Chapter 10

Trachoma-Related Visual Loss

B Thylefors, K Ranson, A-D Négrel,
R Pararajasegaram

Introduction

Trachoma as a cause of blindness has been known to mankind for many centuries; it was documented in ancient China, Egypt and India. The disease probably came to Europe with the Napoleonic troops returning from Egypt and was endemic in most European countries well into the 20th century (Jitta & Luharis 1930).

Trachoma, a communicable eye disease most commonly found amongst poor populations living in crowded conditions with insufficient personal and environmental hygiene, is the most important cause of preventable blindness in the world. The disease is still commonly found in many developing countries, usually in the poorest population groups in rural areas. Trachoma is a typical socioeconomically determined disease, with poverty, low living standards, and lack of hygiene as main risk factors. The disease is typically "clustered" in relation to community development and social class (Dawson, Jones & Tarizzo 1981). The trachomatous infection starts early in life, but the blinding outcome usually does not occur until adulthood, with a predominance of visual loss in women. The disease can constitute a significant cause of visual disability, adding to the already high burden of disease commonly found in poor rural populations.

Trachoma is caused by *Chlamydia trachomatis*, a microorganism that is intracellular (like viruses) but susceptible to some antibiotics (like bacteria). Chlamydial infection may give systemic manifestations, including respiratory tract infections in infants and genital tract infections in adults. The relationship between ocular and genital chlamydial infections is complex and not the subject of this review.

The epidemiology of trachoma is characterized by the early inflammatory phase, often during childhood, involving the tarsal conjunctive (the mucous membrane lining inside the eyelids). The upper eyelid is the main site of inflammation and the infection is invariably bilateral. The invasion of chlamydiae into the conjuctival cells leads to the formation of small

follicles, which represent the inflammatory reaction to the presence of the infectious agent. The follicles gradually increase in size, up to 1–2 mm; as they "mature," reaching their optimal size, they rupture and are eventually replaced by scar tissue. The scars can be seen as discrete white lines or stars on the tarsal conjuctival surface. With an increasing number of scars, there is traction inside the eyelid, leading eventually to an inturned lid (entropion), with eyelashes rubbing against the cornea (trichiasis). This causes superficial lesions in the corneal epithelium, which over time result in a gradual infiltrate and opacification of the cornea, often following severe secondary infections.

The classical profile of trachoma is a severe blinding disease, usually hyperendemic amongst poor and underserved rural populations. The disease can, however, also exist in a non-blinding form with less intense infection, although still prevalent in the communities concerned. Under such circumstances, there is still typically a substantial burden of active inflammatory disease amongst children, whereas there are very few cases of trichiasis or corneal opacification in the adults.

Trichiasis and corneal opacification usually do not occur until the third or fourth decade of life, but this varies in relation to the intensity of infection. Women tend to have more active inflammatory disease because of their close contact with children, who constitute a reservoir of infection. Accordingly, trichiasis is particularly common in middle-aged and elderly women (Dawson, Jones & Tarizzo 1981).

The prevention of blindness from trachoma can be effectively achieved by: prevention of trachoma infection through health education and improved standards of living; antibiotic treatment of inflammatory disease; or surgery against trichiasis to prevent corneal opacification. Specific guidelines have been developed for the antibiotic treatment of trachoma, as well as for standard surgical procedures (Reacher et al. 1992).

There have been few attempts in the past to measure the global disease burden of trachoma and the resulting visual loss.

A WHO Scientific Group on Trachoma Research in 1959 referred to an estimated 400 million cases of trachoma (World Health Organization 1959). In the 1960s, the results of a number of surveys on trachoma and experience gained in several national campaigns led to a global estimate of 500 million cases of trachoma worldwide, with at least 2 million blind as a result of the disease (Bietti, Freyche & Vozza 1962). Subsequently, in the light of better epidemiological data on blindness, the figure for the estimated number of blind was adjusted to 6–9 million (World Health Organization 1984).

In 1985, Dawson & Schachter (1985) estimated by means of a simple model that there could be some 360 million people with trachoma. A more comprehensive model was developed a few years later by the WHO, partially based on the results of a global questionnaire on trachoma (Thylefors, Négrel & Pararajasegaram 1992). Thus, it was estimated in 1992 that approximately 146 million people had active inflammatory disease.

That estimate took into account only cases of active disease in need of treatment, in accordance with a new and simplified grading system for trachoma (Thylefors et al. 1987). A separate estimate was subsequently put forward, taking into account the number of blind attributable to trachoma and cases with disabling, or potentially disabling, lesions, i.e. corneal opacification and trichiasis (Thylefors et al. 1995). The overall figure for this category of blind and those at immediate risk of blindness was 5.9 million.

Definition

A multitude of definitions of blindness were in use up to 1972, when a WHO study group on the prevention of blindness recommended a uniform definition for use in surveys and reporting systems. The definition is expressed as vision less than 3/60 (0.05) in the better eye with best possible optical correction. This corresponds to the inability to distinguish the fingers of a normal hand at a distance of 3 metres (10 feet), and it implies loss of "walk-about" vision. The 1972 recommendation has become universally accepted and is included in the ninth and tenth revisions of the International Classification of Diseases (ICD) (World Health Organization 1977, 1992). The WHO study group also defined other categories of visual loss, notably the concept of "low vision," i.e. significant or severe visual impairment, but not quite blindness, in the individual. Low vision is thus defined as vision less than 6/18 (0.3) but equal to or better than 3/60 (0.05). It should be noted that the above recommended definitions are mainly for uniform reporting of data; each country may still have its own criteria for social and rehabilitative care for people with visual loss.

The definition of trachoma, as given by the WHO Expert Committee on Trachoma in 1962, reads: "Trachoma is a specific, communicable kerato-conjunctivitis, usually of chronic evolution, …characterized by follicles, papillary hyperplasia, pannus, and it its later stages, cicatrization" (World Health Organization 1962). The definition for a case of trachomatous blindness commonly applied is the central opacification of the cornea (leucoma) in the presence of typical conjunctival scars and entropion/trichiasis.

The classification of trachoma and its complications has evolved over a period of several decades, from the classification proposed by MacCallan in the early part of this century, up to the most recent simplified grading system proposed by the WHO (Thylefors et al. 1987).

