Reviews/Analyses

Global data on blindness*

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Globally, it is estimated that there are 38 million persons who are blind. Moreover, a further 110 million people have low vision and are at great risk of becoming blind. The main causes of blindness and low vision are cataract, trachoma, glaucoma, onchocerciasis, and xerophthalmia; however, insufficient data on blindness from causes such as diabetic retinopathy and age-related macular degeneration preclude specific estimations of their global prevalence.

The age-specific prevalences of the major causes of blindness that are related to age indicate that the trend will be for an increase in such blindness over the decades to come, unless energetic efforts are made to tackle these problems. More data collected through standardized methodologies, using internationally accepted (ICD-10) definitions, are needed. Data on the incidence of blindness due to common causes would be useful for calculating future trends more precisely.

Introduction

The number of blind in the world is not accurately known, but it has been estimated at various times by WHO. Thus, in 1972, it was reported that there might be 10–15 million blind globally. In the same year, when a WHO Study Group on the Prevention of Blindness was convened, this value was recognized to be an underestimate, even though based on information provided by Member States (*1*). The Study Group recommended and made a great contribution to the future collection of data on blindness by proposing uniform definitions of blindness and visual impairment, which have been included in the *International Statistical Classification of Diseases, and Related Health Problems, tenth revision* (ICD-10).

When the WHO Programme for the Prevention of Blindness (PBL) was established in 1978, its priority was to obtain more detailed knowledge about blindness and its causes worldwide. A Task Force on Data on Blindness was therefore convened and this developed an epidemiological model for blindness estimates in relation to the developmental stage of the country (*2*).

The programme has, from its outset, developed a simplified population-based assessment methodology for visual loss and its causes (*3*); this has resulted in a standard form and method for low-cost, small-scale field surveys that can be conducted mainly by trained non-specialist staff. The application of this methodology in an increasing number of countries had led to a gradual accumulation of epidemiologically reliable data.

In addition to the WHO Global Data Bank on Blindness (BDB) for the collection and dissemination of epidemiological information and trends assessment, work was undertaken in 1993, in collaboration with the World Bank, to measure the burden of blindness. For this purpose, PBL provided estimates of the prevalence and incidence of the following blinding diseases: cataract, glaucoma, trachoma, and onchocerciasis. The global burden of disease approach combines the premature loss of life with the loss of healthy life years from a disability; the global burden of disease is measured in units of disability-adjusted life years (DALYs) (*4*).

This review reports on and discusses the available information on the prevalence, distribution, and causes of blindness in the world. Described also are the trends in the prevalence of blindness over the last two decades. Attention is drawn to some of the assumptions made and the methodological issues involved in the calculation of the data. Finally, areas are identified that require further investigation.

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Methods

Definitions

In this article, the definitions of blindness and visual impairment used follow those included in ICD-10.

- Blindness is defined as visual acuity of less than 3/60 (0.05) or corresponding visual field loss in the better eye with best possible correction (visual impairment categories 3, 4, and 5 in ICD-10). This corresponds to loss of walk-about vision.
- Low vision corresponds to visual acuity of less than 6/18 (0.3) but equal to or better than 3/60 (0.05) in the better eye with best possible correction (visual impairment categories 1 and 2 in ICD-10).

Data collection

The background information for this article was obtained from selected, epidemiologically sound data on blindness and visual impairment. Two main sources were used to identify relevant existing information as outlined below.

- Routine periodic computerized search of relevant information carried out as part of an ongoing updating of the BDB. This involves a three-step process. First, all abstracts are scanned to identify subject matter of interest. Next, all relevant materials are reviewed in depth and a checklist is used for eligibility criteria for inclusion. Finally, an in-house discussion is held to arrive at a consensus for inclusion of the new data in the bank.

For this purpose, the following inclusion criteria have been established:

— Clear, unequivocal definitions of blindness and low vision have to be stated (preferably according to the ICD-10 categorization).

