

Global burden of onchocerciasis in the year 2000: Summary of methods and data sources

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1. Introduction

Onchocerciasis is caused by infection with the nematode *Onchocerca volvulus* for which man is the only known reservoir. The parasite is transmitted by blackflies which ingest microfilariae during a bloodmeal on a human being. The adult worms are usually found in subcutaneous nodules and have an average longevity of around 9-11 years. The adult female worm produces millions of microfilariae which migrate to the skin of the host. The microfilariae are the main cause of the clinical manifestations of the disease, including: dermatitis, resulting in very severe itching; papular and lichenified skin lesions; depigmentation and atrophy of the skin; and lymphadenitis. The most severe complications of onchocerciasis are irreversible ocular lesions of both the anterior and posterior segment of the eye, resulting first in impaired vision and finally in total blindness.

It is estimated that onchocerciasis is the second leading infectious cause of blindness in the world only preceded by blinding trachoma.^{1,2} It is endemic in 36 countries in Africa, the Arabian peninsula and the Americas, but its distribution is highly concentrated on the poorest regions of the world -- 30 out of 36 endemic countries are in sub-Saharan African countries where approximately 99% of all those infected live (PBD)³ and the disease has had a major impact on the economic and social fabric of endemic communities.⁴

Estimates of the global burden of disease due to onchocerciasis were provided by the World Health Organization Expert Committee on Onchocerciasis in 1987 and 1993.⁵ However, during the 1990s, there was a substantial progress in onchocerciasis control due to a large scale chemotherapy with ivermectin coupled with vector control. Nearly all endemic countries are covered and monitored by the three major control programmes: the onchocerciasis Control Programme (OCP), the African Programme for the Onchocerciasis Control (APOC), and the Onchocerciasis Control Programme of the Americas (OCPA).³ With the success of OCP in West Africa, the largest numbers of infected persons are found in some APOC countries such as Nigeria, Cameroon, Ethiopia, and Uganda.⁴ For this reason, we re-estimated the prevalence of blinding trachoma for the year 2000 based on the existing data sources by taking into account the effects of control programmes.

2. Case and sequelae definitions

The traditional method to diagnose onchocerciasis infection and to determine its intensity is through microscopic examination of skin snips for the presence and number of *O. volvulus* microfilariae. The method is highly specific but lacks some sensitivity in very light infections. Highly sensitive tests based on PCR and recombinant antigen-based EIA have been developed which can be useful both for individual diagnosis and for surveillance.⁶ Other approach includes the rapid assessment of endemicity of a community is usually done through palpation for nodules in a sample of 30-50 adult males per community. Although it is much more rapid and acceptable than skin snipping, it still requires a visit and a rapid survey in all potentially endemic communities. In order to overcome this problem, a method for Rapid Epidemiological Mapping of Onchocerciasis (REMO) has been developed and used successfully in APOC countries.⁷ With this method, surveys are required only in a special sample of 2 to 4 per cent of all communities and the results can then be extrapolated to estimate the approximate endemicity level of the remaining communities.

In this exercise on burden of disease analysis, we focus on three major disabling sequelae of onchocerciasis: low vision, blindness and troublesome itching as shown in Table 1 below. Therefore prevalence data on blindness and skin disease are required rather than prevalence infected cases. For onchocercal ocular disease, OCP has developed a standardised classification scheme for

onchocercal eye lesions and this scheme has been used in all ophthalmologic surveys in the OCP.⁸⁻¹⁰ Other investigators do not always use the same classification, often because their examinations are more detailed than the routine ophthalmologic assessments in the OCP. Observer variation can be a serious problem in the classification of the presence and severity of onchocercal ocular lesions, and an ophthalmologist with considerable experience in ophthalmologic surveys of onchocerciasis is required to obtain reliable results.

As recent studies in endemic countries suggests that onchocercal skin symptom is just as damaging as ocular disease, being responsible for poor school performance as well as a high dropout rate.¹¹⁻¹³ Since troublesome itching is a self-reported symptom, there is no gold standard to measure its prevalence. Thus, we employed the proportion of those having troublesome itching among total infected from several multi-country studies to estimate the prevalence of troublesome itching.^{13,14}

Table 1. Case and sequelae definitions for onchocerciasis

Cause category	GBD 2000 Code	ICD 9 code	ICD 10 code
Onchocerciasis	W027	125.3	B73

Sequelae	Definition
1. Blindness	Corrected visual acuity in the better eye of less than 3/60 due to infection with <i>Onchocerca volvulus</i> .
2. Troublesome itching	Itchy dermatitis of varying severity as a result of infection with <i>Onchocerca volvulus</i>
3. Low vision	Corrected visual acuity in the better eye of less than 6/18 but better than or equal to 3/60 due to infection with <i>Onchocerca volvulus</i> .

3. Methods of epidemiological estimation

3.1 Crude prevalence of blindness

The main sources for data on the distribution of onchocercal ocular disease and blindness are either specific epidemiological surveys on blindness or the various publications and reports of the OCP on the pre-control and follow-up surveys to evaluate the impact of vector control and large-scale ivermectin treatment combined.¹⁵ Estimates of the global burden of disease due to onchocerciasis have been provided by the World Health Organization Expert Committee on Onchocerciasis in 1987 and 1993.⁵ The Committee reports provide country and global estimates of the number of persons infected and the number blind due to onchocerciasis, but no information on the burden of onchocercal skin disease. The estimates were based on published and reported data of highly varying quality, ranging from extensive, reliable data from the OCP area and national prevalence surveys in Liberia and Nigeria to crude estimates based on very little information for some of the endemic countries. GDB 1990 estimate was based on this information.¹⁵

During the 1990s, there was a substantial progress in onchocerciasis control primarily due to a large scale chemotherapy with ivermectin. Nearly all endemic countries have been covered and monitored by one of the three major control programmes.³ However, the major drawback of this approach is its sustainability of high coverage – Parasites could live up to 10 years, and while repeated treatments of ivermectin seem to have some permanent effect on the fertility of adult worms but it is not a macrofilaricidal drug, this effect manifests itself only slowly after years of treatment (Plaiser AP et al, 1995). Thus, relatively high coverage with a longer duration of administration is necessary to eliminate the transmission in a community. Several simulation exercises suggest that the treatment must be repeated once or preferably twice a year at least for 12 years with a coverage of at least 65% to suppress transmission.^{16,17} Even with relatively low coverage around 50%, if the biting rate is small, the probability of controlling the disease is extremely high.³

The coverage and duration of ivermectin in the original OCP countries (Benin, Burkina Faso, Cote d'Ivoire, Ghana, Mali, Niger, and Togo) generally meets the criteria for the perfect control. For example, a study in the mid-1990s showed that coverage rates in Benin, Cote d'Ivoire, Ghana, and Togo were 72, 72, 62 and 64%, respectively.¹⁸ However, in view of imperfect geographical and therapeutic coverage in areas other than OPC, low level of transmission may continue even in these countries.^{3,19} To be conservative, we assume that the incidence of onchocerciasis has reduced by 90-95% in the original OCP countries by year 2000. On the other hand, this condition has not been met in endemic areas other than the original OCP countries. A recent study also shows that outside OCP areas elimination would never be achieved by ivermectin alone within 10 years unless biting rates of blackflies are low enough.²⁰ Therefore, for countries covered by the extended OCP, APOC and OCPA with a medium to high levels of coverage, we assume that the maximum effectiveness of the programme is approximated by the average recent level of coverage. For countries in which the control programme was suspended, very recently implemented, or with a very low coverage, we assume that the incidence did not change substantially from the 1993 estimate. Incidence was estimated from the 1993 estimate of prevalence with the help of DisMod II.

