A population-based study of visual impairment in the Lower Tugela health district in KZN, SA

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Abstract

A cross-sectional, population-based, epidemiological study of blindness and visual impairment was conducted to evaluate the prevalence of vision loss and various sight-threatening conditions in the Lower Tugela health district of the KwaZulu-Natal province, South Africa. This study was conducted on a randomly selected sample of 3444 individuals from the district. This number represented 84% of those who were visited and 80.1% of the total sample selected. The participants ranged in age from 5 to 93 years (mean of 29.2 years and a median of 20.0 years). The proportion of men to women differed between participants aged <30 years and those aged >30 years. In both age groups, women represented the majority of participants (66.5%), but the number of women to men in the older age group was approximately twice that found in the group aged less than 30 years. The difference in age between the men and women in the study was not statistically significant ($p > 0.5$). The study revealed that 6.4% of the population studied were visually impaired. The distribution of uncorrected visual acuity was better for women than for men for both OD and OS ($p = 0.000$ for OD and OS). The main causes of visual impairment were refractive error (44.5%), cataract (31.2%), glaucoma (6.0%), hypertensive retinopathy (4.1%) and diabetic retinopathy (4.1%). Unilateral blindness (OD) was present in 0.78% (95% Confidence interval (CI): 0.42%-1.14%) of participants and unilateral blindness (OS) was present in 1.1% (95% CI: 0.70%-1.50%). Thirty-one participants (0.9%) were bilaterally blind with the main causes being cataracts (54.8%) and refractive error (12.9%). Glaucoma and hypertensive retinopathy were responsible for 6.4% of ..bilateral blindness. Diabetic retinopathy, other retinal conditions (coloboma) and corneal scarring were each responsible for 3.2% of bilateral blindness. Albinism, coloboma and age-related macular degeneration accounted for 9.7% of bilateral blindness. The data provides much needed information to support the planning of eye care programs in KwaZulu-Natal. (*S Afr Optom* 2013 **72**(3) 110-118)

Key words: visual impairment, blindness, refractive error, cataract, diabetic retinopathy

Introduction

VISION 2020, The Right to Sight program, initiated by the World Health Organization (WHO) and the International Agency for the Prevention of Blindness (IAPB) has focussed attention on the elimination of avoidable blindness and impaired vision through a better understanding of the distribution of ocular conditions and diseases; and their relevance in planning of programs, especially at the local level[1]. The paucity of national and local epidemiological data indicates the need for population-based studies which allow for the development of an epidemiological profile of the various visual conditions, thereby informing not only the nature of curative service provision, but also the design of preventative and promotive strategies[2].

Numerous blindness surveys have been conducted in different countries to quantify blindness and visual impairment. These population-based studies have provided valuable information for planning and service delivery[3-7]. Oduntan *et al.*[8] conducted a population-based survey in 2001 to determine the causes and prevalence of low vision and blindness in the central region of the Limpopo Province of South Africa. As in many other African countries, the study confirmed cataract as being the most common cause of low vision (49.21%), monocular (26.09%) and binocular blindness (47.37%). Additionally cataract was the most common cause of blindness in those 60 years and older (47.06% of all causes of blindness)[8]. However, there has been no comprehensive population based survey on blindness and visual impairment conducted in KwaZulu-Natal apart from the rapid assessment of blindness studies conducted in the former Northern Transvaal, Gazankulu area[9] and the Northern KwaZulu-Natal regions[10]. Refractive errors, for example, were evaluated in the context of their contribution to blindness and visual impairment rather than the overall prevalence of myopia and hyperopia, as well as astigmatism - data critical for planning refractive error programs. The first survey conducted in the Northern Transvaal area in 1985, used a random cluster sampling technique, and encompassed a sample size of 18962 people. The study yielded a blindness prevalence of 0.57% (95% CI: 0.46%-0.68%)[9]. Senile cataract (55%), corneal scarring due to trachoma (10%), uncorrected aphakia (9%), and open-angle glaucoma (6%) were the main causes of blindness. This study was followed by the study conducted by Cook *et al.*[10] in Northern KwaZulu-Natal in 1990. They examined 6090 patients of all age groups. The prevalence of blindness was determined to be 1.0%. However, the South African National Guideline for the Prevention of Blindness in South Africa (2002) reported a 0.75% prevalence of blindness in the South African population[11]. The South African National Guidelines for the prevention of blindness identifies the priority groups for refractive error services as those entering high school (12 to 13 years of age) and those over 45 years because of the impact of presbyopia on the ability of adults to retain their jobs[11]. This is in keeping with the study by Naidoo *et al.*[12] which identifies the peak prevalence of myopia in the particular age group and the fact that most adults over the age of 45 experience presbyopia. While there is much global variation in refractive error, the prevalence in the South Africa context ranks at the lower end compared to other countries, making the success of refractive error services and interventions more feasible.