— Cross-sectional design (prevalence survey) ensuring a clear description of the sample design and sampling plan; a random allocation of study sampling units; a large enough sample to achieve the desired degree of precision; and a fair assessment of non-sampling errors and a description of the quality control measures used.

- The data bank also receives unpublished information from national sources; a similar review process to that outlined above is applied to determine its suitability for inclusion.

To overcome the paucity of data on blindness from many parts of the world, a series of WHO consultations was organized. As a result, a consensus was developed on extrapolating available data to neighbouring areas or in countries that share a similar sociocultural, economic and epidemiological environment. Where multiple sources of data were applicable for such extrapolation, agreement was reached on the most appropriate information for application in the model for a specific region or country or for some groups at risk.

Assessment of the magnitude of the problem. Five specific models/algorithms were developed in order to estimate the magnitude of blindness and severe visual impairment and the major causes of blindness, i.e., cataract, glaucoma, trachoma and onchocerciasis.

In relation to "other causes", defined as those causes of blindness and severe visual impairment unrelated to any of those listed above, the paucity of data available, particularly for diabetic retinopathy and aging-related macular degeneration, precluded direct estimation of the prevalence of visual loss due to these causes.

Although each of these five models has a specific structure, they share a common framework. The models enable estimates to be made for defined regions, based on the assessment of specific prevalences by age, sex and, where indicated, race.

As a first step, the 229 countries/territories/economies registered worldwide were grouped, as proposed in the *World development report, 1993*, into eight economic regions (Table 1). Next, the demographic structure for 1990 was taken as the population base, by country and for the defined age groups (*5*). Regional totals were also calculated for these age groups and both sexes.

The selected parameters identified by the review process were applied to the five age groups (0–4, 5–14, 15–44, 45–59, ≥60 years). Where appropriate, the sex, racial distribution (e.g., for glaucoma), and place of residence (e.g., for trachoma and onchocerciasis) were taken into account, as were urban/rural

Table 1: **Distribution of countries according to economic region**[a]

Region	No. of countries or economies	Population ($\times 10^3$)
Established Market Economies (Western Europe, North America, Australia, Japan and New Zealand)	35	797 788
Former Socalist Economies of Europe	14	346 237
India	1	849 515
China	1	1 133 698
Other Asia and Islands	49	682 533
Sub-Saharan Africa	49	510 271
Latin America and the Caribbean	46	444 297
Middle-Eastern Crescent (with newly independent states in Central Asia)	34	503 075
Total	229	5 267 414

[a] See: *World development report, 1993* (*4*).

disparities. Projections of the number of blind people on a regional basis were made by applying the "most valid" age-/sex-/race-specific rates to the demographic structure for 1990.

For estimating the magnitude of low vision, as defined in ICD-10 (categories 1 and 2), 17 relevant population-based surveys were analysed. From the estimate of blindness, this permitted a rough assessment of the extent of low vision, using a corrective factor.

Because of the considerable work already carried out in onchocerciasis control and in new initiatives in ivermectin distribution, data were used from the WHO Onchocerciasis Control Programme and Expert Committee reports. These are discussed below.

Results

Global magnitude of blindness and low vision

According to the algorithm elaborated, there were in 1990 about 38 million blind people in the world (Table 2). The global prevalence of blindness was 0.7%, ranging from 0.3% in the Established Market Economies and Former Socialist Economies of Europe to 1.4% in Sub-Saharan Africa

Table 3 shows the relationship between blindness and low vision, based on surveys from 17 countries. Applying the multiplication factor 2.9 to the blindness estimate, the number of persons with low vision, according to the ICD-10 definition, was about 110 million. Thus, the global burden of visual impairment (people blind or with significant visual loss) is estimated to have been about 148 million in 1990.