3.2 Blindness-to-low vision ratio

To estimate the burden of low vision in addition to blindness, we followed the method used in GBD 1990 exercise,¹⁵ which used information on the relationship between the prevalence of low vision and the prevalence of blindness in the OCP area. Table 3 gives the prevalence of blindness and low vision by age for the 338 OCP villages. On average, the prevalence of low vision is 1.78 times the prevalence of blindness as measured by visual acuity alone, and there is no statistically significant trend with age in the ratio between the prevalence of low vision and of blindness. To obtain estimates (Table 4) of the prevalence of low vision for each age group and sex, the corresponding prevalence of blindness as defined by visual acuity alone was multiplied by age-specific low vision-to-blindness ratios.

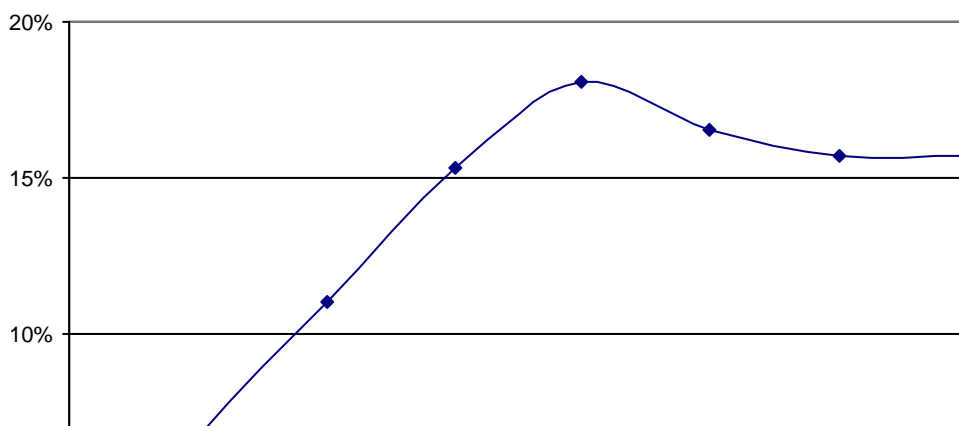
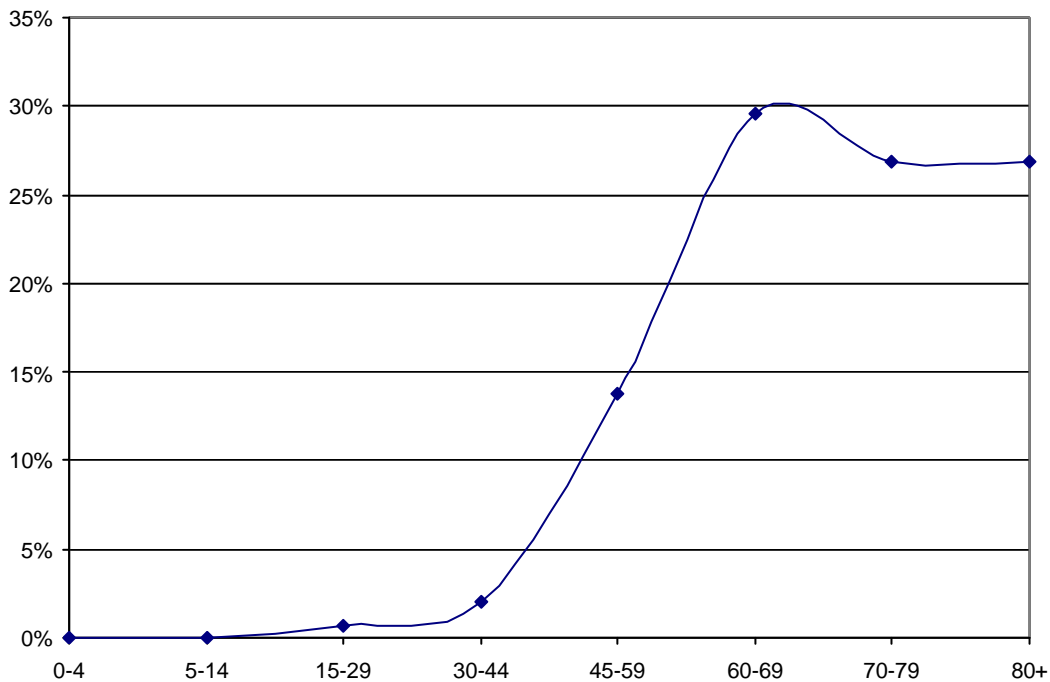
3.3 Troublesome itching

The estimation of the number of cases suffering from troublesome itching due to onchocerciasis has been based on the results of the multi-country study as in the GBD 1990 exercise.¹⁵ There exists a semi-linear relationship between the prevalence of nodules and the prevalence of onchocerciasis infection as measured by the standard skin snip method, and on average the prevalence of nodules is about half the prevalence of infection with a slope coefficient of 0.66.^{13,14} Thus, the prevalence of itching may be estimated as equal to $0.66 \times 0.5 = 0.33$ times the prevalence of microfilariasis, and this factor has been used to estimate the number of persons suffering from onchocercal itching.

3.4 Age- and sex- specific prevalence

To estimate age- and sex- specific prevalence from overall crude rate as an input to DisMod,²¹ information on the distribution of prevalent cases by age and sex in a population is required. Onchocerciasis is more common among males than among females and is estimated to lead to more disabling sequelae among.^{22,23} We employed the sex differential based on GBD 1990 exercise which was estimated from the analysis of 338 endemic villages (VOL4 and ¹⁴.