Differential diagnostic problems refer mainly to other forms of follicular conjunctivitis; criteria for the field diagnosis of trachoma were laid down by the WHO Expert Committee on Trachoma (World Health Organization 1962), e.g. the presence of typical follicles or infiltrate in the tarsal conjunctiva. Trachoma tends to be underestimated as a cause of blindness, especially in situations where complications of trachoma,

such as suppurative keratitis and phthisis bulbi, are mistakenly recorded as the primary cause.

Review of empirical data bases

Data sources on trachoma are unfortunately very limited. The epidemiology of the disease is such that only population-based assessments are of value. Surveys of schoolchildren were carried out in many countries in the 1960s, but they are limited by the low rate of school attendance in some settings and the lack of data on trichiasis to confirm the blinding potential of trachoma in the particular population. Community-based surveys have not been undertaken in many countries in recent years, although the assessment of trachoma is part of the WHO-suggested procedure for an overall blindness survey (Thylefors 1987). The sampling poses a problem in such a situation, when in fact the epidemiological mapping of trachoma is the priority for the planning of intervention. Data for eye clinics are notoriously unreliable for trachoma, in view of the patchy distribution of the disease and its social profile, being most common in impoverished rural populations.

Overall, trachoma studies tend to be biased to focus on areas where trachoma is strongly suspected or known to exist. Very few nationwide surveys have attempted to give a mapping of trachoma, which is obviously difficult, given the focal distribution of the disease in relation to socioeconomic, cultural and environmental circumstances.

Available data on trachoma and related visual loss are reviewed in Table 10.1. Studies are included in this compilation only if they are population-

Box 10.1 International Classification of diseases (ICD) codes related to trachoma

ICD-9		*ICD-10*	
076	Trachoma	A.71	Trachoma
076.0	*Initial stage* Trachoma dubium	A.71.0	*Initial stage of trachoma* Trachoma dubium
076.1	*Active stage* Granula conjunctivities (trachomatous) Trachomatous – follicular conjunctivitis – pannus	A.71.1	*Active stage of trachoma* Granular conjunctivitis (trachomatous) Trachomatous – follicular conjunctivitis – pannus
076.9	*Unspecified* Trachoma NOS	A.71.9	*Trachoma, unspecified*
374.0	*Entropion and trichiasis of eyelid*	B.94.0	*Sequelae of trachoma*
139.1	*Late effects of trachoma*	H.02.0	*Entropion and trichiasis of eyelid*

Table 10.1 Review of available data on trachomatous blindness: population-based surveys after 1974

World Bank Region Country or area	Date of study	Population examined	Blindness (low vision) definition	Comments	Prevalence per 100 000 Blindness (< 3/60)	 Trachomatous Blindness (< 3/60)	Reference
CHI							
China	1982–1985	433 083	< 3/60	Sample survey in suburban and rural areas. No information on sampling method is provided. WHO endorsed examination method was used.	335	32	World Health Organization 1985
China	1987	1 579 316	< 3/60	National random survey. Little information is provided on the sampling method. No definition of "rural" and "urban" is provided.	432	47	Zhang et al. 1992
China	1985	10 279	—	Trachoma survey in one county. Does not present prevalence of trachomatous blindness	NR	NR	Hu et al. 1989
EME							
Australia	1976–1977	5 134	≤ 6/60	Survey of Aborigines in west and central Australia. Method of sample selection is not clear.	711	107	Taylor 1987
Australia	1990	1 514	< 3/60	Survey of Aborigines in one area of southern Australia. Study population consisted of people who voluntarily presented for examination.	1 321	594	Stocks, Newland & Hiller 1994
IND							
India	1973	1 060	≤ 6/60	Community survey in rural Uttar Pradesh. The village surveyed is in the area of a rural health centre. Reports on blindness attributable to both trachoma and associated conjunctivitis.	1 038	377	Chakrabarti, Gary & Siddhu 1974
India	1976	20 134	≤ 3/60	Community surveys in rural Uttar Pradesh. Villages closest to the health centre were chosen for the study. Only those reporting visual difficulty were examined.	353	30	Srivastava & Verma 1978

continued

Table 10.1 Review of available data on trachomatous blindness: population-based surveys after 1974 *(continued)*

World Bank Region Country or area	*Date of study*	*Population examined*	*Blindness (low vision) definition*	*Comments*	*Prevalence per 100 000*		*Reference*
					Blindness (< 3/60)	*Trachomatous Blindness (< 3/60)*	
India	1981	685 200 000	< 3/60	National census. Report includes no information on examination methods. Reports on blindness attributable to both trachoma and associated infection.	250	50	NSSO survey 1981
India	1986–1989	254 758	< 6/60	National random cluster survey. Sample sizes were determined based on the findings of the 1981 NSSO study. Clinical staging of trachoma not consistent with WHO classification. Results are inconsistent from one report to another. Only 11 cases of trachoma blindness (< 3/60) found.	697	4	Mohan 1989
LAC							
Brazil	1986	2 908	< 3/60	Random cluster sample in one municipality in southeastern Brazil. WHO Simplified Grading Scheme is used for assessing prevalence of trachoma infection.	NR	0	Luna et al. 1992
MEC							
West Bank & Gaza Strip	1982–1983	6 038	< 3/60	Random cluster sample in two geographically separate areas mainly populated by Palestinian Arabs. Most children under the age of 5 and a small number of older children and adults were unable to understand or cooperate in visual acuity testing. Authors state that the prevalence of trachomatous blindness in West Bank was twice that in Gaza strip.	2 733	364	Thomson & Chumbley 1984

