (8.0)	**36** (6.7)
Superficial injury	85 (23.3)	42 (24.0)	**127** (23.5)
Mixed	3 (0.8)	2 (1.1)	**5** (0.9)
Orbital fracture	1 (0.3)	4 (2.3)	**5** (0.9)
Eyelid injuries	27 (7.5)	13 (7.5)	**40** (7.5)
Total	**363** (100.0)	**175** (100.0)	**538** (100.0)

* The Birmingham Eye Trauma Terminology system does not include superficial injuries, eyelid wounds and orbital fractures

Visual acuity

Initial VA was not measured in almost half (49%) of all injuries due to the young age of the victim or lack of cooperation of the child. In three eyes with OGI and 75% of registered other injuries, VA at presentation was >6/12. A VA <6/60 was reported in 68% of registered OGI (19 cases), and in 10% of registered other injuries (255 cases).

Data on final VA were available for 313 eyes (59%). For OGI, final VA>6/12 was reported in eight eyes. VA remained <6/60 in 58% of all OGI eyes in which a final VA was reported (24 cases). Particularly globe perforations were associated with poor final VA (100%).

For all other injuries, final VA>6/12 was reported in 92% of all registered eyes (289 cases). Visual acuity <6/60 was observed in thirteen eyes (4%) with ten cases due to contusion, two cases were due to lamellar laceration, and one to a chemical injury. Of all the charts in which a final VA was reported, the odds of having an unfavourable outcome (VA<6/12) were significantly higher for those who poorly complied with scheduled check-ups (OR 14.9, 4.9-45.4, p<0.0001), OGI compared to other injuries (OR 22.5, 6.6-76.5, p<0.0001), and living in rural areas (OR 6.0, 1.6-21.7, p=0.007). Patient delay was not independently related to an unfavourable outcome.

Discussion

This was the first study on paediatric ocular trauma in the Republic of Suriname and to the best of the authors' knowledge the second study of its kind in the Caribbean.[13] In 2011, the population size of Suriname was estimated to be 553,159 people, of which 85,329 (15.4%) were children between 8 and 15 years of age.[14] Our study shows that 538 of these school-aged children previously underwent evaluation and/or treatment at the SEC because of ocular trauma. Injuries included 35 cases of OGI (7%), 458 cases of CGI (85%), 5 orbital fractures (1%), and 40 eyelid injuries (7%). Most injuries occurred in boys. Body parts, sticks or branches, fireworks, and stones caused more than 40% of injuries. Particularly OGI, living in rural areas, and poor compliance were associated with an unfavourable outcome.

Eye injuries were more common in boys between 3 and 11 years of age when compared to girls and younger children of either gender. These findings are in accordance with those from previous studies.[1–3,6,15] Furthermore, the former observation might be attributed to the wilder manner of play of boys in this age group and their use of high-risk toys such as bullet guns, catapults, and fireworks. The latter observation might be related to the tendency of many parents to be more watchful towards younger children.[16,17]

About 40% of eye injuries in both boys and girls were caused by punching, striking, poking (including self poking), and throwing of stones and other objects. This observation emphasises the need of admonishing children to be more cautious while playing and warrants the implementation of preventive measures. The finding that 1.3% of childhood eye injuries was due to abuse by adults is a reason for concern and necessitates particular vigilance of health workers, because this could be an underestimation since probably not all cases of child abuse are reported (expert opinion).

Abbott et al. [16] and various other investigators [15,17–20] concluded that most injuries occurred at home. However, in the current study, the majority of eye injuries (approximately 33%) occurred on the street or at the playground. Home or around the house were the second predominant places of injury. Causes included chemical substances, catapults, bullet guns, and fireworks which were also described in other studies as high risk activities that merit preventive strategies.[16] Better supervision, improved education, increased awareness, and the use of safety glasses should substantially decrease the numbers of these preventable eye injuries. As setting off fireworks is allowed in Suriname between Christmas and New Year, the media may help raise awareness of the dangers associated with eye injuries during such annual festivities. The incorporation of eye injury prevention programmes in school curricula may also help dealing with these issues.[16]

One of the main findings of this study was the relatively high number of children who did not show up for follow-up (31%), even those with severe eye damage requiring further treatment. This number is lower than that reported in Taiwan, where almost half of the patients were lost to follow-up.[21] However, this is still of concern, because close follow-up is particularly important in children to avoid amblyopia. The unexpectedly high number of children who were lost to follow-up while steroid drops had not yet been tapered was also of concern. Long-term use of steroids can cause glaucoma or cataract [22] and parents should be informed about these side-effects. Although not statistically significantly related to unfavourable outcome or hospitalisation, patient delay was another notable finding, especially in the rural population. This is in accordance with data from Nigeria, Ethiopia [6], Colombia [3], and India [15], with negligence and ignorance as common causes of delay. This underlines the need for educational tools to aid early identification and optimal management of ocular injuries by supervisors and primary care givers.[3,16]

The study had some limitations related to the retrospective study design. Not all data could be retrieved from the children's medical records. Data concerning VA at presentation (49%), final VA (41%), and place of injury (32%) were especially lacking. Furthermore, it was difficult to obtain data on duration of hospitalization and social effects in later life, which are essential in assessing the socio-economic impact of ocular trauma in Suriname. On the other hand, the SEC is the only eye care centre in Suriname and its ophthalmologists are consulted by all other hospitals in the country. Therefore, the current data may cover all cases of severe paediatric ocular trauma in school-aged children in the entire country. However, we do not consider the data as population-based since mild cases are treated in other health care settings and cases that were not able to receive ophthalmic care in the SEC were also not included in our analyses.

In conclusion, high-risk factors for childhood ocular trauma in Suriname are being male; aged 3 to 11 years; and playing on the street, at the playground, or around the house with sticks, stones, (toy) guns, catapults, fireworks, and chemical substances. Since most causes of ocular trauma are preventable and both poor compliance and living in rural areas are predictors of poor final VA, the findings of this study highlight the need for educational interventions to promote awareness, parental supervision, immediate action, and compliance in both the rural and the urban population.

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Chapter 9

Summary and General Discussion

Clinical eye care in the Republic of Suriname has made considerable strides in recent years. However, no population-based data were available to provide an exact and up-to-date characterization of the current ophthalmic situation in the country. Without these data, it is difficult to evaluate the current system and to implement and evaluate targeted preventive and therapeutic eye care programmes. The findings described in this thesis provide baseline data about the status of eye care in Suriname. This will help developing a VISION 2020 action plan to reduce the burden of avoidable blindness in Suriname.

The specific aim of this thesis was to provide population-based data on the occurrence of eye disease in Suriname. The studies have specifically focused on preventable and treatable causes of these conditions in high-risk and/or socio-economic vulnerable groups, *i.e.*, individuals of 50 years and older, diabetics, the interior population, and children. Furthermore, data have been collected on the aetiology of uveitis in Suriname in order to develop a targeted screening and therapeutic programme for this eye condition.