Onchocercal blindness appears many years after the infection and thus age-distribution of cases are skewed among older age groups. We generally followed the age-distribution estimated in GBD 1990.¹⁵ In GBD 2000 exercise, however, age groups were further divided into 8 (0-4, 5-14, 15-29, 30-44, 45-59, 60-69, 70-79, and 80+) rather than 5 (0-4, 5-14, 15-44, 45-59, and 60+) so that more accurate estimation among middle and older age groups are possible. Therefore we adjusted the distribution of prevalence for age groups over 60 based on the available data. Using DisMod, we further estimated conversion factor of crude prevalence rate for each age which is consistent with age distribution of actual prevalence numbers in each age group (Figure 1). On the other hand, troublesome itching appears in a short period time after infection with an approximately 50% of chance. Age-distribution of troublesome itching in a multi-center study peaked at middle age groups and is more stable across age groups than that of blindness (Figure 2).^{13,14}

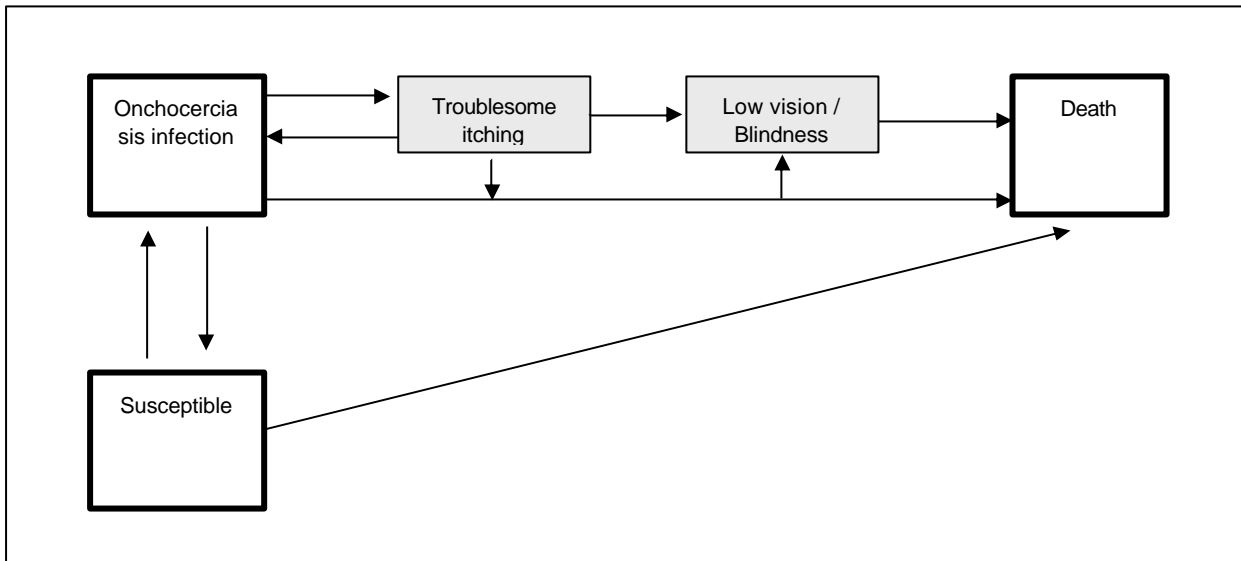


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Figure 2. Age-distribution of prevalence of troublesome itching

4. Disease model for onchocerciasis

The model for onchocerciasis is a simple five-box model as shown in Figure 3. Years lived with disability (YLDs) were calculated for the boxes shaded in grey. The estimated regional prevalence rates were input to DISMOD II together with the estimated remission rate and relative risk of mortality. Assumptions and data sources on remission and mortality relative risk are described in the following sections.



Years lived with disability (YLDs) were calculated for the boxes shaded in grey.

Figure 3. Onchocerciasis disease model

4.1 Excess mortality from blindness and low vision

Studies have shown that the visually impaired are at increased risk of deaths.²⁴ Risk of excess mortality is higher among the blind but still presents among the people with low vision. The relative risk (RR) of mortality among blind due to onchocerciasis varied from 1.5 to 4.1 in developing regions.²⁴⁻²⁷ The study with the largest sample size and based on WHO definition of blindness by Kirkwood and colleagues would yield the most accurate estimate for mortality RR: 2.5 for blind males and 3.8 for blind females, and 1.4 for low visioned males and 1.5 for low visioned females. On the other hand, more recent studies have suggested that there was no statistically significant differences in mortality RR between males and females after controlling for other covariates.^{24,25} Considering the lack of controlling of cofounders in earlier studies, we decided to employ the value of 2.5 for blindness and 1.5 for low vision for both sexes in the present analysis.

4.2 Remission rate

Permanent trachomatous visual impairment may be avoided if control programmes including ivermectin are implemented early in the disease course.²⁸ Otherwise a disabling sequela of blinding trachoma does not remit once it is established. Therefore, remission rates were assumed to be zero for both blindness and low vision in modelling with DisMod II. On the other hand, troublesome skin disease can be treated with ivermectin.²⁹ Therefore, the remission rate was assumed to be a function of ivermectin coverage in a region.

4.3 DISMOD estimation of incidence and duration for blinding onchocerciasis

Table 2 summarises trachoma disease model and assumptions. Table 3 compares the GBD 2000 assumptions with those used in 1990.

Table 2. Disease model assumptions for onchocercal ocular disease

Definitions	As defined in Table 1.
Incidence/Prevalence	Prevalence was derived from the 1993 estimate and population-based blindness surveys carried out thereafter, which were adjusted for ivermectin coverage. Internally consistent estimate of incidence was estimated by DisMod.
Remission	No remission assumed
Relative risk (RR) of mortality	Excess mortality from disabling sequelae was assumed as follows: RR=2.5 for blindness and =1.5 for low vision
Disability distribution	Blindness: 0.60 for both treated and untreated, Low vision: 0.282 for treated and 0.224 for untreated
Other assumptions	Male-to-female ratio of prevalence of blindness = 1.6:1 Blindness-to-low vision ratio = 1:1.78
Data	Prevalence studies from population-based blindness surveys and WHO's 1993 estimate.

Table 3. Comparison between GBD 1990 and GBD 2000 disease models

	GBD 1990	GBD 2000
Stages/Sequelae	Both ocular disease (blindness and low vision) and skin lesion as defined above.	Both ocular disease (blindness and low vision) and skin lesion as defined above.
Prevalence estimate	1989 estimate	1993 estimate and population-based surveys adjusted for onchocerciasis control programmes
Male-to-female prevalence ratio	1 : 1.5	1 : 1.3
Blindness-to low vision ratio	1 : 1.5	1 : 1.8
Incidence rates	DISMOD 1 used to estimate from prevalence rates	DISMOD 2 used to estimate from prevalence rates
Remission	0 for low vision and blindness	0 for low vision and blindness
Relative risk of mortality	Blindness: 2.5 (males) and 3.8 (females) Low vision: 1.4 (males) and 1.5 (females)	Blindness: 2.5 Low vision: 1.5

5. Disability weights and health state descriptions

The GBD 1990 study estimated disability weights for treated and untreated blindness and low vision as shown in Table 4. While disability weights for low vision were kept constant regardless of the

proportion of treated, different values were assigned for treated and untreated blindness. However, this assumption is not plausible since once established there is no way to reverse onchocercal blindness. The Netherlands disability weights study estimated disability weights for two levels of vision loss.³⁰ The Australian Burden of Disease Study employed the same definition as in the Netherlands disability weights.³¹ Since the definition of sequelae in the present study is slightly different from that in the studies in the Netherlands and Australia, slightly modified disability weights for low vision were used for low vision depending on the proportion of treated while disability weights for blindness was kept constant at 0.6 regardless of treatment.