Morocco	1992	8 878	< 3/60	National, randomized, stratified, community-based survey.	760	30	Morocco Ministry of Public Health 1992
Morocco	1993	4 797	—	Randomized cluster survey of a trachoma endemic area. Obvious bias.	NR	NR	Chami-Khazraji, Négrel & Ottmani 1994
Pakistan	1989	6 690	< 3/60	Population-based survey in the North West Frontier Province. Obvious bias.	1 000	90	Pakistan Ministry of Health 1989
Saudi Arabia	1984	14 76	< 3/60	National random cluster sample representing the settled population of Saudi Arabia.	1 509	160	Tabbara & Ross-Degnam 1986
Saudi Arabia	1981–1990	4 268	< 3/60	Random cluster sample in a single province. This province was found to have higher levels of blindness than other regions of Saudi Arabia in the 1984 study.	1 500	141	Badr et al. 1992
Saudi Arabia	1991	2 882	< 3/60	Random cluster sample in a single province. Definition of low vision used is unclear.	659	0	Al Faran et al. 1993
Tunisia	1993	3 547	< 3/60	National, randomized cluster survey. Obvious bias (under representation of males 15–54 years of age).	800	34	Tunisia 1993
OAI							
Mongolia	1991–92	4 345	< 3/60	Random cluster sample in 3 of the 18 regions in Mongolia. Only people aged 40 years and older were examined.	1,588	0	Baasanhu et al. 1994
Myanmar	1990	21 103	< 3/60	Examination of nonrandomly selected villages belonging to 4 Regions of the Prevention of Blindness Programme.	1,240	62	Than 1990
Nepal	1980–81	39 887	< 3/60	National random cluster survey. Most trachoma is located in the Far Western terai (western Nepal).	840	23	Brilliant et al. 1985

continued

Table 10.1 Review of available data on trachomatous blindness: population-based surveys after 1974 *(continued)*

World Bank Region Country or area	Date of study	Population examined	Blindness (low vision) definition	Comments	Prevalence per 100 000 Blindness (< 3/60)	 Trachomatous Blindness (< 3/60)	Reference
Tonga	1991	4 056	< 3/60	National random cluster survey. Study was restricted to persons aged 20 years and over.	468	25	Newland et al. 1994
Vanuatu	1989	3 520	< 3/60	National random cluster sample. Only included persons aged 6 years or older.	369	0	Newland et al. 1992
Viet Nam	1990	15 071	< 3/60	Survey carried out in 4 northern and 4 southern provinces. No information in report as to methods used for sampling or examination.	860	27	Nguyen et al. 1992
SSA							
Benin	1990	7 047	< 3/60	National random cluster sample. Authors state that trachoma is only prevalent in the northern part of the country.	600	0	World Health Organization 1991
Burkina Faso	1991	1 841	—	Randomized cluster survey of one region.	NR	NR	Hutin et al. 1992
Chad	1984–1985	5 002	< 3/60	National random cluster sample. Little information regarding the sampling and examination methods is provided.	2 310	526	World Health Organization 1987
Congo	1988	6 185	< 3/60	National random cluster sample. Little information regarding the sampling and examination methods is provided.	307	0	World Health Organization 1990
Ethiopia	1981	1 383	< 3/60	Random cluster sample in one province. Conducted in a hot, dry, dusty province. The terms "urban" and "rural" are poorly defined.	940	434	Cerruti et al. 1981
The Gambia	1986	874	< 3/60	National random cluster sample. Well-conducted study with no obvious source of bias.	700	119	Faal et al. 1989
Ghana	1991	962	< 3/60	Random cluster sample in one district. Conducted in a savannah area in central Ghana. Study did not include individuals younger than 30 years old. Only 67% of the sample population were examined.	2 495	0	Moll et al. 1994

Kenya	1990	895	< 3/60	Surveys conducted at nonrandomly selected sites in one region. Conducted in a semi-desert area in north-west Kenya. Study is too small to reliably assess prevalence of trachomatous blindness.	1 117	223	Loewenthal & Peer 1990
Kenya	1976	844	< 3/60	Simple random sample at two nonrandomly selected sites. In central Kenya. Methods used for determining cause of blindness are not provided. Definitions of "active" and "inactive" disease are not provided. Study is too small to reliably assess prevalence of trachomatous blindness.	1 659	118	Whitfield et al. 1983
Kenya	1976	13 803	< 3/60	Random cluster sample in 8 rural areas.	700	130	Whitfield et al. 1990
Malawi	1983	1 574	< 3/60	Surveys of randomly selected villages in one region. Conducted in a region of central Malawi where blindness is particularly common. People younger than 6 years were not examined.	1 271	0	Chirambo et al. 1986
Mali	1985	3 538	< 3/60	Randomized, community based survey of a rural region. This thesis study was conducted in the Kayes Region.	1 300	369	Yattassaye 1985
Mali	1985	3 299	< 3/60	Randomized, community based survey of a rural region. This thesis study was conducted in the Mopti Region.	1 000	340	Boré 1985
Niger	1990	2 958	<3/60	Community-based, randomized cluster survey. Obvious bias.	1 300	400	Kabo 1990
Nigeria	1988–1989	6 831	< 3/60	Surveys of nonrandomly selected rural communities. Study conducted in an onchocerciasis mesoendemic area in northern Nigeria. Study did not include children younger than 5 years. Would be a good study for looking at sex ratio, but does not report total numbers of males and females examined.	3 323	278	Abiose 1994

continued

Table 10.1 Review of available data on trachomatous blindness: population-based surveys after 1974 *(continued)*

World Bank Region Country or area	*Date of study*	*Population examined*	*Blindness (low vision) definition*	*Comments*	*Prevalence per 100 000*		*Reference*
					Blindness (< 3/60)	*Trachomatous Blindness (< 3/60)*	
South Africa	1976	1 207	< 6/60	Random cluster sample in a rural community. Conducted in an area known to be trachoma endemic. Sample not representative; working age males underepresented.	NR	331	Ballard, Sutter & Fotheringhan 1978
South Africa	1979	1 749	< 6/60	Random cluster sample in a rural community. Conducted in an area known to be trachoma endemic. Sample not representative; working age males underepresented.	NR	610	Ballard et al. 1983
South Africa	1985	18 962	< 3/60	Examination of all residents in randomly selected villages in one district. District has an ophthalmic hospital. Far fewer males examined than females.	575	58	Bucher & Ijsslmuider 1988
Tanzania	1986	1 827	< 3/60	Random cluster sample in an area known to be hyperendemic for trachoma. Visual acuity was only measured in individuals older than 7 years	1 259	328	Rapoza et al. 1991
Togo	1981–1986	11 081	< 3/60	Random cluster surveys of 4 rural areas. WHO sampling procedures. Prevalence of trachomatous blindness is only available for 1 of 4 areas.	NR	NR	World Health Organization 1989

NR = not reported

based surveys in which the criteria for blindness are clearly defined. Only studies conducted after 1974 are included.

