

# EPIDEMIOLOGY OF CHILDHOOD BLINDNESS

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## SUMMARY

**In this paper an attempt is made to define, quantify and determine the causes of childhood blindness in different parts of the world, with particular emphasis on blinding diseases which are detectable during the neonatal period.**

The patterns of childhood blindness vary depending on the accessibility of affordable health care services as well as socio-cultural factors. A major cause of childhood blindness in one country can be insignificant in another, and even over a decade the causes of childhood blindness can change quite dramatically in the same country. Clear definitions are necessary in order to develop reasonable estimates of the size of the problem of childhood blindness, and of the major disease processes in different parts of the world. Once this information is available control strategies can be developed to reduce the incidence of childhood blindness through both preventive and therapeutic measures.

## TERMINOLOGY

Childhood is defined by UNICEF as 0–15 years. Blindness is defined by the World Health Organisation as a corrected visual acuity in the better eye of less than 3/60, or a central visual field of less than 10° (Table I).<sup>1</sup> The assessment of vision in the newborn or even the young infant can be extremely difficult. By early childhood however (age 2–3 years) it is usually possible to determine the level of visual capacity with a careful examination of the eye and a functional assessment of the child's ability to see.

## MAGNITUDE

There are very little data available on the prevalence of childhood blindness from population based studies. Prevalence and incidence data from blind registers usually under-estimate the true figure because of under-reporting.<sup>2</sup> Table II summarises the available data from different parts of the world.<sup>3</sup> Using these data a World Health Organisation meeting on Childhood Blindness in 1990 estimated that there were approximately 1.5 million blind

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children in the world of which 90% live in developing countries.<sup>4</sup> It was also estimated that approximately 500,000 children go blind each year in the world of which 60–80% die within the subsequent 1–2 years from the diseases which contributed to their blindness or from neglect consequent upon being blind.<sup>4</sup>

The prevalence of blindness in children is closely related to the availability of health care for children (nutrition, immunisation etc) and therefore also to child survival and under five mortality rates (U5MR). Countries with high U5MR (in excess of 170/1,000) are likely to have a prevalence of childhood blindness in excess of one per thousand, while those countries with low U5MR (below 30/1,000) probably have a prevalence of between 0.2–0.5/1,000 children. In Table III an attempt is made to correlate U5MR in various parts of the world with childhood blindness.

The only data on incidence of childhood blindness come from blind registrations in developed countries. The data for England are given in Figure 1.<sup>5</sup> Robinson reviewed the prevalence of congenital blindness in British Columbia from 1945–1984 showing a fairly constant figure for congenital blindness of 4/100,000 births from 1955–80.<sup>6</sup>

In summary therefore, little information is available on the magnitude of childhood blindness, although current estimates would suggest that the majority of childhood blindness occurs in Asia and Africa; that many blind children in developing countries die in childhood; and that with an increase in the childhood population (estimated at

Table I. Categories of Visual Impairment<sup>1</sup>

Category of Visual impairment	Visual acuity with best possible correction	
	Maximum less than	Minimum equal to or better than
1 Visual Impairment	6/18	6/60
2 Severe Visual Impairment	6/60	3/60
3 Blind	3/60	1/60
4 Blind	1/60	Light perception
5 Blind	Light perception	No light perception

<sup>1</sup>Adapted from International classification of diseases. 1975 revision. Geneva, World Health Organisation, 1977.

**Table II.** Prevalence of Childhood Blindness

Country (Ref)	Year	Prevalence/1000
England (5)	1981	0.10 (0-4 years)
		0.22 (5-9 years)
		0.23 (10-14 years)
Bangladesh (18)	1983	0.64 (0-5 years, rural)
		1.09 (0-5 years, urban)
Nepal (19)	1980	0.63 (0-14 years)
Malawi (20)	1983	1.1 (0-5 years)
The Gambia (21)	1986	0.7 (0-19 years)

2,025 million by the year 2,000) the number of blind children is likely to increase from the present estimate of 1.5 million.

### AETIOLOGY

Childhood blindness can be usefully classified from an aetiological viewpoint into:-

- factors which act at the time of conception, e.g. genetic and chromosomal abnormalities
- factors operating during the intra-uterine period, e.g. infections (rubella, toxoplasmosis), toxins (alcohol, quinine)
- factors operating at the time of birth or during the post-natal period, e.g. cerebral hypoxia, retinopathy of prematurity and ophthalmia neonatorum
- factors operating in childhood, e.g. vitamin A deficiency, trauma.