For troublesome itching, the finding from the multi-country study was used to reflect the variation in severity of the itching in terms of disability, of those who complained of itching and who had been interviewed, some 60 per cent complained of sleeplessness, weakness and fatigue.¹⁴ Half of those complained of these conditions in the first open-ended question and the other half after further probing. This yields an overall disability weight of 0.068 for troublesome itching.³²

Further revision of disability weights will be made when data analysis of the modules on health status valuation in the on-going World Health Survey is completed.

Table 4. Disability weights for disabling sequelae from onchocerciasis

Stage/sequela	GBD 1990	Netherlands DW Study	Australian BOD Study	GBD 2000
Low vision	0.245 (treated) 0.245 (untreated)	0.17 for moderate vision loss	0.17 for moderate vision loss	0.224 (treated) 0.282 (untreated)
Blindness	0.488 (treated) 0.600 (untreated)	0.43 for severe vision loss	0.43 for severe vision loss	0.600 (treated) 0.600 (untreated)
Itching	0.068 (treated) 0.068 (untreated)	NA	NA	0.068 (treated) 0.068 (untreated)

6. Results

6.1 Regional prevalence

Table 5 summarises the estimation process of crude blindness prevalence due to onchocerciasis. We classified countries into three broad categories: 1) A country in which the introduction of ivermectin follows a period of 12 years of intensive control and transmission have been reduced to a very low level. This is a pattern characteristic of many areas covered by the original OCP (Benin, Ghana, Niger, Cote d'Ivoire, Burkina Faso, Togo, and Mali); 2) A country in which control programme has been limited up to 5 years of annual ivermectin distribution. This would be characteristic of many areas covered by APOC; 3) A mixture of 1) and 2). We assume the third category is applicable to OCPA countries. We then employed effectiveness of 90-95% reduction in incidence in the first category as suggested by the simulation exercises.^{16,20} For the countries in the second category, we applied the recent coverage of ivermectin distribution.^{18,33-37} Since no blindness case was reported in Yemen in the 1993 estimate,⁵ we assigned zero prevalence of blindness in EMRO region.

Table 5. Crude prevalence rate of onchocercal blindness

1) AFRO region

Control programme	Country	Latest available prevalence per 1,000	Data source	Effectiveness of control programmes	Data source
OCP	Benin	0.61* 5 38	1993 estimate and one population-based survey	0.95	5 18
OCP	Ghana	0.49* 5 39	1993 estimate and one population-based survey	0.95	5 18
OCP	Niger	0.39* 5	1993 estimate	0.95	5 18
OCP	Cote d'Ivoire	0.36* 5	1993 estimate	0.95	5 18
OCP	Burkina Faso	0.33* 5	1993 estimate	0.95	5 18
OCP	Togo	0.27 (1995)	5 18 One population-based survey	0.90	5 18
OCP	Mali	0.29* 5	1993 estimate	0.95	18
Expanded-OCP	Senegal	0.36* 5	1993 estimate	0.8	5
Expanded-OCP	Guinea	1.55* 5	1993 estimate	0.8	5
Expanded-OCP	Sierra Leone	1.98* 5 40	1993 estimate and one population-based survey	0.8	5 40
Expanded-OCP	Guinea-Bissau	0.10* 5	1993 estimate	0.8	5
High/APOC	Nigeria	8.17 (1995)	5 41 42 43 44 Four population-based surveys	0.6	35 33
High/APOC	Central Africa	6.33* 45 5	1993 estimate and one population-based survey	0.75	5 33
High/APOC	Chad	3.51* 5	1993 estimate	0.6	5 33
High/APOC	Cameroon	2.20* 5	1993 estimate	0.6	5 33
High/APOC	Sudan	0.39* 5 46	1993 estimate and one population-based survey	0.6	5 33
APOC	Ethiopia	1.00** 33	No estimate is available and the highest observed regional prevalence was used.	0.6	33
APOC	Malawi	1.00** 33	available and the highest observed regional prevalence was used.	0.6	33
APOC	Tanzania	0.22 47	One population-based survey	0.6	33
APOC	Congo	0.26* 48 5	1993 estimate and one	0.6	48 5 33

APOC	Equatorial Guinea	0.01 (1999) 49	population-based survey	One population-based survey	0.6	33
APOC	Gabon	1.00**		No estimate is available and the highest observed regional prevalence was used.	0.6	33
APOC	Angola	0.20* 5		1993 estimate	0.6	5 33
APOC	Liberia	1.00* 5			0.6	5 33
APOC	Burundi	1.00**		No estimate is available and the highest observed regional prevalence was used.	0.6	33
APOC	Uganda	1.00**		No estimate is available and the highest observed regional prevalence was used.	0.75	33 34 36

2) Crude prevalence rate for AMRO region

Control programme	Country	Latest available prevalence per 1,000	Data source	Effectiveness of control programmes	Data source
OCPA	Mexico	0.001 5	1993 estimate	0.85	37 50
OCPA	Brazil	NA	5	No estimate for blindness is available. Due to very few cases of onchocercal infections, zero prevalence was assigned.	0.58 37
OCPA	Colombia	NA	5	No estimate for blindness is available. Due to very few cases of onchocercal infections, zero prevalence was assigned.	0.98 37
OCPA	Venezuela	0.003 5	1993 estimate	0.42	37
OCPA	Ecuador	0.003 5 51	1993 estimate and one population-based survey	0.5	37 52
OCPA	Guatemala	0.065 5	1993 estimate	0.72	37

For countries where the 1993 estimate or recent prevalence studies are available, both nationally reported data and coverage of control programmes were used to estimate prevalence of both skin and ocular diseases due to onchocerciasis. For those regions with no available studies, prevalence rates were assumed to be similar to other countries within a WHO subregion. An estimate derived from a different region is more likely to be correct than the assumption that the condition does not exist in the region with no data of its own. Crude prevalence in each country was distributed by age and sex to get an age- and sex- specific prevalence. Regional age- and sex- specific prevalence was

derived from population-weighted average of estimated prevalence in each country within the region (see Appendix).