In Table 10.1, blindness and trachomatous blindness refer to best corrected visual acuity less than 3/60. Values from studies that used different definitions of blindness have been adjusted based on the following assumptions:

- the prevalence of best corrected visual acuity less than 6/60 is 1.5 times the prevalence of best corrected visual acuity less than 3/60;
- the prevalence of best corrected visual acuity less than or equal to 6/60 is 2 times the prevalence of best corrected visual acuity less than 3/60 (Thylefors et al. 1995).

Only 11 country-wide, population-based surveys (13 studies) were found to have looked at the prevalence of trachomatous blindness.

Estimation of the burden of trachoma

The calculation of disability adjusted life years (DALYs) lost as a result of trachomatous blindness and low vision requires the following information: age-specific and sex-specific values of the prevalence of trachomatous blindness and low vision for each of the eight GBD regions; the increased risk of mortality incurred by trachomatous blindness or visual loss; and disability weights for both blindness and low vision, which express the fraction of a year of life lost because of having to live for that year with disability (disability weights are discussed in the next section.

In order to develop regional prevalence values for trachomatous blindness, countries were grouped by the authors according to the following scale:

0 = no known trachoma;

1 = trachoma infection, but no trachomatous blindness;

2 = trachoma infection, low prevalence of trachomatous blindness (≤ 100 per 100 000);

3 = trachoma infection, high prevalence of trachomatous blindness (> 100 per 100 000).

For each region with endemic blinding trachoma, estimates based on the 11 available country studies and the country populations concerned were then applied for categories 2 and 3 above. Box 10.2 sets out these estimates.

To consider both blindness and low vision caused by trachoma, the above-mentioned comprehensive review of available population-based surveys was used to determine the ratio of visual loss to blindness. It was found, based on 13 studies, that for each case of trachomatous blindness

Box 10.2 Regional prevalence per 100 000 for trachomatous blindness according to prevalence level

World Bank Region	*Low prevalence (category 2)*	*High prevalence (category 3)*
SSA	75	203
MEC	31	160
OAI	26	—
CHI	47	—
IND	4	—

there are 1.16 individuals with trachomatous visual loss (Table 10.2). This proportion has subsequently been applied in the assessment of low vision attributable to trachoma in each region and globally. Data analysis based on seven studies gave a sex ratio of 1.00:2.86 for male-to-female prevalence of trachomatous blindness. This ratio was applied uniformly to all countries with trachoma-related blindness and low vision (Table 10.3). Furthermore, the age distribution of the prevalence of blindness and low vision was calculated based on four studies, and the final result was applied to all endemic countries or areas (Table 10.4).

Regional prevalence values for trachomatous blindness and low vision are shown in Table 10.5. Tables 10.6 to 10.11 provide age-specific and sex-specific values for the prevalence of trachomatous blindness in each of the regions and globally.

Table 10.2 Ratio of people with low vision (< 6/18 – 3/60) to people with blindness (< 3/60)

Reference	*Population examined*	*Number of Blind (< 3/60)*	*Number with low vision (</6/18–3/60)*	*Ratio of low visioned to blind*
Zgang et al. 1992	1 579 316	742	869	1.17:1.00
Thomson & Chumbley 1984	6 038	22	11	0.50:1.00
Chami-Khazraji et al. 1992	8 878	3	3	1.30:1.00
Pakistan Ministry of Health 1989	6 690	6	1	0.17:1.00
Badr et al. 1992	4 268	6	8	1.33:1.00
Tunisia 1993	3 547	1	1	0.99:1.00
Whitfield et al. 1983	844	1	3	3.00:1.00
Whitfield et al. 1990	13 803	18	46	2.54:1.00
Yattassaye 1985	3 538	13	10	0.78:1.00
Boré 1985	3 299	11	11	1.00:1.00
Abiose 1994	6 831	19	12	0.63:1.00
Rapoza et al. 1991	1 927	6	3	0.50:1.00
Totals	1 645 926	848	981	1.16:1.00

Table 10.3 Ratio of female prevalence of trachomatous blindness to male prevalence

Reference	*Prevalence of trachomatous blindness per 100 000*		*Ratio of female prevalence to male prevalence*
	Males	*Females*	
Taylor 1987	62	147	2.37 :1.00
Tabbasa & Ross-Degnan 1986	146	173	1.19 :1.00
Bucher & Ijsselmuiden 1958	13	89	6.81:1.00
Total	37	104	2.86 :1.00

Table 10.4 Age distribution of the prevalence of trachomatous blindness

Age (years)	*Total population surveyed for visual impairment*[a]	*Trachomatous blindness*		
		Number blind[a]	*Prevalence per 100 000*	*Distribution of prevalence (%)*
0–4	4 280	0	8	0
5–14	6 459	1	11	0
15–44	9 697	6	67	2
45–59	1 500	8	544	18
60+	1 240	30	2 419	80
Total	23 176	46	3 049	100

a. Numbers derived from Ballard et al. (1983), Tabbara & Ross-Degnan (1986), Rapoza et al. (1991), and Badr et al. (1992).

Table 10.5 Prevalence of trachomatous blindness and low vision by region

World Bank Region	*1990 Population (thousands)*	*Trachomatous blindness*		*Trachomatous low vision*	
		Prevalence per 100 000	*Number*	*Prevalence per 100 000*	*Number*
China	1 134 693	47	533 096	54	616 386
Established Market Economies[a]	797 790	0	0	0	0
Formerly Socialist Economies of Europe[b]	346 237	0	0	0	0
India	849 514	4	37 813	5	43 721
Latin America & the Caribbean[c]	444 295	0	0	0	0
Middle Eastern Crescent	503 075	73	364 928	844	21 944
Other Asia & Islands	682 534	10	67 497	11	78 042
Sub-Saharan Africa	510 274	93	472 663	107	546 511
Total	5 268 412	28	1 475 997	32	1 706 604

a. Blinding trachoma is known to exist only among Australian Aborigines, who are not considered representative of the region.

b. Pockets of trachoma may exist but no information on trachomatous blindness could be identified.

c. Trachoma is known to be endemic in parts of Brazil, Guatemala, Mexico and Peru but its blinding propensity is considered insignificant.