An anatomical classification of blindness in children is also of value as it may be difficult to determine whether, for example, optic atrophy is hereditary in origin, or due to toxins acting during pregnancy, or due to hypoxia or trauma consequent upon birth, or secondary to meningitis in early childhood. This is particularly the situation in developing countries where details of past medical history may not be available. An anatomical classification can be used to describe differences in the patterns of childhood blindness between different countries, and in the same country over time. For example, corneal blindness is particularly common in parts of Africa accounting for 40-70% of childhood blindness,<sup>7,8</sup> but is extremely uncommon in Europe, where retinal diseases, particularly dystrophies and retinopathy of prematurity, are responsible for approximately a quarter of blindness in children.<sup>9,13</sup> In Table IV a correlation is given between the aetiological and anatomical classifications in respect to

major causes of childhood blindness from a global perspective.

Genetic factors are the prevailing cause of childhood blindness in societies which have developed good health services for children, e.g. Europe and North America, and in those communities in which, for either cultural or geographical reasons, consanguinity is common, e.g. ethnic minorities, small island communities etc.<sup>12,6,9,10,15</sup>

Relatively little is known about the role of infections or toxins in causing developmental damage to the eye *in utero*. Rubella remains an endemic disease in most parts of the world, but fortunately the majority of females contract the disease in childhood so acquiring natural immunity. In many societies, however, a small percentage of child bearing women will be susceptible to infection and therefore, following intermittent but regular epidemics of rubella, a cluster of often multiply handicapped children are born. In many parts of the world the multiply handicapped child does not survive to school age. Rubella begins to become a significant cause of childhood blindness in those countries where blindness from malnutrition and measles have been eradicated but where rubella immunisation either of school age girls or as part of a universal child immunisation programme has not yet been introduced. Isolated communities (e.g. small islands), because of the irregularity of rubella epidemics, tend to produce populations with more susceptible females of child bearing age and hence occasional epidemics of children with congenitally acquired rubella.<sup>11</sup>

The fetal alcohol syndrome is becoming an increasingly well recognised cause of congenital ocular abnormalities particularly of optic nerve hypoplasia,<sup>12</sup> and it is quite likely that other products, medicines or environmental substances will be found to have a harmful effect on the developing eye and particularly the optic nerve. Optic atrophy accounts for more than a quarter of childhood blindness in England<sup>13</sup> and a recent study from Eire documented optic nerve disease being responsible for over 40% of childhood blindness.<sup>9</sup>

The premature baby is particularly at high risk of visual loss from perinatal factors. Cerebral hypoxia may result in damage to the visual cortex or pathways and is often associated with other central nervous system abnormalities. Retinopathy of prematurity (ROP) can occur in babies with a birthweight under 1.5 kg. In countries with excellent neonatal care services the increased survival of very

**Table III.** Magnitude of Childhood Blindness in Different Countries by Under 5 Year Mortality Rate (U5MR) (1988)

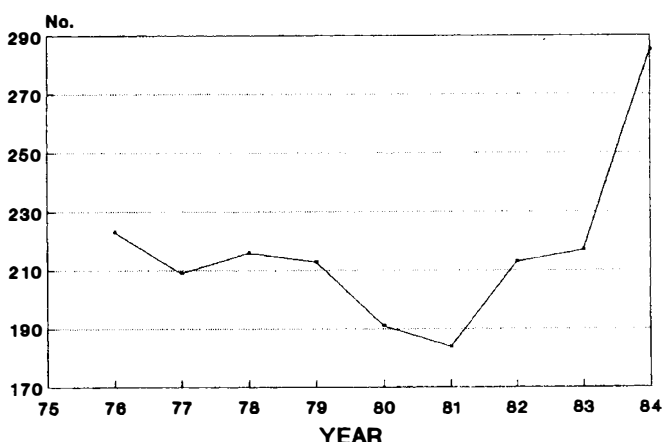
U5MR/1000	Under 16 yrs Population (millions)	Example Countries	Estimated Prevalence/1000	Number of Blind Children
Very High (171+)	233	Nigeria Bangladesh	1.5	350,000
High (95-170)	613	India Kenya	0.9	613,000
Middle (31-94)	706	China Brazil	0.6	424,000
Low (30 and under)	212	USA France	0.3	63,000
	1,764			1,450,000

## ENGLAND 1976 - 1984, INCIDENCE OF NEW BLIND REGISTRATIONS AGE 0-15Yrs

**ENGLAND 1976-1984, INCIDENCE OF NEW  
BLIND REGISTRATIONS AGE 0-15yrs**

YEAR	No.
1976/77	223
1977/78	209
1978/79	216
1979/80	213
1980/81	191
1981/82	184
1982/83	213
1983/84	217
1984/85	285
<hr/>	
Mean 217	
95% C.L. 160-274	
S.D. 28.6	