6.2 Internally consistent estimates of incidence and prevalence of trachomatous blindness and low vision by region

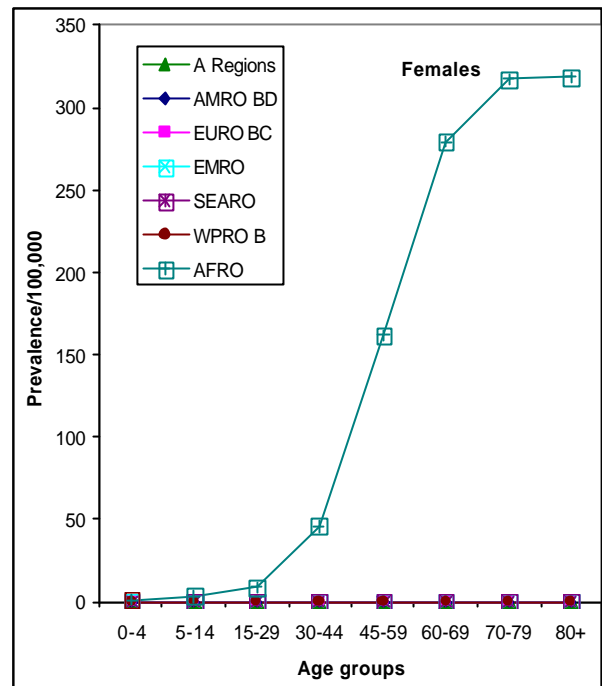
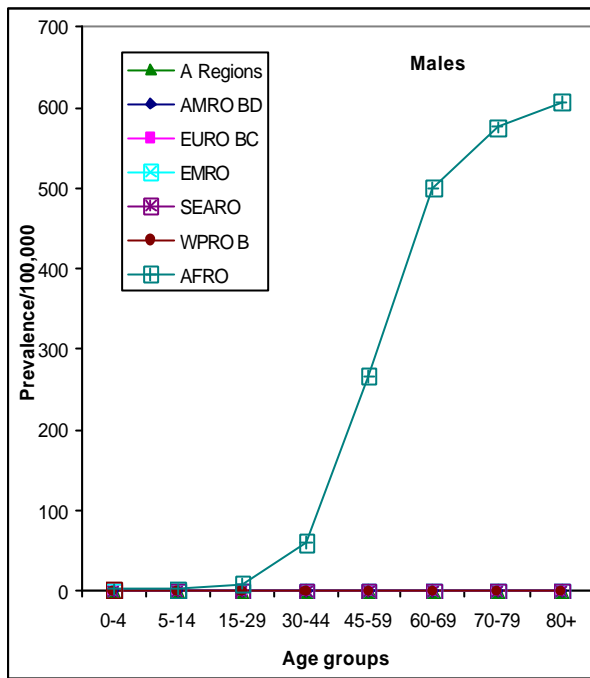
As described above, three parameters (i.e., prevalence, remission, and mortality relative risk) were used as inputs to obtain internally consistent estimates of incidence, prevalence, remission, mortality and duration. Table 6 and Figure 4 below summarise the internally consistent estimates of age-standardised incidence and prevalence by region and age-distribution of prevalence of blindness and low vision from onchocerciasis.

Table 6. Onchocerciasis: age-standardized incidence rates of blindness and low vision for WHO epidemiological subregions, 2000

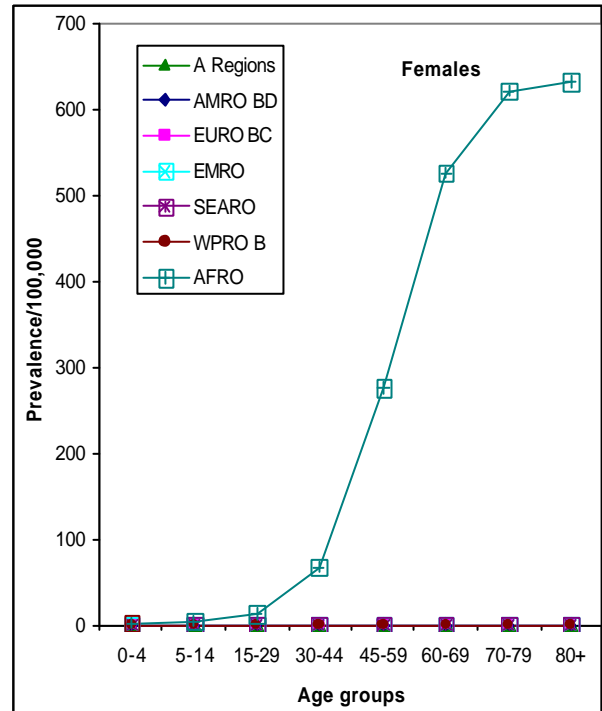
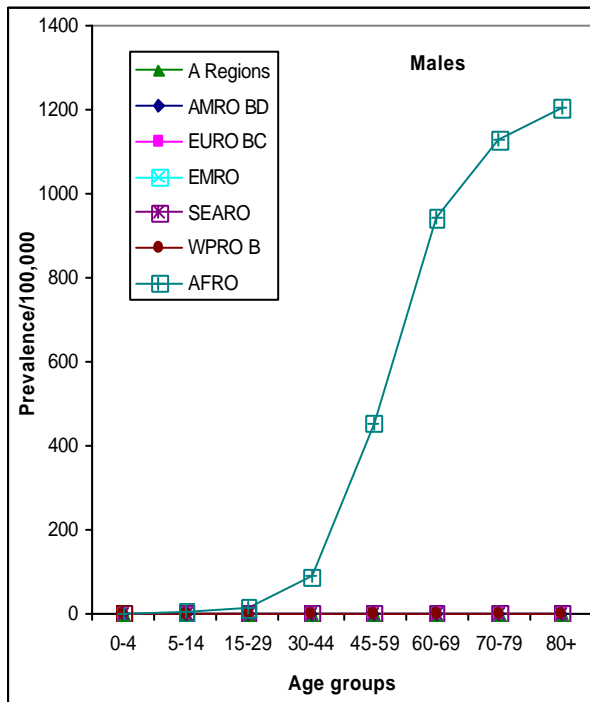
Subregion	Blindness		Low vision		Itching	
	Males	Females	Males	Females	Males	Females
	Age-std. incidence per 100,000*					
AFRO D	24.7	13.7	28.4	16.1	12.5	9.2
AFRO E	3.4	1.8	3.7	2.0	5.0	5.6
AMRO A	0.0	0.0	0.0	0.0	0.0	0.0
AMRO B	0.0	0.0	0.0	0.0	0.2	0.1
AMRO D	0.1	0.0	0.1	0.1	1.0	0.6
EMRO B	0.0	0.0	0.0	0.0	0.0	0.0
EMRO D	0.0	0.0	0.0	0.0	0.2	0.2
EURO A	0.0	0.0	0.0	0.0	0.0	0.0
EURO B1	0.0	0.0	0.0	0.0	0.0	0.0
EURO B2	0.0	0.0	0.0	0.0	0.0	0.0
EURO C	0.0	0.0	0.0	0.0	0.0	0.0
SEARO B	0.0	0.0	0.0	0.0	0.0	0.0
SEARO D	0.0	0.0	0.0	0.0	0.0	0.0
WPRO A	0.0	0.0	0.0	0.0	0.0	0.0
WPRO B1	0.0	0.0	0.0	0.0	0.0	0.0
WPRO B2	0.0	0.0	0.0	0.0	0.0	0.0
WPRO B3	0.0	0.0	0.0	0.0	0.0	0.0
World	<i>0.9</i>	<i>0.5</i>	<i>1.0</i>	<i>0.6</i>	<i>1.1</i>	<i>1.0</i>

* Age-standardized to World Standard Population.