Table 2: **Global distribution of blindness, by economic region**

Region	Reference population (x 10^3)	No. of blind (x 10^3)	Prevalence of blindness (%)
Established Market Economies	797 788	2 400	0.3
Former Socalist Economies of Europe	346 237	1 100	0.3
India	849 515	8 900	1.0
China	1 133 698	6 700	0.6
Other Asia and Islands	682 533	5 800	0.8
Sub-Saharan Africa	510 271	7 100	1.4
Latin America and the Caribbean	444 297	2 300	0.5
Middle-Eastern Crescent	503 075	3 600	0.7
Total	5 267 414	37 900	0.7

Table 3: **Estimate of the relationship between blindness and low vision** (ICD-10 definitions)[a]

Region	Blindness range (%)	Low vision range (%)	Multiplication factor
African (Sub-Saharan) (9 countries)	0.3–1.3	1.4–3.6	2.0–7.0
Middle-Eastern Crescent (6 countries)	0.4–1.5	1.3–7.8	2.5–5.2
Established Market Economy (1 country)	0.5	1.3	3.3
Other Asia and Islands (1 country)	0.8	1.9	2.3
Total (17 countries)			2.9[b]

[a] Based on data available in the WHO/PBL Blindness Data Bank from population-based surveys.
[b] Geometric mean value.

Regional distribution and regional burden of blindness

To address this issue and to provide an easy means of comparison, the ratio of the proportion of the number of blind in a particular region to the global number of blind and the proportion of the regional population to the world population was determined; this ratio is referred to as the regional burden of blindness (RBB) (Table 4). Thus, if a region possesses 0.1 (10%) of world blindness and 0.2 (20%) of the global population, the RBB ratio is 0.5. If the region is characterized by a fair proportionate "share" of blindness in relation to its population, the RBB will be unity. Every RBB ratio greater than unity identifies those regions where the burden of blindness is to be taken into urgent consideration in terms of setting up priorities on a global scale.

The following "regions" have RBB ratios greater than unity: Sub-Saharan Africa (1.93), India (1.46) and Other Asia and Islands (1.18).

Table 4: **Regional burden of blindness (RBB)**

Region	% of global population (A)	% of global blindness burden (B)	RBB (B/A)
Established Market Economies	15.1	6.3	0.41
Former Socalist Economies of Europe	6.6	2.9	0.44
India	16.1	23.5	1.46
China	21.4	17.6	0.82
Other Asia and Islands	13.0	15.3	1.18
Sub-Saharan Africa	9.7	18.8	1.93
Latin America and the Caribbean	8.4	6.1	0.72
Middle-Eastern Crescent	9.6	9.5	0.99

Distribution of blindness by age

Table 5 shows a breakdown of the global blind population, by age. A total of 58% (22 million) are aged ≥60 years, while at the other extreme blindness is estimated to affect 1 430 000 of 0–14-year-olds, i.e., only 3.8% of the global total. Among those aged 45–59 years, blindness affects 12 million persons, i.e., approximately one-third of world blindness.

Table 6 compares the prevalence of blindness among those aged ≥60 years in developed and developing countries. The Established Market Economies and Former Socialist Economies of Europe account for only 11.2% of the world's blindness, despite having 41.5% of the world's population of those aged ≥60 years (RBB = 0.27). Demographically developing countries, with 58.5% of the global population of those aged ≥60 years, have 88.8% of the blindness in this age group (RBB = 1.51).

Distribution of blindness by cause

Table 7 shows regional estimates of the major causes of blindness for which specific models have been applied.

- Cataract causes 41.8% of global blindness (15 829 000 persons), operable/curable cataract being the probable cause of the vast majority.

Table 5: **Global distribution of blindness, by age**

Age (years)	Reference population size ($x10^3$)	No. of blind ($x10^3$)	Prevalence
0–14	1 710 000	1 430 (3.8)[a]	8 per 10 000
15–44	2 445 000	2 470 (6.5)	1 per 1000
45–59	623 000	12 000 (31.7)	1.9%
≥60	488 000	22 000 (58.0)	4.4%
Total	5 267 000	37 900 (100)	0.7%

[a] Figures in parentheses are percentages.