A Rapid Assessment of Avoidable Blindness (RAAB) survey methodology has been carried out to assess the prevalence and causes of blindness and visual impairment (VI) as well as the prevalence of diabetes mellitus (DM) and diabetic retinopathy (DR) and the cataract situation in the Surinamese population of 50 years and older. In addition, the status of cataract surgical care at the Suriname Eye Centre (SEC) has been evaluated by assessing the impact of a new cataract surgical intervention programme on cataract surgical output and other relevant indicators. Experiences of the SEC with, and the outcome of outreach cataract services - phacoemulsification under topical anaesthesia in remote rural areas - are not covered by the RAAB and have separately been described. The same applies to the specific causes of blindness and VI in the Maroon population in Suriname's interior.

Data on avoidable childhood blindness in school-aged children (8-15 years old) in Suriname were retrieved from the records of the SEC. Using this information the epidemiology and most important causes of childhood ocular trauma were identified.

Finally, a prospective hospital-based study has been performed to address the causes of uveitis in Suriname in order to develop a targeted diagnostic and therapeutic uveitis programme.

Visual impairment and blindness in vulnerable populations in Suriname

Results from the RAAB study: visual impairment and blindness in older adults

In a population-based cross-sectional survey, 2,998 individuals aged 50 years and older were included. Fifty clusters of sixty individuals aged ≥ 50 years were randomly selected with a probability proportional to the size of the population unit. Eligible persons were randomly selected through compact segment sampling and examined in their own house using the standard RAAB protocol.[1] Prevalence and causes of blindness (presenting visual acuity (PVA) <3/60), severe VI (SVI: PVA <6/60 – 3/60), and moderate VI (MVI: PVA <6/18 – 6/60) were assessed. Cataract surgical coverage (CSC), main barriers to the uptake of cataract surgery, and outcomes after cataract surgery were evaluated.

Eventually, a total of 2,806 individuals were examined (response rate of 93.6%). The standardized prevalence of blindness was 1.9% (95% CI: 1.0-2.8). Prevalence of SVI and MVI were 1.1% (95% CI: 0.6-1.6) and 5.6% (95% CI: 4.1-7.0), respectively. Untreated cataract was the most common cause of bilateral blindness (54.0%) followed by glaucoma (23.8%). Cataract also accounted for most cases of bilateral SVI (57.9%). The main causes of MVI were uncorrected refractive error (URE, 48.6%) and untreated cataract (33.7%). The CSC for PVA <3/60 was 88.1% when calculated by eye and 94.3% when calculated by individual. 'Cannot access treatment' was the most common barrier (28.9%) for cataract surgery. Of the eyes that received surgery, 80.5% had a good outcome (PVA >6/18) and 9.8% had a poor outcome (<6/60).

This was the first population-based survey on blindness and VI in Suriname. It is concluded that the prevalence of blindness in Suriname is comparable to that in other South American and Caribbean countries. Of note, 87.3% of all bilaterally blind cases were avoidable. The main strategy to reduce this burden is cataract surgery, followed by the development of cost-effective optical and special glaucoma services.

Results from the interior Maroon population study: causes of visual impairment and blindness

In a preliminary study undertaken before the RAAB study, the scale and causes of blindness and VI in Maroons living in the interior of Suriname was assessed in a rural area along the Upper Suriname River between December 2011 and June 2012. Individuals at risk or suspected to be blind or visually impaired were actively recruited for eye examination by co-workers of the Medical Mission. Patients who had previously undergone a cataract operation were also invited for follow-up. Systematic ophthalmic examination was performed using the World Health Organization (WHO) Eye Examination Record version III developed for the Prevention of Blindness Programme (PBL) (1988).

A total of 578 participants were included in the study. Thirty-eight of them (6.6%) were either blind or severely visually impaired, and 102 (17.6%) were visually impaired. Cataract was the leading cause of blindness and SVI (60%). Other major causes of blindness and SVI were glaucoma (16%) and idiopathic optic atrophy (10%). A few patients were blind due to phtysis bulbi, aphakia, corneal opacities, retinitis pigmentosa, or toxoplasmosis.

This was the first study to assess the causes of blindness and VI in the interior of Suriname, and the results suggest a relatively high burden of sight-impairing conditions in the Maroon population. This indicates an urgent need for blindness-prevention programmes in these remote rural areas with emphasis on effective treatment of cataract and strategies for early detection and treatment of glaucoma. The latter condition compromises a great challenge when compared to the former, since treatment of glaucoma often fails in the interior population because of poor patient acceptance, compliance, follow-up and post-operative care.

Insight into specific causes of visual impairment and blindness in Suriname

Cataract and cataract surgical care

A newly implemented cataract surgical intervention programme at the SEC was evaluated by analysing the cataract surgical output and related indicators in the period between 2006 and 2014. As cataract was still the most important cause of blindness in Suriname, findings from the RAAB survey were used to describe the prevalence of cataract blindness and the outcome of cataract surgery in the population aged 50 years and older.

The results from this evaluation showed that 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 1,000,000 inhabitants. Furthermore, the age- and sex-adjusted prevalence of bilateral cataract blindness in Surinamese individuals of 50 years and older was reduced to 0.8% (95% CI 0.2-1.3%). Importantly, the proportion of eyes with a post-operative visual acuity (VA) <6/60 (poor outcome) was lowest in eyes operated at the SEC (8.5%) and highest in surgeries performed by foreign humanitarian ophthalmic missions (33.3%).

It is concluded that 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 with modern surgical equipment, intensive training courses, and improvement in the affordability and accessibility of cataract surgery. The programme may function as an example for other (developing) countries to reduce the burden of cataract blindness and to improve surgical outcomes. However, to avoid recurrence of the backlog in surgeries and the increase in the prevalence of cataract, it is mandatory to increase the yearly output of cataract operations.

Cataract and cataract surgical care in the interior

Although the use of phacoemulsification under topical anaesthesia in mobile eye camps has been described before [9], its use in the setting of the Amazon rain forest is unique. In this retrospective observational study we report the use of high-quality cataract surgery in remote areas of the Amazon in Suriname. The experiences with and the clinical outcome of primary phacoemulsification with intraocular lens (IOL) implantation were described in 88 patients. All surgeries were performed under topical anaesthesia in the field by the ophthalmic team of the SEC. Outcomes were evaluated by comparing pre- and post-operative uncorrected visual acuity using WHO criteria, and assessing intra- and immediate post-operative complications by Oxford Cataract Treatment Evaluation Team (OCTET) definitions.[2]

Before surgery, 54 eyes (61%) were either blind or severely visually impaired. Only 8 patients (9%) had a VA ≥6/18. At the final post-operative visit, 61 patients (70%) had an uncorrected VA ≥6/18 and 8 patients (9%) had remained blind or severely visually impaired. Intra-operatively 2 cases (2%) of posterior capsule rupture (OCTET III) occurred, involving one dropped nucleus (1%). The latter case required vitreoretinal surgery at the SEC.