(1) Blindness prevalence by age



(2) Low vision prevalence by age



(3) Prevalence of troublesome itching by age

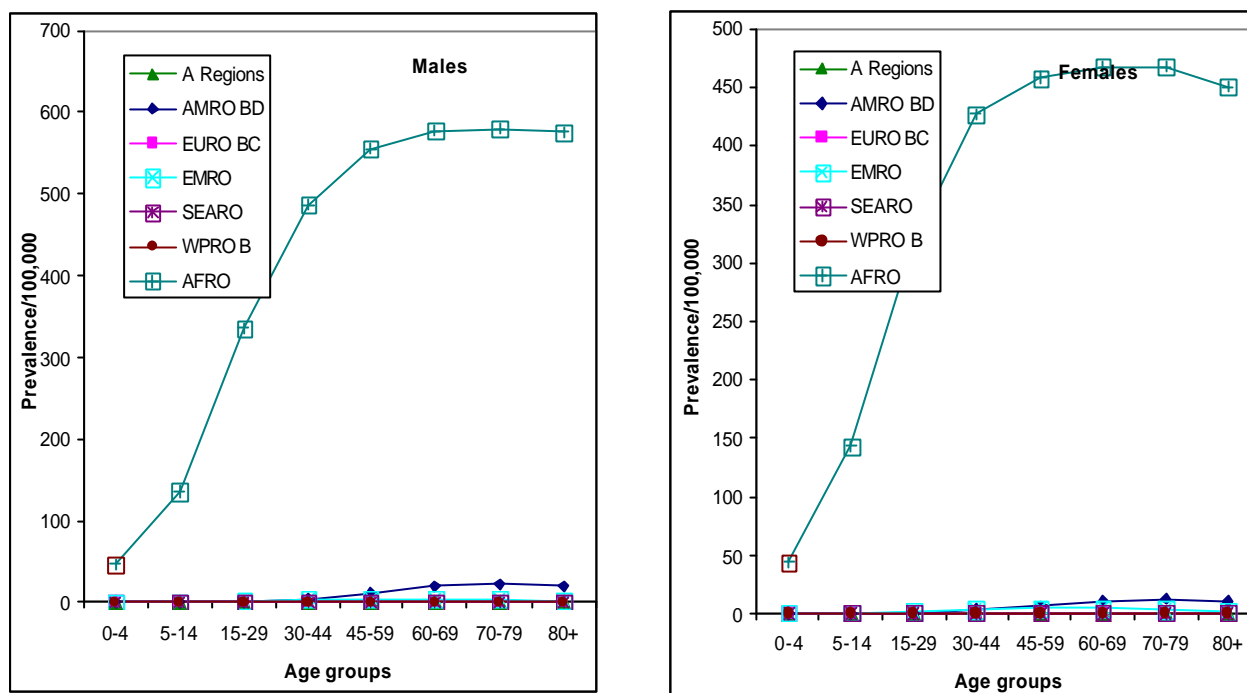


Figure 4. Blinding trachoma: prevalence rates of blindness and low vision, age group and sex, broad regions, 2000

6.3 Global burden of onchocerciasis in 2000

General methods used for the estimation of the global burden of disease are given elsewhere. The tables and graphs below summarise the global burden of blinding trachoma estimates for the GBD 2000 and compare them with those from the GBD 1990.

Table 7. Onchocerciasis: global total YLD, YLL and DALY estimates, 1990 and 2000

	Males	Females	Persons
YLD('000)			
GBD1990	505	379	884
GBD2000	283	216	498
YLL('000)			
GBD1990	0	0	0
GBD2000	0	0	0
DALY('000)			
GBD1990	505	379	884

Table 8. Onchocerciasis: DALYs per 100,000 for WHO subregions, 2000

Subregion	Blindness		Low vision		Troublesome itching	
	DALYs/100,000		DALYs/100,000		DALYs/100,000	
	Males	Females	Males	Females	Males	Females
AFRO D	63.6	44.8	45.7	31.7	33.3	26.9
AFRO E	8.0	5.2	5.9	3.9	12.6	15.2
AMRO A	0.0	0.0	0.0	0.0	0.0	0.0
AMRO B	0.0	0.0	0.0	0.0	0.2	0.1
AMRO D	0.3	0.2	0.2	0.1	0.8	0.5
EMRO B	0.0	0.0	0.0	0.0	0.0	0.0
EMRO D	0.0	0.0	0.0	0.0	0.4	0.2
EURO A	0.0	0.0	0.0	0.0	0.0	0.0
EURO B1	0.0	0.0	0.0	0.0	0.0	0.0
EURO B2	0.0	0.0	0.0	0.0	0.0	0.0
EURO C	0.0	0.0	0.0	0.0	0.0	0.0
SEARO B	0.0	0.0	0.0	0.0	0.0	0.0
SEARO D	0.0	0.0	0.0	0.0	0.0	0.0
WPRO A	0.0	0.0	0.0	0.0	0.0	0.0
WPRO B1	0.0	0.0	0.0	0.0	0.0	0.0
WPRO B2	0.0	0.0	0.0	0.0	0.0	0.0
WPRO B3	0.0	0.0	0.0	0.0	0.0	0.0
World	3.9	2.8	2.8	2.0	2.5	2.4