Table 10.6 Age and sex distribution of the people with blindness or low vision attributable to trachoma, China, 1990

	Population (thousands)			*Number Blinded by Trachoma*			*Number with low vision attributable to trachoma*		
Age (years)	*Males*	*Females*	*Total*	*Males*	*Females*	*Total*	*Males*	*Females*	*Total*
0–4	60 243	57 946	118 189	0	0	0	0	0	0
5–14	96 997	90 401	187 398	0	0	0	0	0	0
15–44	307 305	284 078	591 383	15 265	37 616	53 883	17 650	43 493	6 301
45–59	72 674	64 403	137 077	32 489	76 752	112 406	37 565	88 743	129 968
60+	48 980	51 666	100 646	97 318	273 656	366 807	112 523	316 411	424 116
Total	586 199	548 494	1 134 693	145 072	388 024	533 096	167 738	448 648	616 386

Table 10.7 Age and sex distribution of the people with blindness or low vision attributable to trachoma, India, 1990

	Population (thousands)			*Number blinded by trachoma*			*Number with low vision attributable to trachoma*		
Age (years)	*Males*	*Females*	*Total*	*Males*	*Females*	*Total*	*Males*	*Females*	*Total*
0–4	59 789	56 679	116 468	0	0	0	0	0	0
5–14	101 752	95 263	197 015	0	0	0	0	0	0
15–44	200 525	183 242	383 767	1 136	2 873	4 061	1 314	3 322	4 695
45–59	47 567	46 005	93 572	2 426	6 492	8 911	2 805	7 506	10 303
60+	29 768	28 924	58 692	6 747	18 140	24 841	7 801	20 74	28 723
Total	439 401	410 113	849 514	10 309	27 504	37 813	11 920	31 802	43 721

Table 10.8 Age and sex distribution of the people with blindness or low vision attributable to trachoma, Middle Eastern Crescent, 1990

	Population (thousands)			*Number blinded by trachoma*			*Number with low vision attributable to trachoma*		
Age (years)	*Males*	*Females*	*Total*	*Males*	*Females*	*Total*	*Males*	*Females*	*Total*
0–4	41 161	39 734	80 895	0	0	0	0	0	0
5–14	65 345	61 999	127 344	0	0	0	0	0	0
15–44	113 895	107 211	221 106	12 872	30 991	45 158	14 883	35 832	52 213
45–59	22 337	22 292	44 629	22 720	57 994	82 033	26 270	67 055	94 850
60+	13 651	15 450	29 101	61 712	178 40	237 738	71 354	206 550	274 881
Total	256 389	246 686	503 075	97 304	267 624	364 928	112 507	309 437	421 944

Table 10.9 Age and sex distribution of the people with blindness or low vision attributable to trachoma, Other Asia and Islands, 1990

	Population (thousands)			*Number blinded by trachoma*			*Number with low vision attributable to trachoma*		
Age (years)	*Males*	*Females*	*Total*	*Males*	*Females*	*Total*	*Males*	*Females*	*Total*
0–4	43 763	41 988	85 751	0	0	0	0	0	0
5–14	84 032	80 217	164 249	0	0	0	0	0	0
15–44	160 825	159 611	320 436	2 220	5 761	8 136	2 567	6 661	9 407
45–59	34 138	35 090	69 228	4 242	11 398	15 820	4 905	13 179	18 292
60+	20 208	22 662	42 870	11 160	32 716	43 540	12 903	37 828	50 343
Total	342 966	339 568	682 534	17 622	49 875	67 497	20 375	57 667	78 042

Table 10.10 Age and sex distribution of the people with blindness or low vision attributable to trachoma, Sub-Saharan Africa, 1990

	Population (thousands)			*Number blinded by trachoma*			*Number with low vision attributable to trachoma*		
Age (years)	*Males*	*Females*	*Total*	*Males*	*Females*	*Total*	*Males*	*Females*	*Total*
0–4	47 484	47 030	94 514	0	0	0	0	0	0
5–14	70 258	69 818	140 076	0	0	0	0	0	0
15–44	103 764	106 257	210 021	17 690	45 941	65 250	20 454	53 118	75 445
45–59	20 308	22 117	42 425	31 159	86 062	118 627	36 027	99 508	137 161
60+	10 508	12 730	23 238	71 656	220 155	288 786	82 852	254 552	333 906
Total	252 322	257 952	510 274	120 505	352 158	472 663	139 333	407 178	546 511

Table 10.11 Age and sex distribution of the people with blindness or low vision attributable due to trachoma throughout the world, 1990

	Population (thousands)			*Number blinded by trachoma*			*Number with low vision attributable to trachoma*		
Age (years)	*Males*	*Females*	*Total*	*Males*	*Females*	*Total*	*Males*	*Females*	*Total*
0–4	321 304	309 253	630 557	0	0	0	0	0	0
5–14	551 205	525 543	1 076 748	0	0	0	0	0	0
15–44	1 250 941	1 198 642	2 449 583	49 183	123 181	176 487	56 867	142 427	204 061
45–59	312 385	311 067	623 452	93 036	239 697	337 796	107 572	275 990	390 573
60+	218 857	269 215	488 072	248 594	723 306	961 713	287 433	836 14	1 111 969
Total	2 654 692	2 613 720	5 268 412	390 813	1 085 184	1 475 997	451 872	1 254 731	1 706 604

The increased risk of mortality associated with blindness and low vision is derived from a study conducted in Africa (Kirkwood et al. 1983), in the absence of data from other regions. This study found the standardized mortality rate to be 3.8 times higher among females blind as a result of all causes and 2.5 times higher among blind males than among normal sighted. The standardized mortality rate was found to be 1.5 times higher among females with low vision and 1.4 times higher among males with low vision than among normal sighted controls.

