Prevalence and causes of blindness and visual impairment in Mongolia: a survey of populations aged 40 years and older

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*The survey was conducted in 3 out of the 18 administrative regions (*aimaks*); 4345 people aged ≥40 years were examined, which represented 95.7% of the proposed sample.*

The prevalences of blindness and low vision in the sample were 1.5% (95% CI, 0.8–2.3%) and 8.1% (95% CI, 5.5–10.7%), respectively, from which the prevalences of blindness and low vision in the Mongolian population aged 40 years and older were estimated to be 1.4% and 7.7%, respectively. The prevalence of climatic droplet keratopathy was high (ranging from 15% to 50%) in this population, which included a large number of semi-nomadic cattle breeders, and was responsible for 7.2% of the blindness and 19.3% of the low vision. Cataract and glaucoma were the commonest blinding disorders, each accounting for around 35% of the blindness. Trauma accounts for a high proportion of those monocularly blind. Trachoma and xerophthalmia were not found.

Introduction

The prevalence of severe blindness (defined as no light perception, or inability to see hand movements or count fingers at less than 25 cm) in various regions of Mongolia has been estimated at 0.2%; no figures are available on the basis of the present WHO definition (i.e., less than 3/60 vision in the better eye) (*1*). There appears to be a high prevalence of climatic droplet keratopathy (CDK) and glaucoma but relatively few cataracts, which is a different pattern from most countries in a similar economic situation. In order to direct a future prevention of blindness programme and to allocate resources to the best advantage, it was considered important to obtain population-based figures for the prevalence and causes of blindness.

The population of 2.1 million is widely scattered over an area equal to that of Western Europe. Despite the long distances and high cost of transport, the health infrastructure is well developed. Excellent census data are available and are updated frequently.

The country is composed of 18 *aimaks* (regions), each divided into 17 *somons* (districts). Each district is made up of a centre and 3 to 4 "brigades" (an organization of widely scattered tent houses), the total population varying between 2000 and 4000.

Materials and methods

Populations were sampled from three *aimaks*, which were selected to represent the three main geographical regions of the country: Gobi desert, steppe, and mountainous. Three to five *somons* were selected from each *aimak*, representing their geographical and ethnic features. The aim was to examine every person aged ≥40 years in the selected districts, as many as possible being seen in the hospital at the *somon* centre; the others were seen in their homes (*gers*).

The examinations were carried out and recorded mainly by one ophthalmologist in each *aimak*; four ophthalmologists were involved and were trained together for a standardized approach. During the different stages of the survey, the principal investigator visited each *aimak* during the examinations and was responsible for the overall quality of the records. The timing of the survey in each region, between late May and October 1991 and from July to August 1992, was determined largely by the seasonal activities of the semi-nomadic people.

Visual acuity, with correction, was tested using the Cyrillic alphabet or Landolt's C chart. If vision was worse than 6/18, a pinhole was used to test for improvement. Blindness was defined as visual acuity of less than 3/60, and low vision as visual acuity in the range of 6/24 to 3/60 in the better eye with the

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best available correction. The external eye, cornea, anterior chamber and anterior lens were examined with a Zeiss hand-held slit lamp. CDK or chronic actinic keratopathy was graded according to the criteria set out in Table 1. Pterygium, provided it was clearly extending onto the cornea, was recorded if present, regardless of size.

Cataract was graded by viewing with an ophthalmoscope from a distance of 20 cm against the red glow of the fundus through undilated pupils. However, in the presence of Grades 3 or 4 keratopathy which obscured the view of the lens, the pupils were dilated with 1% tropicamide so that a clear view of the lens could be obtained over the dark band. Estimation of anterior chamber depth was made by slit-light test prior to pupillary dilation. Tropicamide was not used in eyes suspected of being at risk of angle closure. The criteria for grading of cataract (Table 1) were based on a method that has been shown to have good inter-observer agreement in surveys (*2*).

In addition to the systemic assessment of CDK, cataract and pterygium in all subjects, those with impaired vision of less than 6/18 in either eye were examined in detail to ascertain the principal disorder causing the visual impairment, and when possible to record the underlying etiology. The WHO protocol was followed for this purpose.[a] When there were two disorders, one being secondary to the other, the primary disorder was recorded as the cause of the visual loss. When there were two or more co-existing primary disorders, the disorder most readily curable — or if not curable, most easily preventable — was selected as the cause of the poor vision. The detailed eye examination included fundoscopy after dilation of the pupils.