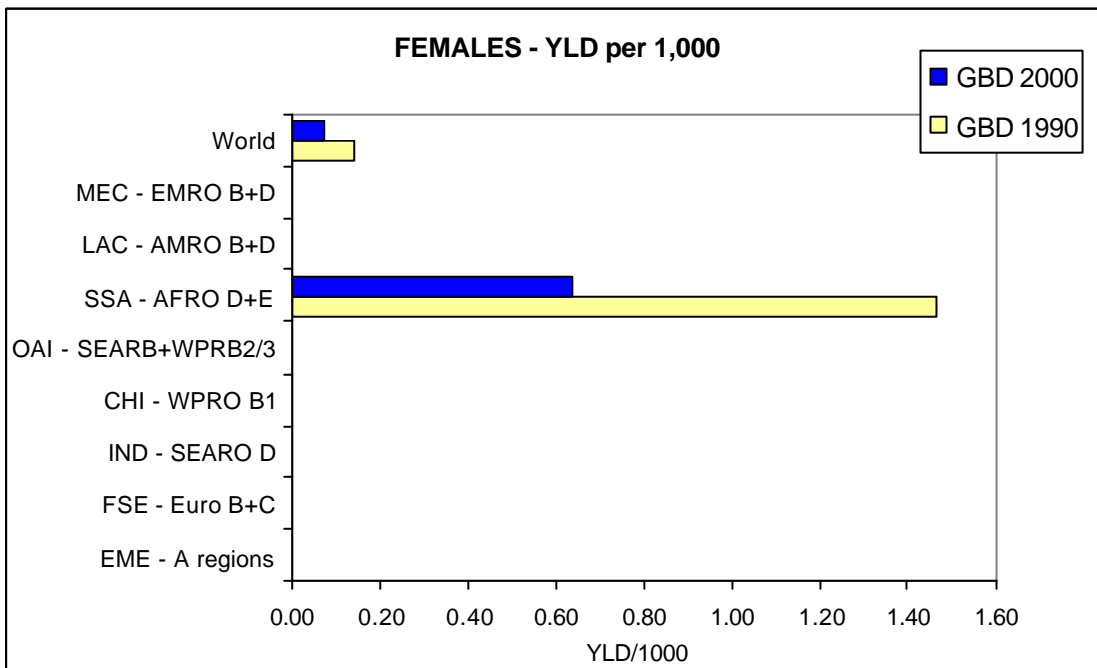
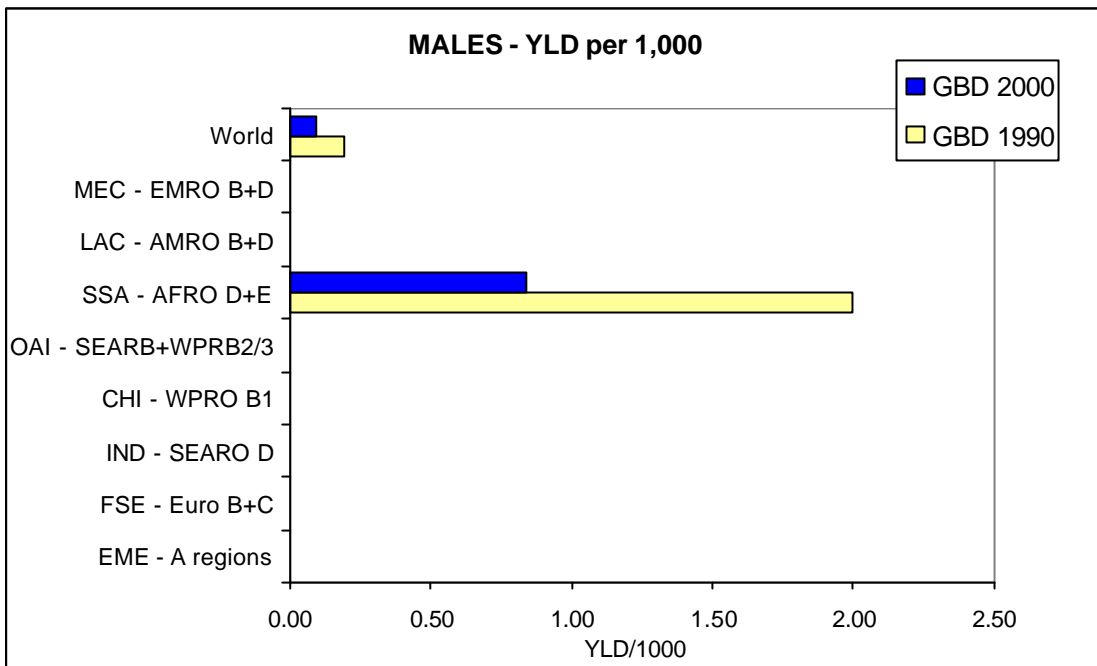


Figure 5. Onchocerciasis: YLD rates, by sex, broad regions, 1990 and 2000

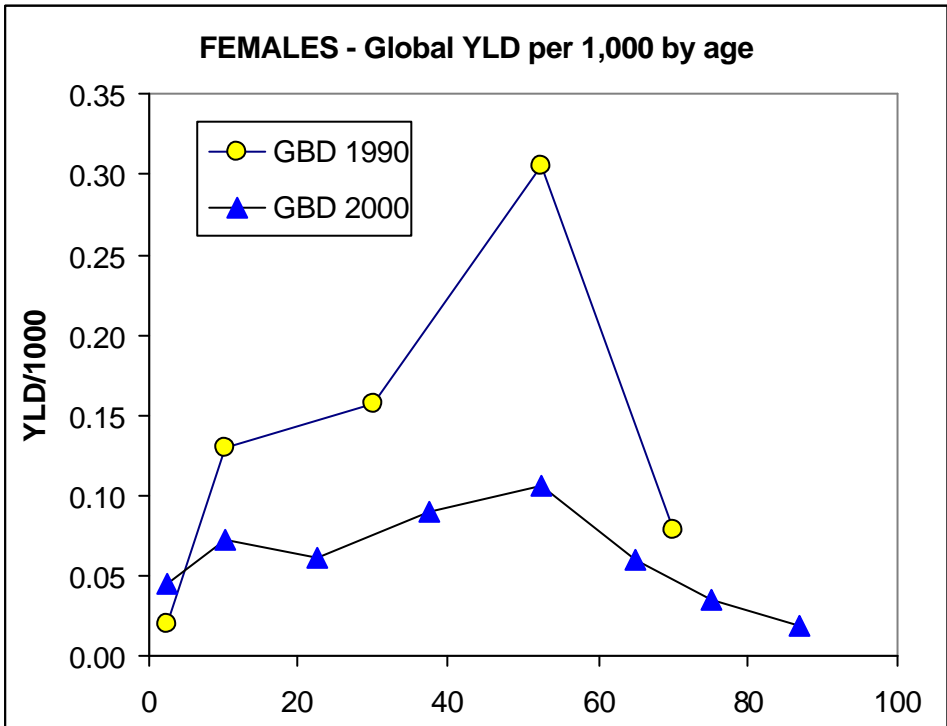
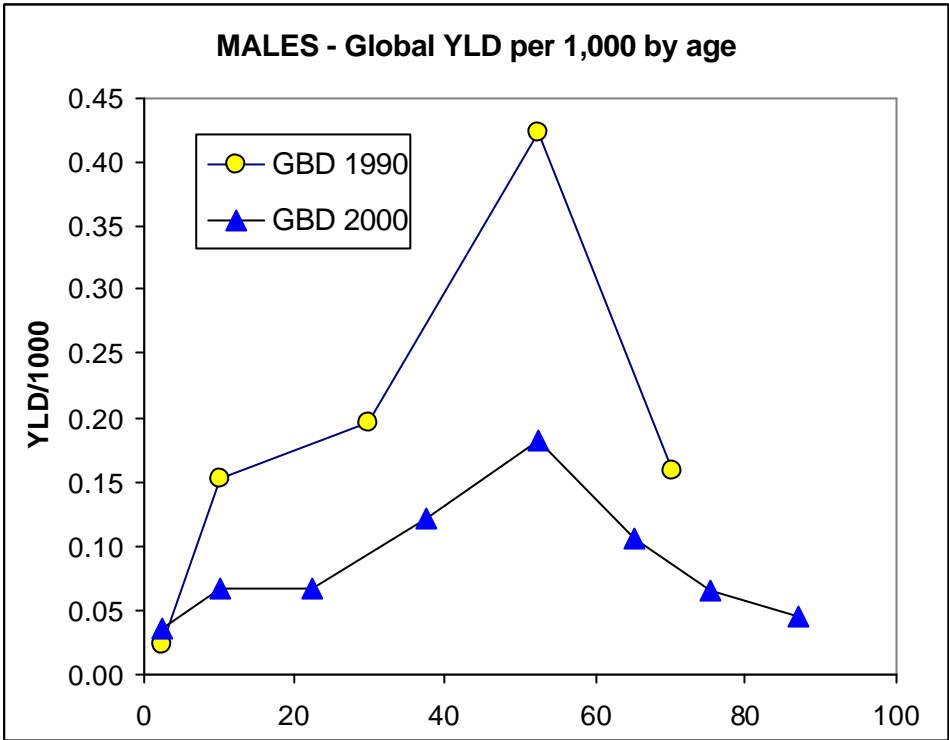


Figure 6. Onchocerciasis: YLD rates, by age and sex, 1990 and 2000

7. Uncertainty analysis

General methods for uncertainty analysis of estimates for the Global Burden of Disease 2000 are outlined elsewhere²¹. Uncertainty analysis for the estimation of prevalence of blinding trachoma and a resulting change in healthy life expectancy (HALE) is under way and will be reported by region and for each Member State.