These results indicate that it is possible to perform high-quality cataract surgery in remote areas of the Amazon rain forest and achieving acceptable results with few complications. Unfortunately, the results from the RAAB survey indicated that visual outcome results were often worse in eyes operated in eye camps organized by others when compared to those treated at the SEC or in eye camps organized by the SEC. Analysis of these unacceptable results indicated that 83% of the poor surgeries was performed by foreign ophthalmic teams. In contrast, only one of seven individuals with a poor outcome was operated in an eye camp of the SEC. This eye had a poor outcome due to posterior capsule opacification.

These observations underscore the importance of meticulously evaluating visual outcome after cataract surgery in eye camps. Detailed pre-operative ophthalmic examinations, careful patient selection, improved diagnostic capacities, experienced cataract surgeons, and the possibilitiye of YAG laser capsulotomy are necessary to obtain satisfactory results.

Diabetes mellitus and diabetic retinopathy in older adults

The standard RAAB protocol was expanded with the DR module.[3] Participants were classified as having DM if they had previously been diagnosed with this condition; were receiving treatment for glucose control, or had a random blood glucose level >200 mg/dL. These participants were dilated for funduscopy, assessed for DR following the Scottish DR grading protocol [4], and evaluated for ethnic background and DR ophthalmic screening frequencies.

Our results showed a prevalence of DM in Suriname of 24.6%. Diabetic retinopathy of any type and/or maculopathy occurred in 21.6% of DM patients, and sight-threatening DR in 8.0%. Furthermore, 34.2% had never undergone an eye examination for DR, and 13.0% had his/her last examination more than twenty-four months earlier. The prevalence of DM was statistically significantly higher in Hindustanis when compared to the other ethnic groups.

This was the first survey on DR in Suriname and the first RAAB survey in South America that included the DR module. It is concluded that the estimated prevalence of DM in Surinamese individuals of 50 years and older was higher than expected, and that the proportions of uncontrolled diabetics and patients who never had an ophthalmic examination was unacceptably high. To decrease the prevalence of DR-induced blindness, patient accrual, regular controls for DR and awareness about the importance of a well-adjusted blood sugar level must be increased.

Aetiology of uveitis

So far, no epidemiological data are available on uveitis in Suriname. In this prospective cohort study, 100 consecutive uveitis cases were included between July 15, 2014 and January 29, 2015. All patients were evaluated for their medical history using a specific uveitis screening questionnaire form, as well as for their standard laboratory values. Subsequently, the patients were classified according to their ethnic background, age, and gender, as well as anatomical and aetiological diagnosis using the Standardization of Uveitis Nomenclature Working Group (SUN) criteria.[5]

The results showed that 64% of the 100 recruited patients had an anterior uveitis. Pan uveitis was the second most common anatomical location (19%), followed by posterior uveitis (15%) and intermediate uveitis (2%). In 59% of cases no underlying cause could be identified, but toxoplasmosis chorioretinitis was diagnosed as the most common cause of uveitis (24%).

The findings of this study will be used for the development of a targeted and multidisciplinary screening programme for uveitis patients in Suriname. Clearly, such a programme is essential for optimal management and care of this condition. Fortunately, the presentation of the results from the current study have led to the introduction of more diagnostic possibilities for the patient with uveitis, including a more standardized uveitis screening protocol and the Qauntiferon test for the diagnosis of tuberculosis-related-uveitis.

Visual impairment and ocular trauma in children

In contrast to blindness in children, no detailed information is available on childhood ocular trauma in Suriname. In this study, all children who were 8 to 15 years old at the time of the survey and who had previously undergone evaluation and/or treatment at the SEC because of ocular trauma, were retrospectively evaluated. As the SEC is the only tertiary eye care centre in Suriname, this sample probably included almost all school-aged children who had previously suffered from (severe) eye injury.

There were 538 records of children with ocular trauma, including 35 (7%) open-globe injuries (OGI), 458 (85%) closed-globe injuries, 5 (1%) orbital fractures, and 40 (7%) eyelid injuries. The most frequent causes of trauma were body parts (18%) and sticks or branches (13%), which had resulted from poking (20%) or punching (13%) the eye. Final VA <6/60 was reported in 58% of the registered cases of OGI. Living in rural areas ($p = 0.007$), OGI ($p < 0.0001$), and poor compliance to scheduled check-ups ($p < 0.0001$) were statistically significantly related to an unfavourable outcome, but patient delay was not. Children having OGI were more often hospitalized than those with other injuries ($p < 0.0001$).

This study was the first providing data on ocular trauma in children in Suriname. According to these findings, targeted preventive strategies to promote awareness, parental supervision, immediate action, and compliance should be developed to eliminate trauma-induced blindness and VI.

Methodological considerations

Strengths and limitations of the study

Rapid Assessment of Avoidable Blindness

The RAAB is an updated and modified version of the Rapid Assessment of Cataract Surgical Services (RACSS).[7] Using epidemiologic methods, the data obtained are used to design and monitor eye care programmes.[1] Important strengths of the RAAB protocol are its rapidness and ease of implementation at relatively low costs. This observation accompanied by the results from the current study, should be communicated to stakeholders in order to develop a comprehensive VISION 2020 action plan that includes the optimum infrastructure for cataract surgical services. The RAAB methodology also helps to identify problems such as causes of poor outcome after surgery and the barriers to surgery, enabling the development of strategies to overcome them.[1] Furthermore, the standardized RAAB method makes it possible to compare results of different countries with each other and develop follow-up studies to evaluate the effects of interventions.

On the other hand, the RAAB does not estimate the prevalence of blindness in individuals younger than 50 years of age, and only identifies sight-impairing eye diseases, while the diagnostic facilities are too limited to accurately diagnose causes of posterior segment disease. [1] Furthermore, in the current study, when compared to the most recent census data, the older age groups were overrepresented. This means that the sample prevalence for blindness was likely higher than the age- and sex-standardized prevalence. In addition, the most isolated areas in the interior of Suriname were not included in the study and were replaced by the next nearest areas that were deemed suitable for examinations and cataract surgeries. For these reasons, the cataract prevalence in Suriname's interior might have been underestimated.

The identification of only visually impairing diseases is also an important limitation of the RAAB method, particularly with regard to the prevalence of glaucoma, the most common cause of bilateral blindness in Surinamese men. As central vision often remains intact in glaucoma patients, this may imply that with so many patients who became blind from glaucoma, the number of patients in Suriname with glaucoma may even be much higher. Unfortunately, these patients may have been overlooked in the current study, as the standard RAAB examination does not include an advanced screening method - such as visual field testing - for glaucoma.