All the findings were entered on the WHO/PBL Eye Examination Record (version III). The causes of low vision or blindness were then entered for each eye, and the principal disorder for the person marked. In each case, a decision was made on the underlying cause. Finally, current action needed was indicated. Data entry into a computer database was carried out in Mongolia and analysis was performed in London.

For internal comparisons, age-standardized prevalence data were used, taking the age structure of the whole sample as the standard. An alternative standard might have been the population of Mongolia, but there was no breakdown after age 70 years in the census data available to us at the time of analysis, which would have been a serious disadvantage. Confidence limits for the prevalence of blindness and low vision were computed, taking the 'design effect' (cluster random sampling) into account. This gives less precise estimates compared to simple random sampling, whereby individual people rather than clusters are selected at random. The 'design effect' for prevalence of blindness in this survey was large at 4.66, making the sampling error about 2 times larger compared to simple random sampling.

Table 1: **Grading of climatic droplet keratopathy (CDK) and cataract**

Grade	Description
CDK:	
0	No CDK
1	Droplets restricted to nasal and temporal bands of cornea
2	Droplets extending into the pupillary area, but not dense enough to interfere with vision
3	Continuous band across the pupil, dense enough to reduce vision
4	Definite raised nodules, yellowish or clear
Cataract:	
0	Clear red reflex
1	Trace opacity present
2	Opacity occupies less than half of red glow
3	Opacity occupies half or more of pupil space, but some red glow still visible
4	Completely opaque; black, no red glow

Results

The number of people aged ≥40 years required for the survey in the 12 sampled districts in the three *aimaks* and the numbers actually examined are shown in Table 2; an average of 95.7% responded. The age distribution of the sample corresponded closely to that of the population of Mongolia for both males and females aged 40 years or older.

The prevalences of blindness and low vision in the sampled populations were 1.5% (95% CI, 0.8–2.3%) and 8.1% (95% CI, 5.5–10.7%), respectively (see Table 3). The age-specific prevalences are shown in Fig. 1. Using the sample age-specific prevalence data, the prevalences of blindness and low vision in the population aged ≥40 years were estimated to be 1.4% and 7.7%, respectively.

Table 4 shows the age-standardized prevalences of blindness, low vision, cataract, and climatic droplet keratopathy. Umnugobi *aimak* showed the lowest prevalence of blindness, but the highest proportion of people with cataract. Conversely, Dornod had the highest blindness rate and highest prevalence of CDK, but the lowest percentage with cataract.

[a] *Coding Instructions for the WHO/PBL Eye Examination Record* (Version III). Unpublished WHO document, PBL/88.1, 1988.

Table 2: **Size of required sample, aged ≥40 years, and response rate in the 3 *aimaks*, 1991–92**

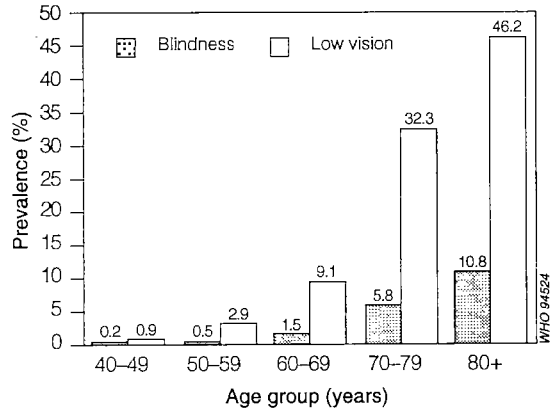
Aimak	No. of *somons* sampled	Sample required	No. examined	Coverage (%)
Umnugobi	4	1 501	1 500	99.93
Dornod	5	1 501	1 403	93.47
Arkhangai	3	1 540	1 442	93.64
Total	12	4 542	4 345	95.66

The causes of blindness, low vision and monocular blindness and their distribution in the 3 *aimaks* are presented in Fig. 2–4. Glaucoma and cataract are important causes of blindness in this population. Climatic droplet keratopathy is an important cause of blindness (7.2%) and low vision (19.3%), and is the major cause of corneal blindness and low vision — 5/6 (83%) and 71/89 (80%) respectively. Among the underlying causes of monocular blindness was trauma (41%), which accounted for a large proportion of the cases of pththisis as well as some of the other categories.