- Trachoma (15.5%) in developing countries and the various types of glaucoma worldwide (13.5% of blindness) are two conditions that cause a major proportion of blindness.

- Onchocerciasis was reassessed by a WHO Expert Committee in 1993; the number of blind caused by this condition was estimated to be 360 000, including blindness due to restricted visual fields and taking into account the detection of new foci of the disease in Africa (*6*).

Fig. 1 depicts the relative importance of cataract, trachoma, glaucoma, and other disorders as causes of blindness, by economic region. Cataract is the most important cause of blindness in all develop-

Table 6: **Distribution of blindness among those aged ≥60 years, by economic region**

Region	Total population ($x10^3$)	Population aged ≥60 years ($x10^3$)	No. of blind aged ≥60 years ($x10^3$)	Prevalence (%)
Established Market Economies + Former Socialist Economies of Europe	1 144 027 (21.7)[a]	202 470 (41.5)	2 450 (11.2)	1.2
Demographically developing countries	4 123 385 (78.3)	285 602 (58.5)	19 550 (88.8)	6.8
Total	5 267 414	488 072	22 000	4.4

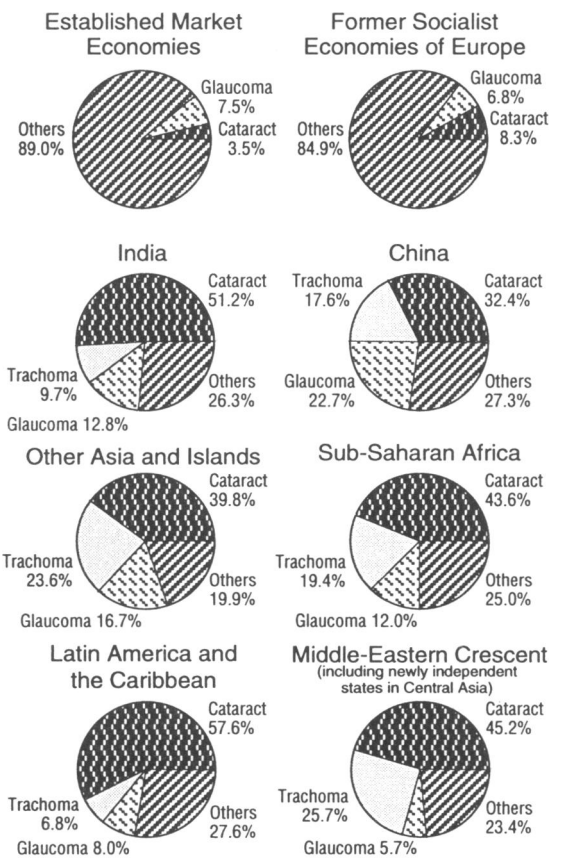
[a] Figures in parentheses are percentages.

Table 7: **Global distribution of blindness, by major cause and region**

Region	No. of blind ($x10^3$) from: Cataract	Trachoma	Glaucoma	Onchocerciasis	Others	Total
Established Market Economies	84	—	180	—	2 136	2 400
Former Socialist Economies of Europe	91	—	74	—	935	1 100
India	5 120	865	1 141	—	1 774	8 900
China	2 166	1 174	1 514	—	1 846	6 700
Other Asia and Islands	2 314	1 362	973	—	1 151	5 800
Sub-Saharan Africa	3 101	1 380	853	358.5	1 407.5	7 100
Latin America and the Caribbean	1 326	158	183	1.5	631.5	2 300
Middle-Eastern Crescent	1 627	927	205	—	841	3 600
Total	15 829 (41.8)[a]	5 866 (15.5)	5 123 (13.5)	360 (0.9)	10 722 (28.3)	37 900 (100)

[a] Figures in parentheses are percentages.

Fig. 1. **Major causes of blindness, by economic region.**



ing regions, whereas "others" (e.g., diabetes, macular degenerations, etc.) largely dominate in the Established Market Economies and in the Former Socialist Economies of Europe.