The overrepresentation of older age individuals in the current study might also have led to an underestimation of the prevalence of DM. The latter value may have further been biased by measuring non-fasting glucose levels only once instead of repeatedly, and the lack of an oral glucose tolerance test and/or fasting glucose level test.

Still, the relatively new DR module of the RAAB survey is a feasible tool to rapidly obtain large numbers of population-based data on DM and DR.

Studies in the interior

The studies described in this thesis were the first on blindness, VI, and cataract surgery in the Maroon population living in the interior of Suriname. A limitation of this study was the self-created selection bias to ensure the inclusion of all blind and visually impaired individuals. Thus, patient recruitment was not ad random, which makes it difficult to determine the exact prevalence of blindness and eye diseases in these people. The most important limitation of the report on cataract surgery in the Amazon rain forest was the retrospective study design.

Hospital-based studies: uveitis and childhood ocular trauma

An important drawback of the uveitis study was the relatively small sample size (only 100 patients). In addition, the lack of comprehensive diagnostic tools – largely attributable to financial constraints - prohibited analyses of HLA-B27 status and angiotensin-converting enzyme levels. This information is particularly helpful for the prognosis and the identification of underlying systemic diseases in patients with suspected acute anterior uveitis. It was also not possible to perform polymerase chain reaction-based aqueous fluid analysis for the diagnosis and treatment of patients suspected of having posterior uveitis caused by an infection such as herpes simplex. Notwithstanding, the data that emerged from this study are very useful for the development of a targeted uveitis screening and treatment programme at the SEC.

The most important weakness of the study on childhood ocular trauma was the incompleteness of the medical records, particularly with respect to data on VA at presentation and final VA. Still, as the SEC is the only eye care centre in Suriname, the current data probably covered most cases of severe ocular trauma in school-aged children in Suriname and consequently, are useful for the planning of preventive eye care programmes. However, we do not consider the data as population-based since mild cases are treated in other health care settings and cases that were not able to receive ophthalmic care in the SEC were also not included in our analyses.

Implications for policy makers and clinical practice

The results of the RAAB and the studies on cataract in the interior of Suriname led to the following recommendations for the SEC and policy makers:

1. Maintain and expand the cataract surgical rate (CSR) through:
    a. intensified national health promotion campaigns about the benefits of cataract surgery;
    b. appeals for allocating more resources to the treatment of cataract with argument that treatment of cataract reduces poverty;
    c. intensified case finding;
    d. an increased efficiency in the referral system for cataract surgery;
    e. the application of more high-output methods;
    f. measures to increase CSR by at least 10% per year to compensate for population growth.
2. Increase the number of women undergoing cataract surgery by:
    a. developing special strategies to promote cataract surgery in women.
3. Improve the visual outcome of cataract surgery in eye camps through:
    a. analyses of the reasons for poor visual outcome after surgery in eye camps through routine monitoring of cataract outcome, including analyses of current (foreign) surgical practices to reduce surgical complications;
    b. detailed reports that underscore the importance of detailed pre-operative ophthalmic examinations and improvements of the diagnostic capacity of eye camps;
    c. analyses of current practice to determine the power of IOLs;
    d. improvement of biometry and optical services for cataract surgery;
4. Develop and expand the uptake of special services for glaucoma by:
    a. expanding health information on glaucoma and emphasizing the importance of regular check-ups;
    b. active screening of family members of glaucoma patients aged 40 years and older, and the interior Maroon population.
5. Expand the uptake of special services for DR by:
    a. increasing the number of regular fundus controls for DM patients;
    b. increasing the proportion of DM patients with a well-adjusted blood sugar level.
6. Expansion of low-vision and optic services.

The results from the studies on ocular trauma in children indicate the need for:

1. educational interventions to promote awareness, parental supervision, immediate action, and compliance in both rural and urban populations, particularly in the high-risk population of boys of 3 to 11 years of age.
2. the use of protective glasses and restrictions on the use of catapults, fireworks, and chemical substances by children.

The most important recommendation of the uveitis study is:

1. the need to develop and extend the diagnostic tools for uveitis patients

Considering the burden of (avoidable) VI and blindness and societal costs, especially with respect to productivity losses, it may be cost-effective to carry out the above recommendations and to invest into adequate ophthalmic care as soon as possible.

Future studies

As mentioned above, the findings from the RAAB survey can be used to prioritize the specific needs for ophthalmic care in Suriname. Importantly, a follow-up RAAB survey can be implemented to assess achievements over time and make adjustments if necessary. In order to maintain and even improve the level of cataract surgical care, the SEC should also obtain a detailed analysis of the current cataract surgical services to identify possibilities to increase the surgical output and to improve the outcome of cataract surgery in eye camps.

When considering the magnitude of DM in Suriname, prospective cohort studies involving every new patient with DM should address the risk factors involved in the susceptibility of diabetics to develop DR. These studies should also elaborate on methods to improve care for individuals suffering from DM. Furthermore, the multi-ethnic and multicultural composition of the Surinamese population warrants studies on the influence of genetics and life-style on the development of DM and DR.

The multi-ethnic nature of the Surinamese population also warrants studies on the genetic background of glaucoma, the second most important cause of bilateral blindness in Surinamese of 50 years and older. Particularly primary open angle glaucoma (POAG) frequently manifests in certain Afro-Surinamese families (expert opinion ABM), supporting the hypothesis about a genetic background of this disease. Although various POAG genes have been identified in Caucasian and Asian patients, most of them are presumably not associated with the development of POAG in individuals from African descent. For all these reasons, studies on the genetic risk factors for POAG in Suriname may help contribute to the growing knowledge on the genetics of this condition.

A notable finding of the current study was the relatively high percentage of blindness caused by idiopathic optic atrophy, which is consistent with comparable population-based studies with black participants.[8] Between 1974 and 1977, a retrospective case record and field study was conducted about the occurrence, forms, and aetiology of optic atrophy in Suriname [9]. It was concluded that the black population groups in Suriname might develop optic atrophy because of a hereditary predisposition combined with exogenous factors such as toxic influences of nutritional cyanide intake in various cassave products [9], but the exact cause is still unknown. Thus, more detailed studies should be carried out to understand the aetiology of optic atrophy in populations of African descendent.

When considering the data gathered in children, much work has already been done, but further research should be performed to optimize ophthalmic health education and eye care for children in Suriname.