8. Discussion

The burden from onchocerciasis has substantially decreased for the past decade primarily due to the implementation of control programmes.³ For this reason the current analysis takes into account the effectiveness of control programmes by country and assess the recent changes in prevalence of such sequelae. It is suggested that, compared to the GBD 1990 estimate,^{15,32} the burden from onchocerciasis approximately halved in 2000.

Given the lack of longitudinal studies on the effects of control programmes on prevalence of disabling sequelae, the current estimate is based on the assumption that the incidence of disabling sequela declines in accordance with incident cases of onchocerciasis. This may be a reasonable assumption for incidence of troublesome itching but may not be valid for blindness and low vision because of a relatively long time-lag between the infection and appearance of disabling sequelae. However, compared to prevalence, incidence is more sensitive to interventions and in fact it is shown that there have been virtually no new cases of blindness in OCP areas.¹⁹

Another limitation in the current study is that estimates of age and sex distribution of prevalence were based on those observed among the endemic villages before the intensified control programmes. After the introduction of control programmes, such patterns would be modified. In the same token, for example, a ratio of low vision to blindness would be somewhat biased after the introduction of control programmes since the severity of disabling sequelae would be different.

The current analysis was based on the original 1993 prevalence estimate since there are no other systematically compiled data sources for prevalence of disabling sequela from onchocerciasis⁵. It should be noted that the quality of the information on which the estimates of the burden of onchocerciasis are based is extremely variable and ranges from extensive and reliable data for the OCP countries and Ecuador to only sketchy information for some of the largest endemic countries in Africa.^{5,15} Furthermore, because of the focal nature of onchocerciasis, the burden of the disease is very unevenly distributed in the endemic regions. Although the burden of onchocerciasis is relatively small at the global level, at the local level it can be the most important health problem for endemic communities and in some situations it may threaten the survival of the community itself.

Despite these limitations, the present estimates are based on best available empirical data and comparable to the GBD 1990 estimate the 1993 estimate has been used as a reference data for the GBD 1990 and other estimates made during the past decade. These are version 2 estimates for the GBD 2000. Apart from the uncertainty analysis, updating estimates to reflect revisions of mortality estimates and any new or revised epidemiological data or evidence, it is not intended to undertake any major addition revision of these estimates. We welcome comments and criticisms of these draft estimates, and information on additional sources of data and evidence. Please contact Kenji Shibuya (EBD/GPE) on email shibuyak@who.int

Acknowledgements

We wish to thank the department of Prevention of Blindness and Deafness (PBD), particularly Sergi Rentokoff, Silvio P. Mariotti and Donatella Pascolini for data and valuable comments. The authors also thank the many staff of the Global Program on Evidence for Health Policy who contributed to the development of life tables and cause of death analysis. In particular we thank Brodie Ferguson, Mie Inoue, Alan Lopez, Doris Ma Fat, Christopher Murray, and Chalipati Rao.

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Appendix.

Age-specific prevalence rates (per 1,000) of blindness, low vision and troublesome itching due to Onchocerciasis by WHO subregion

AFRO D						
Age group	Males			Females		
	Blindness	Low vision	Troublesome itching	Blindness	Low vision	Troublesome itching
0-4	0.15	0.10	0.68	0.10	0.07	0.56
5-14	0.05	0.19	4.01	0.04	0.13	3.32
15-29	0.43	0.60	6.77	0.28	0.39	5.44
30-44	1.53	2.14	7.17	1.00	1.41	5.72
45-59	4.32	7.77	11.04	2.67	4.81	8.31
60-69	10.65	19.18	9.90	5.86	10.55	6.64
70-79	10.22	20.44	9.81	5.70	11.39	6.67
80+	9.66	19.32	9.63	5.68	11.35	6.84

AFRO E						
Age group	Blindness	Low vision	Troublesome itching	Blindness	Low vision	Troublesome itching
0-4	0.02	0.01	0.31	0.01	0.01	0.34
5-14	0.01	0.02	1.76	0.00	0.02	2.00
15-29	0.05	0.07	2.86	0.03	0.04	3.17
30-44	0.18	0.25	2.99	0.12	0.16	3.42
45-59	0.51	0.91	4.34	0.31	0.56	4.87
60-69	1.22	2.19	3.75	0.66	1.19	3.80
70-79	1.24	2.48	3.90	0.67	1.35	3.81
80+	1.23	2.45	3.89	0.66	1.32	3.72

AMRO B						
Age group	Blindness	Low vision	Troublesome itching	Blindness	Low vision	Troublesome itching
0-4	0.000	0.000	0.00	0.000	0.000	0.00
5-14	0.000	0.000	0.00	0.000	0.000	0.00
15-29	0.000	0.000	0.00	0.000	0.000	0.00
30-44	0.000	0.000	0.02	0.000	0.000	0.01
45-59	0.001	0.001	0.04	0.000	0.001	0.03
60-69	0.001	0.002	0.10	0.001	0.001	0.05
70-79	0.001	0.002	0.09	0.001	0.001	0.05

80+	0.001	0.002	0.09	0.001	0.001	0.05
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AMRO D

Age group	Blindness	Low vision	Troublesome itching	Blindness	Low vision	Troublesome itching
0-4	0.000	0.000	0.02	0.000	0.000	0.02
5-14	0.000	0.001	0.01	0.000	0.000	0.01
15-29	0.001	0.002	0.06	0.001	0.001	0.04
30-44	0.004	0.005	0.18	0.002	0.003	0.11
45-59	0.010	0.018	0.50	0.006	0.011	0.30
60-69	0.025	0.045	1.24	0.013	0.023	0.65
70-79	0.025	0.051	1.28	0.013	0.026	0.65
80+	0.023	0.046	1.17	0.011	0.022	0.58

EMRO D

Age group	Blindness	Low vision	Troublesome itching	Blindness	Low vision	Troublesome itching
0-4	0.00	0.00	0.01	0.00	0.00	0.01
5-14	0.00	0.00	0.03	0.00	0.00	0.03
15-29	0.00	0.00	0.04	0.00	0.00	0.03
30-44	0.00	0.00	0.04	0.00	0.00	0.03
45-59	0.00	0.00	0.04	0.00	0.00	0.04
60-69	0.00	0.00	0.04	0.00	0.00	0.03
70-79	0.00	0.00	0.04	0.00	0.00	0.03
80+	0.00	0.00	0.03	0.00	0.00	0.02