Discussion

The projections/estimates of global blindness are based on an increasing amount of epidemiological data from various parts of the world. There are, however, several shortcomings in the models developed for disease estimates due to paucity of population-based data on the prevalence of blindness, particularly for the Established Market Economies, Former Socialist Economies of Europe, and Latin America and the Caribbean.

The estimates presented here highlight the trends between the eight economic regions. Although attempts have been made to standardize the available information, it has not always been possible to do so between regions. This stemmed largely from variations in data collection procedures in the available studies; for this reason, the regional burden of blindness ratio (RBB) was introduced.

Application of the WHO simplified assessment methodology for blindness in more than 30 countries has led to a gradual accumulation of reliable data. This, in turn, was taken as the basis for a revision of the Blindness Data Bank with the 1984 global population. In 1984 the estimated number of blind was 31.2 million, based on a global population of 4760 million.[a]

The estimates for the total number of blind in 1978 (28 million), 1984 (31 million), and 1990 (38 million) are not directly comparable, since they were derived using three different methodological approaches. Globally, there has been an apparent increase of 10 million blind people from 1978 to 1990. The latest projection is based on an increased amount of data and can therefore be considered to be the most accurate.

The 1990 estimate indicates that blindness will experience an accelerated growth unless sufficient resources for its prevention are made available. This increase is occurring almost exclusively in Africa and Asia; 75% of world blindness currently occurs in those two continents, where the high population growth and the rapid increase in the number of elderly contribute to the upward trend. This tendency will be even more marked in those countries where eye care services are particularly scarce.

More attention needs to be given to the issue of low vision, in view of its importance as a cause of disability, and the potential for remedial measures. As shown in this article, available data indicate that for each blind person there are three people with low vision. This is of great socioeconomic and public health significance, and more data should be collected on low vision and its causes to permit proper national programme planning.

The three main causes of blindness in the world, i.e., cataract, trachoma, and glaucoma, together account for more than two-thirds (71%) of all blindness. The relative importance of each of these three diseases varies greatly by region because of differences in demographic structures, disease incidence, and availability/accessibility of eye care services.

- Cataract remains the single largest cause of blindness (15.83 million persons). The backlog of unoperated cataracts has increased from the number estimated in 1990 by a WHO Consultation (13.6 million persons) (*7*). This may have arisen because of the

[a] *Available data on blindness (update 1987).* Unpublished document WHO/PBL/87.14, 1987.

Table 8: **Population growth and aging in developed versus developing countries from 1980 to 2020**

Region	1980[a]		1990[b]		2020[c]	
	Total population ($x10^3$)	Population aged ≥60 years ($x10^3$)	Total population ($x10^3$)	Population aged ≥60 years ($x10^3$)	Total population ($x10^3$)	Population aged ≥60 years ($x10^3$)
Established Market Economies and Former Socialist Economies of Europe	1 136 668	173 325 (15.2)[d]	1 144 027	202 470 (17.7)	1 376 686	321 930 (23.4)
Others	3 312 899	207 880 (6.2)	4 123 385	285 602 (6.9)	6 445 507	739 710 (11.5)
Total	4 449 567	381 205 (8.6)	5 267 412	488 072 (9.3)	7 822 193	1 061 640 (13.6)

[a] *Global estimates and projections of population by sex and age: the 1984 assessment.* Unpublished United Nations document ST/ESA/SER.R/70, 1987.
[b] **World Bank.** *World development report 1993. Investing in health* (*4*).
[c] U.S. Department of Commerce, 1991.
[d] Figures in parentheses are percentages.

use of more and better data in the latest cataract burden projection, which pays more attention to the effects of aging in developing countries.

• Trachoma is still an important global cause of blindness, being responsible for approximately 15% of world blindness. There are indications from several countries that trachoma is gradually coming under control (*8*), but there are still large pockets in many of the least developed countries. The remaining high toll of trachomatous blindness should be viewed against the perspective of neglected, underserved rural populations in those countries where the link to poverty makes it difficult to achieve sustainable disease control.