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Chapter 10

Nederlandse Samenvatting

Epidemiologie, etiologie en zorg van oogaandoeningen in Suriname

Slechtziendheid en blindheid gaan vaak gepaard met psychosociale problematiek, verhoogde mortaliteit en verlies van arbeidsproductiviteit. De preventie ervan heeft daarom over het algemeen hoge prioriteit in nationale 'public health' sectoren. Volgens schattingen bedroeg de wereldwijde prevalentie van slechtziendheid in het jaar 2010 285 miljoen individuen. Onder hen bevond zich een onbekend, maar substantieel aantal individuen bij wie de visusproblemen middels relatief eenvoudige ingrepen behandeld of vermeden hadden kunnen worden. Met als doel het aantal gevallen van vermijdbare blindheid terug te brengen, formuleerde de Wereldgezondheidsorganisatie (WHO) op 18 februari 1999 het VISION 2020 actieplan dat beoogt in het jaar 2020 vermijdbare blindheid te hebben uitgebannen. Essentieel hierbij is de beschikbaarheid van betrouwbare nationale data over de stand van zaken op het gebied van de oogheelkunde zodat gerichte preventieve behandelingsprogramma's geïmplementeerd kunnen worden. In Latijns Amerika en het Caraïbisch gebied zijn in de periode tussen 1980 en 2012 echter maar zes nationale studies uitgevoerd over de prevalentie van blindheid en slechtziendheid. En voordat de studies beschreven in dit proefschrift waren uitgevoerd was deze informatie niet beschikbaar voor de Republiek Suriname.

Suriname is een onafhankelijk land in ontwikkeling en is gelegen aan de noordoostkust van Zuid Amerika. In 2014 werd de populatie van Suriname geschat op 573,311 inwoners, waarvan 90% in de stedelijke en kustgebieden woont. De overige 10% woont verspreid over het tropische regenwoud dat 80% van het oppervlak van het land beslaat. Het bruto nationaal product per capita bedraagt U$ 9,370. Suriname maakt deel uit van het Caraïbisch gebied en is lid van de Pan American Health Organization (PAHO) die de WHO vertegenwoordigt in de regio. Gespecialiseerde oogheelkundige zorg wordt in Suriname verleend door de tien oogartsen van het Suriname Eye Centre (SEC) dat deel uitmaakt van het Academisch Ziekenhuis Paramaribo (AZP). De oogheelkundige zorg in Suriname heeft zich sterk ontwikkeld in de afgelopen jaren en het SEC is recent toegetreden als geassocieerd lid van de 'World Association of Eye Hospitals (WAEH)'. Het SEC organiseert regelmatig missies naar de omliggende districten en het binnenland waarbij patiënten worden voorzien van poliklinische en chirurgische oogheelkundige zorg. Ondanks de huidige capaciteit van oogheelkundige zorg presenteren zich elke dag nieuwe patiënten bij het SEC met vergevorderde oogheelkundige pathologie waarvoor slechts weinig behandelopties beschikbaar zijn. Het is duidelijk dat deze situatie verbetering behoeft. Een manier om dit te verwezenlijken is het verkrijgen van inzicht in de prevalentie en de meest voorkomende oorzaken van blindheid en slechtziendheid in de verschillende populatiegroepen in Suriname.

Potentiële oorzaken van blindheid in Suriname

Cataract (staar) is wereldwijd de meest voorkomende oorzaak van blindheid. Vooral de snel groeiende populatie van ouderen in ontwikkelingslanden wordt door deze aandoening getroffen. Dit is voor een belangrijk deel een gevolg van de slechte toegankelijkheid van oogheelkundige zorg en de gebrekkige mogelijkheden voor behandeling. Om de cataract chirurgische zorg in Suriname te verbeteren, zijn allereerst studies nodig die het huidige cataract zorgsysteem evalueren en de omvang van blindheid veroorzaakt door cataract in kaart brengen.

Diabetische retinopathie (DR) is een ernstige oogcomplicatie van diabetes mellitus (DM) en de meest voorkomende oorzaak van blindheid in de productieve westerse populatie. De prevalentie van DM neemt over de hele wereld toe, met name in de minder ontwikkelde landen. In Suriname wordt het aantal individuen met suikerziekte in de leeftijdsgroep boven 50 jaar geschat op 20%. Over de prevalentie van DR is echter geen informatie beschikbaar.

Glaucoom is één van de vaakst gediagnosticeerde oogaandoeningen in Suriname. In veel ontwikkelingslanden leidt deze aandoening tot een fors verlies van het gezichtsveld als gevolg van late diagnose en gebrek aan behandelopties. In Suriname zijn voldoende behandelopties voor glaucoom voorhanden. Teneinde deze aandoening in dit land terug te dringen zijn daarom - net als in de bovengenoemde gevallen - vooral prevalentiedata essentieel.

Uveïtis is een veelvoorkomende inflammatoire oogziekte en een belangrijke oorzaak van blindheid in ontwikkelingslanden. Deze aandoening heeft zijn oorsprong onder andere in infectieuze en niet-infectieuze systemische oorzaken. Vroege diagnostiek en behandeling kan de complicaties van uveïtis voorkomen en daarmee de kans op slechtziendheid verminderen. In Suriname zijn geen data beschikbaar over de prevalentie en de onderliggende oorzaken van uveïtis. Er zijn ook geen gestandaardiseerde diagnostische en behandelprotocollen voor deze aandoening beschikbaar. Data betreffende de etiologie van uveïtis zijn dus hard nodig om de oogheelkundige zorg van patiënten met deze oogziekte in het land te verbeteren.

Informatie over de etiologie van bilaterale blindheid en slechtziendheid bij kinderen in Suriname kwam voor het eerst relatief recent beschikbaar. Uit deze studie kwam naar voren dat cataract en premature retinopathie de belangrijkste onderliggende oorzaken zijn. In 20% van de gevallen bleek unilaterale blindheid bij kinderen te worden veroorzaakt door ***oculair trauma***. Gelet op het feit dat 90% van de oculaire traumata te voorkomen is, zal onderzoek naar de epidemiologie en etiologie van deze oogaandoening bij kunnen dragen aan de ontwikkeling van preventieve oogheelkundige zorgprogramma's.

Doel van het proefschrift

Het doel van het proefschrift is het in kaart brengen van de oogheelkundige situatie in Suriname. Hierbij is gebruik gemaakt van de 'Rapid Assessment of Avoidable Blindness' (RAAB) methode en informatie uit het archief van het SEC. De nadruk is vooral gelegd op voorkombare en behandelbare oorzaken van blindheid en slechtziendheid in de hoog-risico- en socio-economisch belangrijke groepen zoals individuen ouder dan 50 jaar, de binnenlandse bevolking, diabeten en kinderen. De verkregen data kunnen worden gebruikt voor de ontwikkeling van preventieve en chirurgische oogheelkundige zorgprogramma's. Zoals eerder aangegeven bestaat er in Suriname nog geen behandelprotocol voor de screening en behandeling van uveïtis. Teneinde voorstellen te formuleren voor een gericht zorgpad zijn tevens de oorzaken van deze aandoening in kaart gebracht.