Disability

The rating of blindness in the grading of severity of disability needs to be adjusted. Blindness implies severe repercussions for daily living activities, as defined in category 6; all blind people should therefore be classified in category 6, and people with low vision in category 5.

Other considerations

The pathway to blindness from trachoma is not specific, in the sense that the corneal opacification induced by trachomatous trichiasis may be the result of secondary infections. Therefore, if there is not enough awareness of the endemicity of trachoma in an area, it is likely that there will be an underestimate as to the role of trachoma as a cause of blindness. Furthermore, in certain rural settings, particularly in north Africa, there are regular seasonal epidemics of conjunctivitis (Kupta, Nicetic & Reinhards 1968, Reinhards et al. 1968), which is transmitted by flies in great numbers. There is a known interaction between conjunctivitis epidemics and the increased prevalence and intensity of trachoma in such populations, but this fact may easily be overlooked by local health staff.

A majority of victims of trachomatous blindness are women because of their prolonged and close contact with affected children, who act as a reservoir of *Chlamydia*. The impact of severe trachoma can therefore be considerable in making women of working age unable to fulfil their family and socioeconomic role.

Disease as risk factor for other diseases

Trachoma in its advanced stage, with corneal complications, increases considerably the risk of secondary corneal infections, which often lead to ulcers and severe loss of vision. Long-standing cases of trachoma are likely to develop the "dry eye" syndrome because of tear gland involvement; this, again, acts as a further risk factor for blindness from infections as a result of increased susceptibility of the eye. Furthermore, it should be noted that cases of advanced trachoma with corneal complications are difficult and high risk cases for eye surgery such as corneal transplants or cataract or glaucoma surgery.

It has been demonstrated in Africa and North America that blindness is associated with increased mortality (Hirsh & Schwartz 1983, Kirkwood et al. 1983). This may be a result of increased vulnerability, as a consequence of neglect, absence of social care and increased risk of accidents; it may also be that blindness attributable to certain causes, such as cataract, is a marker of ageing and thus an increased mortality.

Burden of trachoma and intervention

Treatment of trachoma should be carried out on a priority basis in communities with blinding trachoma. The objective of treatment is normally limited to elimination of blindness from trachoma, as it is neither feasible to eradicate the disease nor to eliminate the chlamydiae in the populations concerned.

Treatment of trachoma is based on antibiotic topical or systemic treatment or both, surgery for inturned eyelids, and health education pertaining to improved personal and environmental hygiene. Given that trachoma is often highly endemic in affected rural communities, the antibiotic treatment is mainly a suppressive scheme (Dawson, Jones & Tarizzo 1981) to reduce disease intensity; reinfections rapidly occur in the communities or families concerned unless other measures to improve living standards and behaviour occur (West et al. 1991). Thus, the effectiveness of trachoma antibiotic treatment is limited to disease suppression, not to elimination. Trichiasis surgery has recently been systematically evaluated (Reacher et al. 1992) and a uniform method proposed.

Access to trachoma treatment for affected populations must be provided regularly and in a long-term (several years) perspective.

The annual cost of preventing blindness from trachoma can schematically be calculated as the cost of one tube (5 gram) of tetracycline eye ointment per person per year; at present, this amounts to approximately 15 US cents in a bulk purchase. The preventive treatment should be provided throughout childhood if the level of intense inflammatory disease remains high in the community concerned. Distribution costs will depend on how community-based the control programme is in terms of primary health care, or volunteer or self-treatment options. A more comprehensive model for the cost of preventive topical or systemic treatment of trachoma has been put forward (Dawson & Schachter 1985).

Trichiasis surgery can commonly be made available for a cost of approximately US$5–10 (consumables and partial cost of instruments).

Cessation of the current trachoma control activities could potentially result in a doubling of the incidence of blindness from trachoma over a period of 10–20 years. In contrast, if currently available interventions were systematically applied in all endemic areas, it might be possible to eliminate trachoma as a cause of blindness over the next 10 years. This would necessitate strong governmental commitment with allocation of needed resources, as well as environmental improvements (water and sani-

tation) where needed, and behavioural changes for improved hygiene. A new and more effective antibiotic treatment could substantially improve the perspective of global trachoma control such as may be possible with azithromycin, a new and long-acting macrolide.

Discussion

Trachoma has been subject to numerous attempts of control in the past. Various medical and surgical treatment schemes have been used over the centuries to get rid of the characteristic follicles on the inside of the eyelids, from copper-sulphate etching in pharaonic Egypt, to surgical compression of follicles with special forceps well into the 20th century. On a public health level, trachoma was recognized as an important infectious eye disease and cause of blindness; it was a matter of concern in relation to population movements in Europe, and in the past immigration to the United States of America in the 19th and early 20th centuries.

Effective public health measures specifically against trachoma were not taken until after the Second World War. By then antibiotics were becoming available, and when the WHO started its work in the late 1940s, trachoma was one of the first diseases subject to field research on more effective large-scale control measures. After a number of field studies during the 1950s, particularly in North Africa, a control strategy was designed consisting of:

- antibiotic treatment with 1 per cent tetracycline eye ointment, which could be applied on an intermittent basis;
- access to simplified and standardized trichiasis surgery;
- health education.

This strategy was consistently implemented over the following two decades by the WHO, often in partnership with UNICEF , in most of the endemic countries. The results were often quite positive, particularly in areas of socioeconomic development, where there were improved living standards and opportunities for changes in lifestyle. This is not surprising; trachoma disappeared spontaneously in several European countries as a result of better hygiene and living standards well before the antibiotic era. Suppressive treatment of trachoma with antibiotics allows for rapid control of the blinding intensity of infection. That element of the strategy is very important in terms of preventing blindness, particularly in areas where there are no immediate prospects of improving living standards.

The global picture of trachoma has changed considerably over the past few decades as a result of the above-mentioned disease control efforts and socio-economic developments. As the disease is so closely linked to the social and public health situation, with poverty, crowding, and lack of hygiene as major propagating factors, the epidemiological pattern varies accordingly. This leads in many settings to difficulties in properly

assessing trachoma and its blinding propensity. The distribution of the disease is often quite focal, with variations in its intensity. Furthermore, significant differences in disease patterns can occur rapidly, as a result of sudden behavioural or environmental changes, for example urbanization or access to tap water.