The prevalence of blindness, visual impairment and the various causes thereof is not as high in South Africa as in other African countries[8, 13, 14]. This may indicate access to better health care services and resources in South Africa. However these figures are often masked by the unequal provision and access of eye care services among various sectors of the South African population. Despite aspects of the eye care system being highly developed and comparable with that of Western countries, access to eye care is largely confined to a minority of the population[15]. The majority of South Africans are, thus, subjected to eye care services that are reflective of eye care service delivery in the remainder of the African continent. Quantifying the prevalence of disease in KZN is anticipated to enable an evidence-based approach to service delivery and planning and aid in the determination of the resources needed in KwaZulu-Natal and similar settings which have a significant rural base.

Methodology

A cross-sectional, population-based study of a health district in KwaZulu-Natal was designed to elicit qualitative and quantitative information from participants. Ethical clearance for the study was received from the University of New South Wales and the University of KwaZulu-Natal Ethics Committees. This article emphasises on the quantitative aspects of the study. Data was collected through a series of comprehensive eye examinations that were conducted in temporary sites set up in clinics, schools and community centres. Eye examinations included visual acuity, assessment of orbit and adnexa, refraction, slit-lamp biomicroscopic evaluation of anterior and posterior segments of the eye and a dilated fundus examination. Fundus examinations were conducted with a 90 D and 20 D lens using the slit lamp and binocular indirect ophthalmoscope respectively. The Goldmann Tonometer (R900) was used for examining the intraocular pressure of participants. However, those participants with physical limitations or poor-health (9%) and were unable to sit behind the slitlamp were examined with the Perkins Tonometer. The data from the Goldmann and Perkins Tonometers were combined for the analysis. Fundus examinations were conducted post dilation using a slit lamp and 90 D lens as well as a 20 D lens and binocular indirect ophthalmoscope. Blood pressure and visual fields were evaluated when indicated, for example, glaucoma suspects in the case of visual fields.

Classification of visual impairment and blindness

All participants were classified as being visually impaired or not (<6/18 in the better eye) based on their presenting vision. The cause of blindness and visual impairment was attributed using the WHO algorithm for allocating the cause of visual impairment when there was more than one cause[16]. Participants were classified as being blind if they presented with <3/60 in their better eye.

The research environment

The KwaZulu-Natal province of South Africa, has a population of 8417021 and are classified by the census as Blacks (82%), Indians (9.4%) Whites (6.6%) and Coloureds or mixed race (1.4%)[17]. Forty-three percent of the population in KwaZulu-Natal live in urban areas[17]. The province consists of eight health districts, including the study area, which is the health district of the Lower Tugela. This district includes the Lower Tugela and Maphumulo magisterial districts[17]. The Lower Tugela Health District (currently part of the Ilembe District) was chosen as the study site because it represents an under-served area, with rural and semi-rural components, as well as a small urban area, KwaDukuza (Stanger). This was deemed representative of many of the outlying health districts in the province. Districts closer to the city of Durban were ruled out as they have better access to healthcare facilities than the outlying districts.

Sample size and sample selection

The Lower Tugela area and the Maphumulo magisterial districts have a population of 109240 and 270330 respectively[17]. The sample size required was calculated to be 4259 using the Minassian (1998) equation for the calculation of sample sizes in a two stage cluster random sampling method[18]. The Minassian equation was used as it allows for a sample size to be determined based on a projected prevalence. The underlying assumptions in determining the sample size was that the prevalence of blindness will be approximately 0.5% and a design effect of 1.5 and a maximum tolerable sampling error of 0.25 was utilized. All age groups from 5 years onwards were considered for the sampling frame. Children ≤ 15 years of age comprised 40% of the sampled participants.

Cluster sampling was used to identify the study population. Clusters were defined in each of the administration areas as all local primary schools. There are six administrative areas in the sampling frame and within these areas households were selected using school children at the local primary school. A two-stage sampling strategy was employed. The first stage included the selection of all primary schools in the area. Thereafter, a sample of 15 schools per administrative area, were randomly selected for the study. This was done to ensure that there was an even distribution of schools per district and this number was influenced by the number of schools, the average number per class and the sample size required for the study.