• Glaucoma has been only summarily alluded to in previous blindness estimates; a detailed review of available data and disease projections in 1993 revealed that the problem is greater than previously thought (*9, 10*). Effective intervention to prevent blindness from glaucoma is quite difficult, particularly in developing countries, where its early detection and management pose great problems. The likely future scenario is therefore that glaucomatous blindness will continue to increase globally, reflecting the aging of populations and the lack of sufficient eye care resources for effective intervention against the disease.

Vitamin A deficiency (xerophthalmia) is still the leading cause of childhood blindness; in a recent analysis of data, it was estimated that 70% of the 500 000 children who become blind annually do so because of xerophthalmia (*11*). This corresponds to a prevalence of roughly 1 million blind children, in view of the high mortality among affected children.

The lack of relevant epidemiological data makes it impossible to present separate specific statistics for a number of other well-known causes of blindness such as diabetic retinopathy—generally recognized to be the leading cause of blindness among those of working age in developed economies, and rapidly emerging also in the urban areas of the developing world—and aging-related macular degeneration, whose prevalence will increase with the "greying" of the world population. Other causes of blindness include ocular trauma, estimated to be responsible for about 500 000 cases (*12*) and ocular leprosy (250 000 cases) (*13*).

The elderly population is commonly defined as "persons aged ≥60 years", and Table 8 summarizes the evolution (from 1980) and projected future trends for this population up to the year 2020. To date, population aging is a prominent issue in the Established Market Economies and the Former Socialist Economies of Europe. In these regions the projected increase in the population aged ≥60 years for the period 1980 to 2020 is 186%. Nevertheless, population aging is also occurring in developing countries. The pace of demographic changes has been — and is expected to continue to be — faster in developing countries. Thus, in these countries, the projected increase for the considered age group from 1980 to 2020 is 356% (Table 8).

In view of the very strong correlation between aging and the incidence of blindness, eye health services must cope with aging-related causes of blindness. By applying the age-specific prevalences of blindness for the elderly shown in Table 6 — 1.2% for the most developed countries versus 6.8% for the rest of the world — and assuming that there will be no additional resources to reduce the expected burden of unnecessary blindness among the elderly, we estimate that there will be about 54 million blind people aged ≥60 years by the year 2020, of whom more than 50 million will be in developing countries.[b]

[b] Specific information on blindness and its causes in various countries is provided in: *Available data on blindness (update 1994).* Unpublished document WHO/PBL/94.38. Single copies of this document are available on request from the WHO Programme for the Prevention of Blindness.

Résumé

Données sur la cécité dans le monde: une mise à jour

L'importance absolue de la cécité n'est pas connue avec précision à l'échelle mondiale. Dans le passé, le nombre d'aveugles avait été estimé à 28 millions (1978) puis à 31 millions (1984). Aujourd'hui, grâce à la disponibilité de procédures simplifiées d'évaluation de la prévalence et des causes de cécité recommandées par l'Organisation mondiale de la Santé, la communauté scientifique dispose de meilleures informations épidémiologiques.

Dans le cadre d'une collaboration avec la Banque mondiale pour tenter de chiffrer le poids imposé par certaines maladies cécitantes (cataracte, glaucome, onchocercose, trachome) et la cécité en général, sur les populations de huit regroupements de pays/territoires proposés par la Banque mondiale en fonction de paramètres économiques, une nouvelle estimation est proposée. En sélectionnant les indices épidémiologiques "régionaux" les plus pertinents et en ne retenant que la seule définition des déficiences visuelles proposée par la Dixième Révision de la Classification internationale des Maladies, il est estimé qu'il y avait, en 1990, environ 38 millions de personnes aveugles et 110 millions de personnes présentant une acuité visuelle résiduelle comprise entre 0,05 et 0,3 pour le meilleur des yeux avec la meilleure correction possible.