The distribution of the grades of climatic droplet keratopathy in the sample is shown in Table 5 (see page 775); grades 3 and 4 CDK were more prevalent in males in each age group except the oldest (≥80 years). The relationship in each *aimak* can be deduced from the data in Table 4.

The numbers requiring various eye care services in each *aimak*, as estimated by the examining ophthalmologist, are given in Table 6. For example, the need for cataract extraction is much higher in Umnugobi than in the other regions. If the sampled *aimaks*, despite the variations between them, can be considered as representative of the country as a whole, the eye care services needed by the whole population of Mongolia aged 40 years and over, which is 363 000, can be estimated. This gives a figure of approximately 22 000 persons requiring cataract surgery, 2600 for glaucoma surgery, 3000 for lid surgery and, including other treatment, a total of 49 500 requiring eye care.

Fig. 1. **Age-specific prevalences of blindness and low vision in ≥40-year-olds, 1991–92.**



Discussion

The very good response rate (95.7%) in this survey was due to the very good census data, the well-developed health infrastructure, and the outstanding cooperation of the health officials and other administrators.

Climatic droplet keratopathy was found to be very common and more severe than in Labrador (Canada), although not as pronounced as in Somalia and the Red Sea coastal areas. Its frequency and severity could have been expected in the cattle-breeders, who all their lives are exposed to the bright glare of the sun reflected from the snow, which in some areas is present for up to 6 months of the year. There are 260 sunny days a year in Mongolia and the climate is dry; there are also strong winds. The high prevalence of CDK, in the presence of a low rate of cataract, deserves comment. There is strong circumstantial evidence that CDK is due to exposure to reflected UV light, possibly made worse by particulate injury from wind-blown sand or snow and ice particles. The findings therefore raise questions as to whether UV light is likely to be a major etiological

Table 3: **Prevalences of blindness and low vision in the samples, 1991–92**

Aimak	No. with blindness	No. with low vision	No. with monocular blindness (%)	Sample total
Umnugobi	16 (1.07)[a]	128 (8.53)	24 (1.60)	1 501
Dornod	34 (2.27)	174 (11.59)	51 (3.40)	1 501
Arkhangai	19 (1.23)	66 (4.29)	40 (2.60)	1 540
Total:	69 (1.52)	368 (8.10)	115 (2.53)	4 542
Upper limit[b]	(2.29)	(10.70)	(3.15)	
Lower limit[b]	(0.75)	(5.51)	(1.92)	

[a] Figures in parentheses are percentages.
[b] 95% confidence limits for overall prevalence.

Table 4: **Percentage age-standardized prevalences of blindness, low vision, cataract, and climatic droplet keratopathy (CDK) in the 3 *aimaks*, 1991–92**

	Age-standardized[a] prevalences (%) in:		
	Umnugobi	Dornod	Arkhangai
Blind	1.08	1.97	1.39
Low vision	8.98	10.05	4.77
Blind + low vision	10.05	12.02	6.16
Cataract:			
Grade 1–4	16.17	5.09	8.38
Grade 2–4	8.49	3.93	5.02
CDK present (grade 1–4)	18.60	49.71	15.31

[a] For age-standardization, the age structure of the whole sample was used as the standard.

factor for cataract in this setting. The correlation between these two conditions will be the subject of a separate analysis and further research.

The substantial number of people requiring lid surgery, in the absence of trachoma, is explained by the fact that spastic entropion is common in old age among the cattle-breeders. Many of them have no protective glasses in the severe continental climate.

What are the measures to be taken within a programme for preventing blindness? Because of the very large distances between settlements in Mongolia and the difficulty and cost of transport, the key to progress appears to be development of preventive and curative services at the level of the *aimaks*. At present, each of these has one to three ophthalmologists. Upgrading of diagnostic and microsurgical facilities, and additional training in microsurgery for ophthalmic surgeons would mean that most cases of cataract, trauma and corneal disease could be treated

Fig. 2. **Causes of blindness, 1991–92** (CDK = climatic droplet keratopathy).