Today trachoma is largely confined to the poorest population groups in some 40 developing countries that are still endemic. The disease has been pushed back in many countries, and is now found mainly in underserved rural areas where there is little hope of socioeconomic development. This makes it imperative to mount interventions for the prevention of blindness from trachoma in these particularly vulnerable populations, as it may take many years before the benefits of improved living conditions wipe out the disease as a cause of visual loss.

For the reasons given above, the present global estimate of trachoma given in this report can only be indicative. It is based on patchy epidemiological data, indicating only the likely magnitude of trachoma-related visual loss in known endemic countries. Still, in the absence of the large-scale population-based surveys that would be needed to derive a more reliable estimate, the present estimate is probably the most reasonable, recognizing the limitation of not having more accurate and updated information from several major populations where recent disease changes are likely to have occurred (e.g. China and India). It should also be noted that the present estimate is very conservative, as it is based on a strict definition of visual loss only in conjunction with trichiasis. This definition, although specific, does not take into account other pathways to blindness from trachoma, e.g. invasive pannus or corneal ulceration, often leading to a condition of phthisis bulbi, which can have multiple origins.

It is important to recognize the association of blinding trachoma with low standards of living; this allows for the focusing of interventions on the poorest population groups, where trachoma is likely to be a very significant cause of blindness and an obstacle to community development. The SAFE strategy (surgery; antibiotics; facial cleanliness; environmental hygiene) includes all the essential elements for successful trachoma control. The surgery for trichiasis can prevent new cases of blindness; the antibiotics can control the infection; and the personal and environmental hygiene provide the answer to sustainability of achievements in the future. The recent availability of much-improved antibiotic treatment with azithromycin opens up new perspectives for rapid and effective control of trachomatous infection in the target populations, thus allowing for an accelerated implementation of the SAFE strategy where needed.

Conclusions

Trachoma is the most important cause of easily preventable visual loss in the world. It adds significantly to the disability burden amongst vulnerable poor population groups, where the disease is commonly found today.

Trachoma control efforts, together with socioeconomic progress, have pushed back the disease in many countries, but in remaining endemic areas there is still a great need for the prevention of blindness from trachoma. A comprehensive intervention strategy, including improved antibiotics, holds out the promise of eliminating trachoma as a public health problem.

References

Abiose A (1994) Distribution and aetiology of blindness and visual impairment in mesoendemic onchocercal communities, Kaduna State, Nigeria. *British Journal of Ophthalmology*, 78:8–13.

Al Faran MF et al. (1993) Prevalence and causes of visual impairment and blindness in the south western region of Saudi Arabia. *International Ophthalmology*, 17:161–165.

Badr IA et al. (1992) Changing patterns of visual loss in the Eastern Province, Kingdom of Saudi Arabia, *Saudi Journal of Ophthalmology*, 6:59–68.

Baasanhu J et al. (1994) Prevalence and causes of blindness and visual impairment in Mongolia: a survey of populations aged 40 and older. *Bulletin of the World Health Organization*, 72:771–776.

Ballard RC, Sutter EE, Fotheringham P (1978) Trachoma in a rural South African community. *American Journal of Tropical Medicine and Hygiene*, 27:113–120.

Ballard RC et al. (1983) Trachoma in South Africa. *Social Science and Medicine*, 17:1755–1765.

Bietti GB, Freyche MJ, Vozza R (1962) La diffusion actuelle du trachome dans le monde. *Revue internationale du Trachome*, No. 2-3:114–310.

Boré, O. (1985) Thèse Doctorat en Médecine. École nationale de Médecine et de Pharmacie du Mali. [Doctoral thesis in Medicine. National school of Medicine and Pharmacology of Mali].

Brilliant LB et al. (1985) Epidemiology of blindness in Nepal. *Bulletin of the World Health Organization*, 63:375–386.

Bucher PJM, Ijsselmuiden, CB (1988) Prevalence and causes of blindness in the Northern Transvaal. *British Journal of Ophthalmology*, 72:721–726.

Cerruli L et al. (1981) Preliminary epidemiological study on the causes of blindness in one region of Ethiopia. *Revue Internationale du Trachome et de Pathologie Oculaire Tropicale et Subtropicale*, 3:117–129.

Chakrabarti J, Garg AC, Siddhu CMS (1974) Prevalence and pattern of blindness in the field practice area of a rural health training center. *Indian Journal of Ophthalmology*, 22:4–8.

Chami-Khazraji Y, Akalay O, Négrel AD, (1992) Prévalences et causes de la cécité et de la vision au Royaume de Maroc. Résultats de l'enguête nationale sur les causes de la prévalence des déficiences visuelles (ENCPDV). Rapport final. [Prevalence and causes of blindness and low vision in Morocco. Results of the national survey on the causes of vision loss. Final report] Morocco, Morocco Ministry of Public Health.

Chami-Khazraji Y, Négrel AD, Ottmani S (1994) Prévalence et gravité du trachome dans les provinces de Tata, Figuig et Errachidia [Prevalence and severity of trachoma in the provinces of Tata, Figuig and Errachidia]. Ministère de la Santé publique, Programme OMS de Prévention de la Cécité.

Chirambo MC et al.(1986) Blindness and visual impairment in southern Malawi. *Bulletin of the World Health Organization*, 64:567–572.

Dawson CR, Schachter,J (1985) Strategies for treatment and control of blinding trachoma: cost-effectiveness of topical or systemic antibiotics. *Review of Infectious Diseases*, 7:768–773.

Dawson CR, Jones BR, Tarizzo ML (1981) *Guide to trachoma control*. Geneva, World Health Organization.

Faal H et al. (1989) National survey of blindness and low vision in The Gambia: results. *British Journal of Ophthalmology*, 73:82–87.

Hirsh R, Schwartz B (1983) Increased mortality among elderly patients undergoing cataract extraction. *Archives of Ophthalmology*, 101:1034–1037.

Hu et al. (1989) An epidemiologic survey of trachoma in Shunyi County, Beijing. *Chinese Journal of Ophthalmology*, 25:175–178.