Epidemiologische dataverzameling

RAAB (Rapid Assessment of Avoidable Blindness)

De RAAB is een snelle, eenvoudige en relatief goedkope gestandaardiseerde methode om de prevalentie en oorzaken van blindheid in individuen van 50 jaar en ouder in een specifiek gebied in kaart te brengen. De RAAB is met name gericht op vermijdbare en behandelbare oorzaken zoals cataract- en refractieafwijkingen. Middels de RAAB kan een gedetailleerd overzicht van de cataractsituatie in Suriname worden verkregen. Dit houdt onder meer in: informatie over welk deel van de bevolking een cataractoperatie heeft ondergaan (de zgn. 'cataract surgical coverage'), de resultaten van de ingrepen alsmede de barrières die voorkomen dat men optimaal gebruik maakt van de zorg. Aan deze informatie wordt toegevoegd een uiteenzetting over de cataract chirurgische zorg van het SEC gebaseerd op de beschikbare ziekenhuisdata.

Al meer dan zestig landen in de hele wereld hebben met succes een RAAB studie uitgevoerd. Omdat deze methode gestandaardiseerd is, kunnen de resultaten van verschillende landen en regio's gemakkelijk met elkaar worden vergeleken. De resultaten van de RAAB kunnen niet alleen gebruikt worden om interventieprogramma's op te zetten, maar ook om het effect van deze programma's te meten door de studie op een later tijdstip te herhalen. Vanwege de wereldwijd toenemende prevalentie van DR is een nieuwe module aan de RAAB methode toegevoegd waardoor het mogelijk is de prevalentie van DM en DR te meten (bij individuen die ouder zijn dan 50 jaar).

Ziekenhuisarchief

Het SEC is het belangrijkste oogziekenhuis in Suriname en de oogartsen die daar werkzaam zijn worden geconsulteerd door alle andere ziekenhuizen in het land. Het archief van het SEC bevat dan ook gedetailleerde informatie over het grootste deel van de oogpatiënten in Suriname. Deze informatie is bruikbaar voor epidemiologisch onderzoek. Informatie over de meest voorkomende oorzaken van slechtziendheid bij kinderen, inclusief de frequentie en oorzaken van oogtraumata, is verkregen middels retrospectief statusonderzoek. Daarnaast zullen de binnenlandse oogheelkundige zorg en de etiologie van bepaalde specifieke oogziektes in de patiëntenpopulatie van het SEC in kaart gebracht worden, inclusief de meest voorkomende oorzaken van uveïtis.

Resultaten en Discussie

Hoofdstuk 2 beschrijft de prevalentie en oorzaken van blindheid en slechtziendheid in Suriname alsmede een deel van de cataract chirurgische data die middels de RAAB zijn verkregen in individuen ouder dan 50 jaar. Dit bevolkingsonderzoek omvatte 2.998 individuen van 50 jaar en ouder (dekking 93.6%). Deze werden in hun eigen huis onderzocht op basis van het RAAB protocol. De gestandaardiseerde prevalentie van blindheid (visus <3/60 met beschikbare correctie) was 1.9% (95% CI: 1.0-2.8), ernstige slechtziendheid (visus <6/60 – 3/60 met beschikbare correctie) 1.1% (95% CI: 0.6-1.6), en matige slechtziendheid (visus <6/18 – 6/60 met beschikbare correctie) 5.6% (95% CI: 4.1-7.0). De meest voorkomende oorzaak van bilaterale blindheid was onbehandelde cataract (54.0%) gevolgd door glaucoom (23.8%). Cataract was ook de meest voorkomende oorzaak van bilaterale ernstige slechtziendheid (57.9%). De meest voorkomende oorzaken van matige slechtziendheid waren ongecorrigeerde refractieafwijkingen (48.6%) en cataract (33.7%). De 'cataract surgical coverage' voor visus <3/60 was 94.3% (per individu). Het meest genoemde obstakel voor cataractchirurgie was 'geen toegang tot behandeling' (28.9%). In 80.5% van de gevallen leidde een cataract operatie tot een positief resultaat (visus >6/18) terwijl de uitkomst in 9.8% van de gevallen slecht was (visus < 6/60). De belangrijkste conclusies van dit onderzoek waren dat de prevalentie van blindheid in Suriname vergelijkbaar is met die in andere Zuid-Amerikaanse en Caraïbische landen; dat bilaterale blindheid in 87.3% van de patiënten te voorkomen of te behandelen is; en dat verbetering van de cataract chirurgische zorg de belangrijkste en meest kosteneffectieve interventiestrategie is om blindheid te voorkomen.

Hoofdstuk 3 beschrijft de oorzaken van blindheid en slechtziendheid in de Marron populatie woonachtig in het binnenland van Suriname. Deze groep bestaat uit ongeveer 23.000 individuen van Afrikaanse origine. Het onderzoek werd uitgevoerd in verschillende dorpjes langs de Boven Surinamerivier. Zowel de blinde en slechtziende mensen als de risicogroepen werden opgeroepen en oogheelkundig onderzocht volgens een gestandaardiseerd protocol van de WHO.

Cataract was de meest voorkomende oorzaak van blindheid en ernstige slechtziendheid (60%). Andere belangrijke oorzaken waren glaucoom (16%) en idiopathische opticus atrofie (10%). Een enkel individu was blind als gevolg van phtysis bulbi, afakie, cornea troebeling, retinitis pigmentosa of toxoplasmose. Deze studie bevestigde de noodzaak voor preventieve programma's gericht op het voorkomen van blindheid met de nadruk op de cataract chirurgische zorg en de vroege opsporing en behandeling van glaucoom. De behandeling van glaucoom in het binnenland van Suriname is problematisch door slechte compliance van medicamenteuze therapie, weinig mogelijkheid tot postoperatieve zorg en slechte follow-up.

Hoofdstuk 4 geeft een gedetailleerd overzicht van de cataractsituatie in Suriname sinds de implementatie van een nieuw cataract chirurgisch interventieprogramma in 2006. De effectiviteit en veiligheid van het huidige zorgsysteem werden geëvalueerd aan de hand van de resultaten van de RAAB studie en verschillende indicatoren van het SEC.

Sinds de invoer van het nieuwe interventieprogramma is het aantal staaroperaties in het SEC gestegen, van 1.150 in 2006 naar 4.538 in 2014. Als gevolg hiervan is de prevalentie van blindheid als gevolg van cataract momenteel 0.8% (95% betrouwbaarheidsinterval 0.2-1.3%) in individuen ouder dan 50 jaar. Het percentage patiënten met een slechte uitkomst na cataractchirurgie was het laagst in het SEC (8.5%) en het hoogst in de groep patiënten die waren geopereerd door buitenlandse oogheelkundige teams. Deze resultaten geven aan dat de cataractsituatie in Suriname, vergeleken met andere landen in de regio, goed onder controle is. Belangrijke factoren die bijdragen aan dit succes zijn de ingebruikneming van een Ambulant Chirurgisch Dagcentrum, de aanschaf van moderne chirurgische apparatuur, de introductie van nieuwe chirurgische technieken, intensieve training van zowel de medische als de paramedische staf en de verbetering van de toegang tot en de vergoeding van de cataract chirurgische zorg. Gelet op de toename van de populatie van ouderen is het belangrijk de cataract chirurgische capaciteit op peil te houden en zelfs met 10% te verhogen.