The second stage involved obtaining a sample of Grade 1 children in the selected schools. An alphabetical list of children from the class register was numbered and 14 children were randomly selected using a table of random numbers. In order to locate the households to be examined, the randomly selected child was accompanied home by a member of the field team or the class teacher. Parents were informed and given details of the study. The nearest neighbour's home was selected for the study to avoid excluding households which may not have had school-going children. This choice of sampling strategy was chosen because of the lack of formal housing and infrastructure in rural and semi-rural areas, making sampling of households difficult. In the rural areas of South Africa, many households do not have a physical address and are reliant on the local shop for their mail. In circumstances such as these, using schools as the sampling unit becomes a viable option. The total number of households selected from the six administrative districts, fifteen schools and fourteen pupils was 1260 with an enumerated population of 3444. Eligible participants included all those living permanently in a household who were five (5) years and above in age.

Data Collection and Analysis

The pilot participants were clinically examined and a clinical form with coded options was provided to the clinicians to complete. Given the difficulties that clinicians experienced during the pilot phase, the clinic recording form was subsequently adjusted and was field tested and approved. The clinical data was entered into an Epi Info programme template. The Statistical Package for Social Sciences (SPSS version 12.0) was used for statistical analysis to determine the age and sex-specific prevalence rates for blindness, low vision and all eye diseases. The statistical tools used for analysis included prevalence rates with their confidence intervals (CI), chi-square and *t*-tests for univariate analyses and regressions for multivariate analyses. The Mann-Whitney U test was used to test for differences between gender and age groups. The confidence interval was set at 95%.

Results

Demographic and Socio-Economic Characteristics

A total of 3444 participant's consented to participate in the study and were surveyed and examined. This number represented 84% of those who were visited and 80.1% of the total sample selected. The participants ranged in age from 5 to 93 years (mean of 29.2 years and a median of 20.0 years). The proportion of men to women differed between participants aged <30 years and those aged >30 years. In both age groups, women represented the majority of participants, but the number of women to men in the older age group was approximately twice that found in the group aged less than 30 years. The difference in age between the men and women in the study was not statistically significant ($p > 0.5$). When comparing the responders and non-responders the non-responders were more in the 16-30 year age group (30.2% vs. 21.2%) and in the >30 year age group (40.1% vs. 38.8%). The mean age was 34.3 years in the non-responders while it was 29.2 years in the responders. The percentage of men increased in the non-responders (42.5%) as compared to the responders (32.5%).

The study population comprised 97% Blacks, while the remaining 3% were Whites, Indians and Coloureds. Thirty-one percent of the study population were from the Lower Tugela area and 69% from the Maphumulo area. The distribution of the sampled population reflects the population distribution of the study area which is 28.7% in Lower Tugela and 71.3% in the Maphumulo area, and the distribution of schools according to population density.

Causes of visual impairment and blindness

In line with the WHO criterion, 6.4% of participants were visually impaired. All participants who presented with visual impairment were refracted. They were subsequently re-classified as visually impaired due to non-refractive reasons only if their visual acuity was still reduced with the best refractive correction. Refractive error was the major cause of visual impairment (44.5%). The second prevalent cause was cataract (31.2%) followed by glaucoma (6.0%), hypertensive retinopathy (4.1%), and diabetic retinopathy (4.1%). Other conditions such as corneal scar, trauma, optic atrophy and amblyopia were present in 4.4% of the sample (Figure 1).

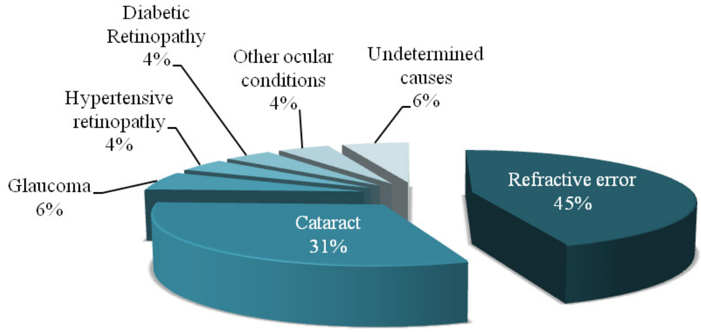

Figure 1: Causes of visual impairment based on presenting visual acuity

Unilateral blindness (OD) was present in 0.78% (95% CI: 0.42%-1.14%) of participants and unilateral blindness (OS) was present in 1.1% (95% CI: 0.70-1.50%) of participants. None of the participants presented with visual fields less than 10 degrees; therefore they were not classified on the basis of visual fields.