**ENGLAND 1976-1984, INCIDENCE OF NEW  
BLIND REGISTRATIONS AGE 0-15yrs**



**Fig 1**

low birth weight infants is resulting in a re-emergence of ROP as an important cause of childhood blindness. In other countries, e.g. parts of Latin America and Asia, the use of high dose, often unmonitored oxygen in neonates is only now being recognised as a significant and preventable cause of visual loss. While in the poor areas of the world ophthalmia neonatorum due to *Neisseria gonococcus* occurring in the first week after birth, may remain untreated because of inadequate eye care services resulting in corneal ulceration and blindness in the neonatal period.<sup>14</sup>

The most important cause of childhood blindness on a worldwide basis is corneal ulceration due to vitamin A deficiency. This occurs most commonly in children aged between one and four years and often follows measles infection or severe gastroenteritis. The use of harmful traditional medicines in areas without eye or health care is also an important cause of childhood blindness.<sup>8,14</sup>

### GEOGRAPHIC DISTRIBUTION

The causes and time of onset of childhood blindness vary from one part of the world to another. Table V summarises the anatomical cause of blindness in children in blind schools in different regions of the world from examin-

ations conducted since 1975. These show the importance of corneal diseases acquired during childhood in East Africa (70%), West Africa (40%) and South Asia (30%). Cataract is usually found to be responsible for between 5–20% of blindness in children. Unoperated mature cataracts in children are seen in around 10% of children in blind schools in developing countries.

Retinal causes of visual loss which may present during infancy include retinal dystrophies, and retinopathy of prematurity. These account for 20–30% of cases in South Asia, Latin America and Europe. Glaucoma at birth or in childhood is relatively uncommon although it does account for 5–10% of blindness in children from West Africa, South Asia and Latin America. Optic nerve disease as already mentioned is an increasingly important cause in industrialised countries.

Studies in various countries have noted the changing pattern in childhood blindness over time. In Saudi Arabia acquired childhood diseases accounted for 75% of childhood blindness prior to 1962, while genetically determined diseases accounted for 84% of childhood blindness after 1962.<sup>15</sup> Similarly in Kenya corneal scarring has been observed to be less of a problem now than ten years ago,<sup>16</sup> and in Chile there is evidence that ROP is becoming an

**Table IV.** Relationship between Aetiological and Anatomical Causes of Childhood Blindness for Major Blinding Diseases in Children

	Cornea	Lens	Retina	Optic nerve
Genetic Factors	Rare	Familial cataract	Inherited dystrophies	Inherited optic atrophy
In-utero Factors	Rare	Rubella	Toxoplasmosis	Alcohol and other toxins
Peri-natal Factors	Ophthalmia Neonatorum	Rare	ROP	Cerebral hypoxia
Childhood Factors	Vit A deficiency Measles Harmful medicine	Rare	Retinal detachment	Meningitis, neoplasia

**Table V.** Childhood Blindness in Different Areas of the World by % Anatomical Cause: 1975–1991

Area of world (no. of blind children exam)	Cornea	Lens	Uvea	Retina	Glauc.	Optic Atrophy	Others
East Africa <sup>1</sup> (n = 1845)	72	6	2	3	1	6	10
West Africa <sup>1</sup> (n = 567)	39	15	6	11	10	7	12
South Asia <sup>1</sup> (n = 424)	33	7	1	20	5	5	29
Latin America <sup>1</sup> (n = 991)	8	20	1	26	10	10	25
Europe/N. America <sup>2</sup> (n = 1806)	1	8	1	30	2	23	35

<sup>1</sup>Data from surveys of the causes of blindness in children attending blind schools.

<sup>2</sup>Data from registrations of blind children and examination of blind children in institutions.

increasing problem.<sup>17</sup> It is therefore important that data be obtained either from registrations or from regular examination of blind school children to document the changing patterns of childhood blindness so that appropriate control measures can be implemented.

### CONTROL MEASURES

It is not possible to go into any depth concerning all the possible control measures, but certain general comments can be made. First, at least 50% and probably 75% of childhood blindness in the world is potentially preventable or curable with today's knowledge. Secondly, each country needs to determine the important causes of childhood blindness and develop appropriate programmes for the prevention or cure of these causes. Thirdly, in order to develop control measures against childhood visual loss, an integrated approach involving community paediatricians, experts in special education, ophthalmologists and health planners is required, together with appropriate specialised personnel as indicated, e.g. geneticists, nutritionists, neonatologists etc.

### CONCLUSION

Of the estimated 1.5 million blind children in the world 1.3 million live in Asia and Africa and probably 75% of causes are preventable or curable. More information is needed on the magnitude and severity of visual loss in children in different parts of the world, and on the changing patterns of childhood blindness over time in individual countries. This information, when available for each country, should be used to develop a co-ordinated and integrated control programme against the important causes of avoidable blindness in children in each individual country.

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