In **hoofdstuk 5** wordt de ervaring met phacoemulsificatie onder druppelanesthesie in 88 patiënten in het binnenland van Suriname beschreven. Gegevens over visuele uitkomsten voor en na cataractchirurgie en de frequentie van intra- en postoperatieve complicaties zijn geëvalueerd. Voor de operatie waren 54 ogen (61%) blind of zeer slechtziend terwijl slechts 8 patiënten (9%) een visus hadden van ≥6/18. Na de operatie hadden 61 patiënten (70%) een ongecorrigeerde visus van ≥6/18 (goede uitkomst) en bleven 8 patiënten (9%) blind of zeer slechtziend (7 ogen pre-existente pathologie, 1 oog met cornea oedeem). Twee achterste kapselrupturen (2%) waarvan 1 'dropped nucleus' (1%) konden worden toegeschreven aan intra-operatieve complicaties. Deze resultaten geven aan dat een ervaren team uitgerust met hoogwaardige apparatuur in staat is zelfs onder relatief ongunstige omstandigheden resultaten van hoge kwaliteit af te leveren.

De prevalentie van DM en DR in Suriname - inclusief diabeten die bij de oogartsen bekend zijn - werden verkregen middels de RAAB + DR methode en zijn beschreven in **hoofdstuk 6**. Individuen werden geclassificeerd als diabeet indien ze eerder als zodanig waren gediagnosticeerd, bloedsuikerverlagende middelen gebruikten of een bloedglucosespiegel >200 mg/dL hadden (niet-nuchter). De patiënten ondergingen fundoscopie in mydriasis en DR werd geclassificeerd volgens het 'Scottish DR grading protocol' zoals aangegeven in de RAAB+ DR onderzoeksmethode. Tevens werden etnische achtergrond, duur van de DM, frequentie van screening op DR en behandelmethode van elke patiënt genoteerd.

De prevalentie van DM in individuen ouder dan 50 jaar was 24.6%. DR werd gediagnosticeerd in 21.6% en visusbedreigende DR in 8.0% van de gevallen. Meer dan een derde van de patiënten (34.2%) had nooit een oogarts bezocht en 13.0% had al meer dan 2 jaar geleden voor het laatst een bezoek aan de oogarts gebracht. De prevalentie van DM was statistisch gezien significant hoger in Hindoestaanse individuen vergeleken met individuen behorende tot andere grote etnische groepen. Meer dan 40% van de diabeten was niet goed ingesteld (glucose >200mg/dL; significant meer mannen dan vrouwen). Concluderend kan worden gesteld dat een groot deel van de oudere Surinaamse diabeten niet gescreend is op DR. De prevalentie van DM-gerelateerde blindheid kan worden verminderd door, in samenwerking met de eerstelijns- en de specialistische zorg, speciale zorgpaden te ontwikkelen om de screening op DR te verbeteren en de instelling van diabeten te optimaliseren.

Hoofdstuk 7 behandelt de resultaten m.b.t. de etiologie van uveïtis in Suriname. Deze zijn verkregen middels een prospectieve cohortstudie waarin 100 uveïtispatiënten werden opgenomen en werden gestratificeerd op basis van hun etnische achtergrond alsmede anatomische en etiologische diagnostische criteria. Deze waren gebaseerd op de criteria van de 'Standardization of Uveïtis Nomenclature

Working Group (SUN)'. Vierenzestig procent van de patiënten werd gediagnosticeerd met een uveïtis anterior, 19% met een panuveïtis, 15% met een uveïtis posterior en 2% met een intermediaire uveïtis. Een infectieuze oorzaak werd gevonden in 34% van de gevallen. De meest voorkomende oorzaken waren toxoplasma chorioretinitis (24%), herpes virus uveïtis anterior (3%) en syfilis (3%). Vier patiënten (4%) werden verdacht van tuberculose-gerelateerd uveitis. Bij 59% van de patiënten kon de exacte diagnose niet worden vastgesteld.

De resultaten van deze studie verschaffen een eerste indruk van het klinisch spectrum van uveïtis in Suriname en geven aan dat ongeveer 41% van alle uveïtiden in deze serie correct kon worden geclassificeerd. Deze informatie kan worden aangewend voor de ontwikkeling van een diagnostisch en therapeutisch zorgpad voor uveïtispatiënten in Suriname.

In **hoofdstuk 8** worden de epidemiologie en etiologie van oculaire traumata bij kinderen beschreven. Hiertoe is gebruik gemaakt van de gegevens van kinderen die tussen 8 en 16 jaar oud waren ten tijde van de studie en in het verleden het SEC hadden bezocht vanwege een oculair trauma. Het betrof 538 gevallen waaronder 35 (7%) 'open-globe injuries' (OGI), 458 (85%) 'closed-globe injuries', 5 (1%) orbita fracturen, en 40 (7%) ooglidtraumata. De meeste gevallen waren het gevolg van een prik (20%) of slag (13%) en waren veroorzaakt door lichaamsdelen (armen, benen en vingers, 18%) en stokken of takken (13%). In 58% van de gevallen van OGI was de uiteindelijke visus <6/60. 'Leven in afgelegen gebieden', 'OGI' en 'slechte therapietrouw aan overeengekomen controleafspraken in het SEC' waren gerelateerd aan een slechte visuele uitkomst ($p \leq 0.007$). Tenslotte werden patiënten met OGI vaker in het ziekenhuis opgenomen dan kinderen met een ander soort trauma ($p < 0.0001$).

Dit is de eerste studie naar de oorzaken van oculaire trauma bij kinderen in Suriname. Gegeven de consequenties en het voorkombare karakter van deze aandoening is het zaak om effectieve en preventieve strategieën te ontwikkelen gericht op bewustwording van de risico's en zorg van potentiële patiënten.

Aanbevelingen

De belangrijkste aanbevelingen voor de klinische praktijk die voortkomen uit de RAAB, de studies in het binnenland van Suriname en de cataractstudies betreffen handhaving en zelfs uitbreiding van het niveau van het aantal uitgevoerde cataractoperaties. Hiertoe zal het aantal uitgevoerde cataractoperaties met tenminste 10% moeten groeien ter compensatie van de verwachte groei van de bevolking. Dit kan bereikt worden door de bewustwording omtrent en de toegang tot cataractchirurgie te verbeteren, met name voor de binnenlandse en de vrouwelijke populatie. Ook kan er winst behaald worden in de efficiëntie van het verwijssysteem voor cataractchirurgie en d.m.v. intensievere 'case finding'.