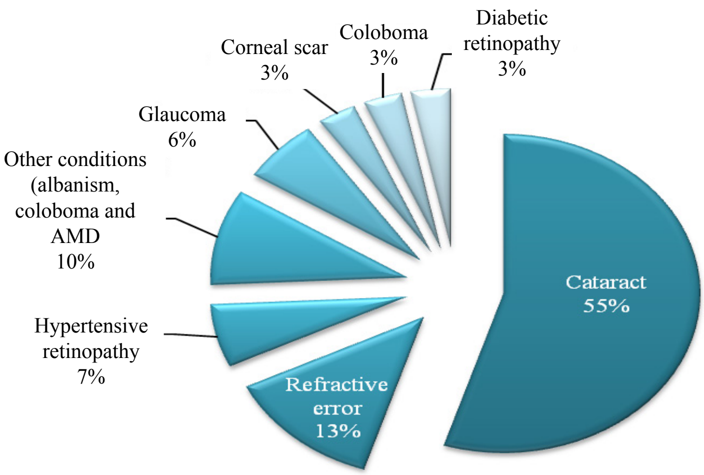

Figure 2: Causes of blindness

Visual acuity: Measurements were conducted in 3428 left eyes and 3427 right eyes, as it was not possible to conduct visual acuity measurements in 16 right eyes and 17 left eyes. Only 0.5% of the participants who presented for the clinical evaluation had a pair of spectacles. Eighty-seven percent of the sampled participants presented with uncorrected visual acuity of > 6/9 (LogMAR 0.2) in one or both eyes. Fifteen percent (516) of participants had presenting vision < 6/12 (LogMAR 0.3) in the better eye, with 31 participants (0.9 %) blind (<3/60, LogMAR 1.3) in both eyes. The proportion of participants who presented with visual impairment <6/18 in the right, left, either eye or binocularly was 9.5%, 10.3%, 13.4% and 6.4%, respectively. Unilateral blindness (OD) was present in 0.78% (95% CI: 0.42-1.14%) of participants and unilateral blindness (OS) was present in 1.1% (95% CI: 0.70-1.50%). Of the 0.9% of participants presenting with blindness (<3/60 or LogMAR 1.3), 87.1% remained blind with best correction and 12.9% were no longer blind when their vision was corrected with spectacles.

The Mann-Whitney U-Test indicated better uncorrected visual acuity for women than for men for both OD and OS (p=0.000 for OD and OS). The distribution of uncorrected visual acuity was better in the >30 years of age cohort than that of the < 30 year age category in both OD and OS.

Uncorrected visual acuity of ≥ 6/9(0.2) in one or both eyes was found in 94.3% of children. A small percentage of children (4.8%) had uncorrected vision ≤ 6/12 (0.3) in the better eye, with only one child presenting blind <3/60 (1.3) in both eyes.

Refractive error: The number of participants with visual impairment due to refractive error (unaided acuity) was 102 (3%) with 17 (0.5%) blind. Of those participants who presented with visual impairment due to refractive error, 24% were men and 76% were women. Women (p=0.0005) were more likely to have refractive error than men. Majority of participants (80%) that presented with visual impairment due to refractive error were over the age of 30, while 8% were between 16 and 30 years and 10% were 15 years and below.

The age and gender adjusted prevalence of presbyopia was 67.6% (95% CI: 64.0-69.2). Only 10% of the participants with presbyopia presented for evaluation with spectacles, indicating an unmet need of 90%. A higher prevalence of presbyopia was associated with women (odds ratio 1.98: 95% CI: 1.66 - 2.35). Of those needing a presbyopic correction 7.3% needed a 1 D add, 20.8% a 2 D and 31.4% a 2.5 D add.

Anterior segment: Most participants presented with open angles while 0.2% were found to have a closed angle and were allocated a grade zero. All participants with open angles ranged from grade 1 (2.1% OD and 1.9% OS), grade 2 (7.8% OD and 8.1% OS) and grade 3 (20.8% OD and 21.1% OS). The majority of participants presented with wide open angles and were classified as grade 4 (69.2% OD and 68.8% OS).

Participants uncooperative during either of the two procedures were examined using digital pressure

(0.9%). The intraocular pressure measurements ranged from a high of 72 mmHg to a low of 1 mmHg (Mean 15.26; 95% CI, 15.13-15.39). Only 0.6% of the participants ≤ 30 years had intraocular pressures greater than 22 mmHg and 3.5% had intraocular pressures of greater than 22 mmHg in the >30 yrs group.