En résumé, 75% des cas de cécité sont concentrés en Afrique et en Asie; 58% des cas (soit 22 millions de personnes) affectent des personnes âgées de plus de 60 ans, alors que 3,8% des cas (soit 1 430 000 enfants) ont moins de 15 ans. La cataracte liée à l'âge et non opérée, représente de loin la principale cause de cécité, alors que le trachome (15,5%) et les différentes formes de glaucome (13,5%) restent des fléaux préoccupants. L'onchocercose ne représente aujourd'hui qu'environ 0,9% des cas (soit 360 000 personnes), compte tenu des résultats de la lutte efficace contre la maladie entreprise par l'OMS en Afrique occidentale depuis vingt ans.

En raison de la rareté des informations épidémiologiques dans de nombreuses régions, il s'est avéré peu judicieux de proposer des estimations acceptables pour la rétinopathie diabétique et la dégénérescence maculaire liée à l'âge. Des efforts de recueil de données par des enquêtes en population devront être développés dans ces deux directions pour permettre de futures estimations.

Les estimations de 1978 et 1984 avaient été réalisées à partir de modèles de conception différente et ne peuvent être comparées avec les chiffres présentés ici qui s'appuient sur des sources d'informations épidémiologiques plus variées et plus pertinentes. Il semble pourtant que le nombre des aveugles ait effectivement augmenté au cours de la dernière décennie. Cet état de fait est sans nul doute imputable à l'inadéquation existant entre les ressources et les infrastructures en matière de prévention et de soins d'une part et les besoins sans cesse croissants d'autre part en raison même du vieillissement de la population dans toutes les régions du monde.

Ainsi, si les mesures qui s'imposent ne sont pas arrêtées et pérennisées dès à présent, il est prévu que dans le groupe d'âge des personnes de plus de soixante ans, le nombre des aveugles passera de 22 à 54 millions d'ici l'an 2020; 50 millions d'entre eux vivront dans les pays en développement.

References

1. *The prevention of blindness. Report of a WHO Study Group.* Geneva, World Health Organization, 1973 (WHO Technical Report Series, No. 518).
2. Data on blindness throughout the world. *WHO Chronicle*, 1979, **33**: 275–283.
3. **Thylefors B.** A simplified methodology for the assessment of blindness and its main causes. *World health statistics quarterly*, 1987, **40**(2): 129–141.
4. **The World Bank.** *World development report, 1993. Investing in health.* New York, Oxford University Press, 1993.
5. **Bos E et al.** *World population projections 1992–1993. Estimates and projections with related demographic statistics.* Baltimore, MD, Johns Hopkins University Press, 1992.
6. *Onchocerciasis control. Report of a WHO Expert Committee.* Geneva, World Health Organization, 1994 (WHO Technical Report Series, in press).
7. Use of intraocular lenses in cataract surgery in developing countries. Memorandum from a WHO meeting. *Bulletin of the World Health Organization*, 1991; **69**: 657–666.
8. **Thylefors B, Négrel A-D, Pararajasegaram R.** La surveillance épidémiologique du trachome: bilan et perspective. *Revue internationale du trachome*, 1992: 107–114.
9. **Négrel A-D.** *Cécité et glaucome.* In: *Pression oculaire et glaucome débutant: question d'actualité — attitudes pratiques. Symposium de Paris, October 1992.* Paris, Comité de Lutte contre le Glaucome, 1992: 17–27.
10. **Thylefors B, Négrel A-D.** The global impact of glaucoma. *Bulletin of the World Health Organization*, 1994, **72**: 323–326.
11. *The prevention of childhood blindness.* Geneva, World Health Organization, 1992.
12. **Anderson JDC, Foster A.** Ocular trauma. *Tropical doctor*, 1989, **19**: 35–40.
13. **Courtright P, Johnson G.** *Prevention of blindness in leprosy.* London, International Centre for Eye Health, 1988.