De uitkomsten van cataractchirurgie in het binnenland van Suriname moeten verbeterd worden. Hiervoor zullen de oorzaken van slechte uitkomsten beter geanalyseerd moeten worden, moet er meer nadruk gelegd worden op het preoperatieve onderzoek (inclusief indicatiestelling), de biometrie en de postoperatieve refractie. Het aantal complicaties kan gereduceerd worden door de huidige (buitenlandse) chirurgische praktijken te monitoren en te verbeteren.

Naar aanleiding van dit onderzoek is glaucoom officieel erkend als een belangrijke oorzaak van blindheid in zowel de stedelijke gebieden als het binnenland van Suriname (en zelfs als de belangrijkste oorzaak van slechtziendheid bij mannen ouder dan 50 jaar). Er zullen daarom speciale zorgpaden ontwikkeld moeten worden voor de screening en de daaropvolgende behandeling van deze aandoening. Daarnaast zal de bewustwording omtrent glaucoom vergroot moeten worden door de Surinaamse populatie van informatie te voorzien en het belang van reguliere screening uit te leggen. Met name familieleden van glaucoompatiënten zullen actief benaderd moeten worden, ook bij de binnenlandse Marronpopulatie. Voor de behandeling van glaucoom in het binnenland van Suriname moet een oplossing gevonden worden.

Ook de bewustwording van de problematiek en de ontwikkeling van speciale zorgpaden voor de screening op DR moet verder uitgebreid worden. Samen met de diabetologen (huisartsen en internisten) moeten er tevens zorgpaden ontwikkeld worden om het aantal DM patiënten met goed gereguleerde bloedsuikerspiegels en bloeddruk te vergroten. De belangrijkste aanbeveling die voortkomt uit de uveïtis studie is dat de diagnostische middelen die nodig zijn voor optimale diagnostiek en behandeling van uveïtis uitgebreid moeten worden.

Uit de studieresultaten bij kinderen in Suriname kan worden geconcludeerd dat er geïnvesteerd moet worden in educatieve interventie ter verbetering van bewustwording van het risico op oogheelkundig trauma. Ter preventie van oogheelkundige traumata spelen ouderlijke supervisie, snelle oogheelkundige hulp en goede therapietrouw een belangrijke rol, met name bij de hoog-risico populatie van jongens tussen de 3 en 11 jaar oud. Daarnaast zal het gebruik van katapulten, vuurwerk en chemische substanties zoveel mogelijk beperkt moeten worden gezien het daaraan gerelateerde risico op blijvend oogletsel.

Toekomstig onderzoek

Zoals beschreven geven de bevindingen van de RAAB aan waar de prioriteit ligt ter verbetering van de oogheelkundige zorg in Suriname. Nadat de nodige interventieprogramma's zijn ingevoerd kan een tweede RAAB ingezet worden om het effect daarvan te monitoren en aan te passen waar nodig. Daarnaast zou toekomstig onderzoek zich kunnen toespitsen op de etiologie van de belangrijkste oogziektes in Suriname zoals DR en glaucoom. Welke genetische en omgevingsfactoren spelen een rol bij het ontstaan van deze ziektes in de Surinaamse populatie? Zijn er verschillen die gebonden zijn aan etnische achtergrond of worden mogelijke verschillen meer bepaald door culturele factoren? Van open kamerhoek glaucoom, bijvoorbeeld, is bekend dat het voorkomt in een aantal Surinaamse families van Afrikaanse origine. Dit suggereert een sterke genetische associatie. In Kaukasische en Aziatische patiënten is al een aantal genen 'voor' deze aandoening geïdentificeerd, maar deze blijken niet gerelateerd te zijn aan een verhoogd risico van open kamerhoek glaucoom in individuen van Afrikaanse origine. Om de ziekte beter te begrijpen en kansen te ontwikkelen voor vroege risicoscreening en 'personalized medicine' is specifiek onderzoek naar genetische risicofactoren van open kamerhoekglaucoom in deze populatie essentieel.

Een andere belangrijke bevinding van het huidige onderzoek was de hoge frequentie van idiopathische opticus atrofie bij de binnenlandse Marronpopulatie in Suriname. Dit komt overeen met vergelijkbare studies in andere populaties van Afrikaanse origine. Tussen 1974 en 1977 voerde professor Hendrikse een retrospectief casusonderzoek uit naar de etiologie van idiopathische opticus atrofie in Suriname. Uit dat onderzoek bleek dat bilaterale onverklaarbare opticus atrofie meer voorkwam bij Creoolse mensen (die van Afrikaanse origine zijn) dan bij individuen met een Hindoestaanse achtergrond en dat de incidentie het hoogst was bij mannen in de districten Para en Saramacca. Hij suggereerde dat de ontwikkeling van opticus atrofie bij de Creolen een gevolg zou kunnen zijn van genetische factoren in combinatie met exogene factoren. In dit verband werd genoemd de inname van cyanide door de consumptie van diverse cassaveproducten maar de exacte oorzaak is nog niet bekend. Voortbordurend op het werk van professor Hendrikse en gebruikmakend van nieuwe onderzoekstechnieken zouden nieuwe studies naar de etiologie van idiopathische opticus atrofie in Suriname kunnen leiden tot nieuwe inzichten.

De data betreffende blindheid en slechtziendheid bij kinderen in Suriname zouden verder uitgebreid kunnen worden met prospectief onderzoek naar de andere oorzaken van slechtziendheid en de psychosociale en maatschappelijke gevolgen.

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-Janna Minderhoud-

Curriculum Vitae

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Education

2017-present	Fellowship eyelid surgery	Academic Medical Centre, The Netherlands
2012 - 2017	Resident Ophthalmology	VU University Medical Centre, The Netherlands
2012 - 2017	PhD student	VU University Medical Centre, The Netherlands Academic Hospital Paramaribo, Suriname
2009 - 2012	MSc Biomedical Sciences	Leiden University, The Netherlands
2004 - 2011	Medical Doctor	Leiden University, The Netherlands
2004 - 2007	Bachelor Biomedical Sciences	Leiden University, The Netherlands
1998 - 2004	Secondary school	Da Vinci College, Leiden, The Netherlands

Work

2017 - present	**Ophthalmologist Alrijne Hospital, The Netherlands**
2015 - 2016	**Fellowship cataract surgery Rwanda, Cape Verde and Suriname** *Jan Pameijer*
2014 - 2015	**Rapid Assessment of Avoidable Blindness Survey, Suriname**
2013	**Organisation 'Access To Ophthalmologic Advances Congress', Suriname**
2011 - 2012	**Resident Ophthalmology, Suriname Eye Centre, Suriname**
2006 – 2009	**Docent-assistent physiology and microscopy, Leiden University**

General

2014	Standardized Ophthalmic Echography Course, AKH University Hospital in Vienna, Karl Ossoinig