Cataracts: The overall prevalence of pseudophakia, aphakia and total (mature) cataract in the over 30 years age sample was 0.3%, 0.1% and 1.4% OD and 0.3%, 0.2% and 1.4% OS respectively. Cataract surgery was performed in either eye of 16 participants (0.5%) and in both eyes of 5 (0.6%) participants. Eleven participants (0.3%) presented with intraocular lenses and 3 (0.1%) participants presented with aphakia in the right eye. Nine (0.3%) patients presented with intraocular lenses and 6 (0.2%) with aphakia in the left eye.

Retinal Causes: Examinations were possible and a clear view of the fundus was elicited in 98.2% (OD) and 90% (OS) of the participants who were examined. Of the participants who underwent successful fundus examinations 92.0% (OD) and 92.4% (OS) had normal fundi while 6.6% (OD) and 5.9% (OS) had retinal abnormalities.

Hypertensive retinopathy: The overall prevalence of hypertensive retinopathy in the population was 1.7%. The prevalence of hypertensive retinopathy was 0% (95% CI: -0.29%-0.29%) in the < 30yrs group and 4.3% (95% CI: 3.13%-5.43%) in the > 30 years group. Of these participants, 19% were men and 81% were women. In the > 30 years of age group this ranged from a low of 0% in the 33 years of age group to 16.7% in the 70 and 76 years of age group. The prevalence in men was 3.5% (95% CI: 2.99%-4.01%) and women were 4.5% (95% CI: 3.66%-5.34%). Of this group, 17.6% presented with normal vision (6/6 or better), 68% had mild, 15.9% moderate and 1.8% had severe visual impairment and 1.8% were classified as being blind.

Diabetic retinopathy: The prevalence of diabetic retinopathy in the study population was 1% (95% CI: 0.69%-1.31%). The prevalence of diabetic retinopathy among participants less than and equal to thirty years of age was 0% (95% CI: -0.09%-0.09%) and in the > 30 years of age group, it was 2.6% (95% CI: 2.01%-3.19%). The age specific prevalence ranged from 0% (95% CI: -0.10%-0.10%) in the 31-36 years age group to 12.5% (95% CI: 10.9%-14.1%) in 78 year olds. Of those participants with diabetic retinopathy, 2.9% had vision of 6/6 or better, 68.7% mild, 25.7% moderate and 0% severe visual impairment. Twenty nine percent of participants were classified as being blind and the prevalence in men was 1.3% and women 3.0%.

Discussion and Conclusion

About 20% of the South African population are considered as affluent (generally able to access private eye care services) and 80% is reflective of the less affluent or indigent population who access the public sector services[19]. This study is relevant to the indigent population rather than for the whole population of the district, since only 5% of the study population was from the affluent segment of society, given the semi-rural nature of the district. The data from this study could be useful for public sector planning as most districts in South Africa are rural or semi-rural[20]. The low response rate from Indian, Coloured and White participants was considered a limitation of the study.

Demographic information

The results revealed that there were 1356 participants that were 30 years of age or older (mean age 56.7 ± 16.0 years) and there were a greater number of women (66.5%) than men in the study area. This is a consequence of the migratory patterns in the rural areas of KwaZulu-Natal and the country in general[21]. Similar results were found in another study in South Africa[10]. This can be attributed to apartheid policies that prevented Black families from migrating to key urban areas. Instead hostel dwellings were created for men working in urban areas and this resulted in them leaving their families back at home. Furthermore, poor salaries compounded this reality even after the demise of apartheid because the cost of relocating families from rural areas and paying for rent in the cities is prohibitively expensive. As a result many men still leave their families in semi-rural/rural areas to seek jobs in the major cities.

Prevalence of blindness

When comparing the findings of this study with the other studies in South Africa, a very similar prevalence of blindness and the causes is found. This is probably a consequence of large rural populations in of all of the studies (Table 1).

Table 1: Comparison of the prevalence of blindness found in the study with previous studies.