Hutin YJF et al. (1992) Le trachome dans la Région de Sabou (Burkina Faso). Une enquête épidémiologique [Trachoma in Sabou (Burkina Faso). An epidemiological investigation]. *Bulletin de la Societé de Pathologie Exotique*, 85:350–354.

Jitta NM, Luharis A (1930) *Rapport sur le trachome dans différents pays*. Geneva, Société des Nations, Organisation d'Hygiène.

Kabo (1990) Ministry of Public Health, Niger, (unpublished data).

Kirkwood B et al. (1983) Relationship between mortality, visual acuity and microfilarial load in the area of the Onchocerciasis Control Programme. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, 77:862–868.

Kupka K, Nižeti B, Reinhards J (1968) Sampling studies on the epidemiology and control of trachoma in southern Morocco. *Bulletin of the World Health Organization*, 39:547–566.

Loewenthal R, Peer J (1990) A prevalence survey of ophthalmic diseases among the Turkana tribe in north-west Kenya. *British Journal of Ophthalmology*, 74:84–88.

Luna EJA et al. (1992) Epidemiology of trachoma in Bebedouro State of Sao Paulo, Brazil; prevalence and risk factors. *International Journal of Epidemiology*, 21:169–177.

Mohan M (1989) Epidemiological studies on prevalence of trachoma and impact of trachoma control programme in India. (unpublished data).

Moll, AC et al. (1994) Prevalence of blindness and low vision of people over 30 years in the Wenchi district, Ghana, in relation to eye care programmes. *British Journal of Ophthalmology*, 78:275–279.

Newland HS et al. (1994) Epidemiology of blindness and visual impairment in the Kingdom of Tonga. *British Journal of Ophthalmology*, 78:344–348.

Newland HS, et al. (1992) Epidemiology of blindness and visual impairment in Vanuatu. *Bulletin of the World Health Organization*, 70:369–372.

Nguyen et al. (1992) Cataract Intervention Programme in Vietnam. (unpublished data).

National Sample Survey Organization (NSSO) survey (1981) (unpublished data). Pakistan Ministry of Health (1989) (unpublished data).

Rapoza PA et al. (1991) Prevalence and causes of vision loss in central Tanzania. *International Ophthalmology*, 15:123–129.

Reacher MH et al. (1992) A controlled trial of surgery for trachomatous trichiasis of the upper lid. *Archives of Ophthalmology*, 110:667–674.

Reinhards J et al. (1968) Studies in the epidemiology and control of seasonal conjunctivitis and trachoma in southern Morocco. *Bulletin of the World Health Organization*, 39:497–545.

Stocks NP, Newland H, Hiller J (1994) The epidemiology of blindness and trachoma in the Anangu Pitjantjatjara of South Australia. *Medical Journal of Australia*, 160:751–756.

Srivastava RN, Verma BL (1978) An epidemiology study of blindness in an Indian rural community. *Journal of Epidemiology and Community Health*, 32:131–135.

Tabbara KF, Ross-Degnan D (1986) Blindness in Saudi Arabia. *JAMA*, 255: 3378–3384.

Than KM (1990) The model village eye health survey. (unpublished data).

Taylor HR (1987) Prevalence and causes of blindness in Australian Aborigines. *Medical Journal of Australia*, 1:71–76.

Thomson IM, Chumbley LC (1992) Eye disease in the West Bank and Gaza Strip. *British Journal of Ophthalmology*, 68:598–602.

Thylefors B, Négrel AD, Pararajasegaram, R (1992) La surveillance épidémiologique de trachome; bilan et perspective [Epidemiological surveillance of trachoma: evaluation and perspective]. *Revue internationale du Trachome et de Pathologie Oculaire*, 69:107–114.

Thylefors et al. (1987) A simple system for the assessment of trachoma and its complications. *Bulletin of the World Health Organization*, 65:477–483.

Thylefors, B et al. (1995) Global data on blindness: an update. *Bulletin of the World Health Organization*, 73:115–121.

Thylefors B (1987) A simplified methodology for the assessment of blindness and its main causes. *World Health Statistics Quarterly*, 40:129–141.

Tunisia National study (1993) (unpublished data).

West SK, et al. (1991) Facial cleanliness and risk of trachoma in families. *Archives of Ophthalmology*, 109:855–857.

Whitfield R et al. (1983) Cataract and corneal opacity are the main causes of blindness in the Samburu Tribe of Kenya. *Ophthalmic Surgery*, 14:139–144.

Whitfield R et al. (1990) Blindness and eye disease in Kenya: ocular status survey results from the Kenya Rural Blindness Prevention Project. *British Journal of Ophthalmology*, 74:333–340.

World Health Organization (1959) Scientific Group on Trachoma Research, London, Paris, Geneva.

World Health Organization. (1962) *Expert Committee on Trachoma*. Third report. Geneva, WHO (Technical Report Series No. 234).

World Health Organization (1977) *International Classification of Diseases*, 1975 revision, Vol. 1. WHO, Geneva.

World Health Organization (1984) *Strategies for the prevention of blindness in national programmes*. Geneva, World Health Organization.

World Health Organization (1985) Prevention of blindness: China. *WHO Weekly Epidemiological Record*, 60:369–371.

World Health Organization. (1987) Prevention of blindness. *Weekly Epidemiological Record*, 43:322–323.

World Health Organization (1989) Prevalence surveys on the causes of blindness and visual loss: Togo. *Weekly Epidemiological Record*, 12:87–90.

World Health Organization. (1990) Prevention of blindness: prevalence and causes of blindness and visual loss Congo. *Weekly Epidemiological Record*, 65:249–251.

World Health Organization. 1991) Prevention of blindness: prevalence and causes of low vision: Benin. *Weekly Epidemiological Record*, 66:337–340.

World Health Organization (1992) *International Statistical Classification of Diseases and Related Health Problems*, vol. 1, Geneva, WHO World Health Organization.

Yattassaye M (1985) Thèse Doctorat en Médecine. École national de Médecine et de Pharmacie du Mali. [Doctoral thesis in Medicine. National school of Medicine and Pharmacology of Mali].

Zhang et al. (1992) National epidemiological survey of blindness and low vision in China. *Chinese Medical Journal*, 105:603–608.