Prevalence	Current Study	Other South African population-based studies	
Blindness	**0.9%**	Cook *et al*[10]: 1.0%	Bucher[9]: 0.57 %
Cause:	**Current Study**	**Other South African population-based studies**	
Cataract	**54.8%**	Cook *et al*[10]: 59.0 %	Bucher[9]: 55.1%
Refractive Error	**12.9%**	Cook *et al*[10]: 10.0 %	
Glaucoma	**6.4%**	Cook *et al*[10]: 22.9%	Bucher[9]: 6.0%

*Blindness was defined in previous studies similar to this study as (<3/60)

The prevalence of blindness (0.9%) in this study is similar to the results from Cook *et al.*[10], where the prevalence of blindness was 1%; however, the result differs from the study conducted in Northern Transvaal by Bucher[9]. The Northern Transvaal study elicited a prevalence of 0.57%.

The profile of the Northern KwaZulu-Natal study[10] more closely represents the profile of this study area, as both areas are rural districts in the north of KwaZulu-Natal. The Northern Transvaal study was conducted in what is now known as the Limpopo province. The study area is served by the Elim Hospital which has enjoyed a good eye care service for many years[10]. However, in much of the planning for the country, especially at community eye health workshops, the blindness prevalence figure of 0.7-0.75% is used[22]. Based on the Northern Transvaal study[9], this is a reasonable assumption to be made when involved in planning at a national level because of the better resources of the urban areas and thus lower prevalence of blindness. However, this does call into question the value of using aggregated figures that encompass highly urban areas in the planning process. Despite the backlog of surgeries in the urban areas, cataract blind patients are prioritised and thus have accessible services. However in the rural areas there are delays in cataract surgeries due to the lack of facilities, limited eye care education and non-existent eye care services at clinics. Many people therefore do not go for cataract surgeries as this involves long trips to the major city[10]. This may explain the higher prevalence of blindness particularly since cataract is such a major contributor to blindness.

Causes of Blindness

The data from the study supports some of the assumptions that have generally been made when planning for eye care in South Africa, with cataract being considered the main cause of blindness and accounting for approximately 50% of blindness[23]. This study suggests that cataract is the main cause of blindness with 17 (54.8%) of the participants presenting with <3/60 visual acuity bilaterally having cataracts.

Refractive error was the next major contributor having caused 12.9% of presenting blindness. It has often been estimated within the South African situation, based on international studies and experiences, that refractive errors cause 10% of blindness[21]. This study suggests that the figure is approximately 3% higher (12.9% vs. 10%). South Africa has over 2500 optometrists,[24] however only a few practise in remote urban or rural areas. Rural and semi-rural areas depend on government hospitals for this service which is usually non-existent or very limited. The study area at the time of the study was served by a weekly eye clinic that provided refractive services and the sale of spectacles. This is based at the regional hospital which is a distance from many of the rural patients. The lack of access, affordability and uptake of refractive services may be indicated by the fact that only 0.5% of the participants wore spectacles, with 7.7% in need of a distance prescription.

Glaucoma was responsible for 6.4% of bilateral blindness in the study area. Cook *et al.*[10] found that 22.9% of those blind in Northern KwaZulu-Natal had glaucoma while Bucher *et al.*[9] found a prevalence of 6%. Subsequently most planning meetings as well as the Community Eye Health workshops in South Africa have utilized a lower percentage for glaucoma (10%) as the cause of blindness. The difference in percentages in terms of glaucoma blindness could be related to the fact that Cook *et al.*[10] did not conduct visual fields and relied on optic nerve appearance as a means to classify glaucoma. They acknowledge this by stating that the high percentage could be "due to a methodological misclassification as blind of those eyes with cup/disc ratios of 0.8 or more but with a visual acuity of 3/60 or better"[10]. If these cases are reclassified then chronic glaucoma alone would account for 12.9% of blindness[10].

In earlier blindness surveys in South Africa[9-11], hypertensive retinopathy and diabetic retinopathy did not rank among the main causes of blindness. Corneal scarring accounted for 14.7% of blindness in the Northern KwaZulu-Natal study but in the current study corneal scarring only accounted for 3.2% of blindness.

Even though trachoma is a major cause of blindness in Africa[25] none of the participants from this study presented with trachoma. In a study conducted by Lewin *et al*.[26] on the health impact of water supply found that shorter distances to water led to a 30% reduction in trachoma. Since 1994 and the advent of a democratic government more than a million new households have received access to piped water[27]. This may be the main contributor to South Africa being declared a trachoma free country by the World Health Organisation[28].

The results from this study provide valuable information on the prevalence of eye diseases/ conditions in semi-rural and rural populations. This information serves as a useful indicator for future planning efforts in underserved areas in South Africa. Given the development of a National Health Insurance Scheme and the subsequent planning that it demands, it is hoped that the information presented in this article, will have increased significance.

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