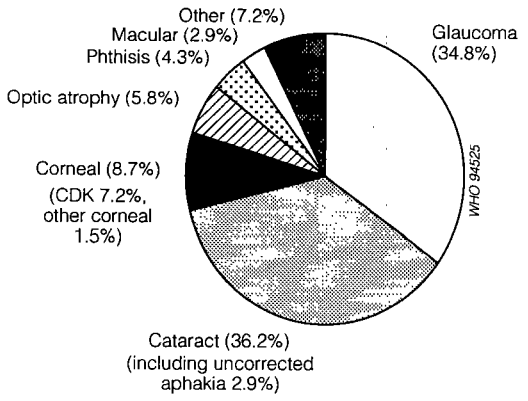


Fig. 3. **Causes of low vision, 1991–92** (CDK = climatic droplet keratopathy).

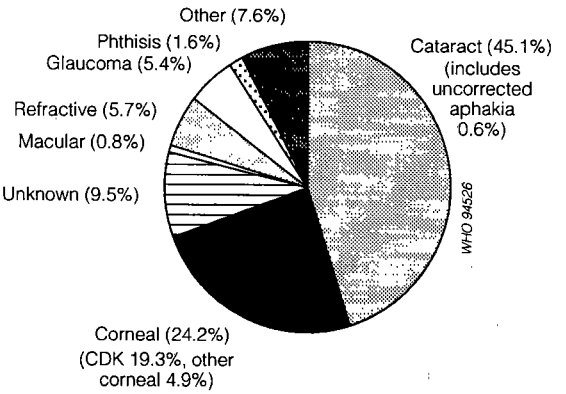
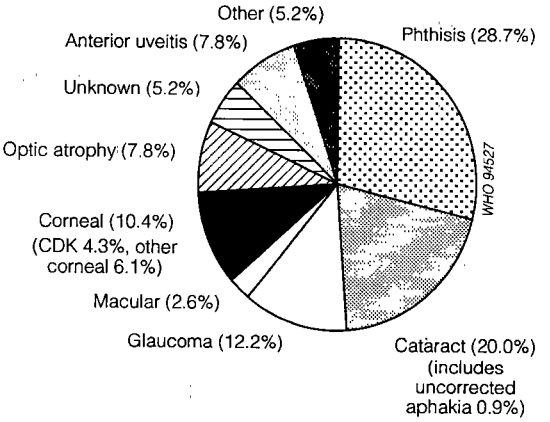


Fig. 4. **Causes of monocular blindness, 1991–92** (CDK = climatic droplet keratopathy).



locally and promptly within the *aimak*. Consideration may be given to a trial of prophylactic treatment for second eyes and cases at high risk of acute angle-

Table 6: **Numbers needing basic eye care services among ≥40-year-olds, 1991–92**

	Estimated number in:			
	Umnugobi	Dornod	Arkhangai	Mongolia
Total population aged ≥40 years	7 732	14 244	16 326	363 000
Need cataract surgery	979	323	530	22 004
Need glaucoma surgery	67	95	95	2 563
Need lid surgery	113	19	138	2 959
Need spectacles	118	104	233	4 473
Need medication	227	380	64	7 249
Need other treatments	340	399	201	10 207
Total needing basic eye care	1 844	1 320	1 261	49 455

Table 5: **Distribution of grades (0 to 4) of climatic droplet keratopathy (CDK) in the sample, by age group and sex, 1991–92**

Age group	CDK 0	CDK 1	CKD 2	CDK 3	CDK 4	Total
40–49 years:						
Males	599	52	17	6	3	677
	(88.5)[a]	(7.7)	(2.5)	(0.9)	(0.4)	
Females	834	39	17	0	0	890
	(93.7)	(4.4)	(1.9)	(0.0)	(0.0)	
50–59 years:						
Males	484	101	49	25	14	673
	(71.9)	(15.0)	(7.3)	(3.7)	(2.1)	
Females	517	78	38	8	2	643
	(80.4)	(12.1)	(5.9)	(1.2)	(0.3)	
60–69 years:						
Males	226	78	72	39	36	451
	(50.1)	(17.3)	(16.0)	(8.6)	(8.0)	
Females	219	61	77	29	7	393
	(55.7)	(15.5)	(19.6)	(7.4)	(1.8)	
70–79 years:						
Males	76	45	43	31	24	219
	(34.7)	(20.5)	(19.6)	(14.2)	(11.0)	
Females	111	55	43	34	8	251
	(44.2)	(21.9)	(17.1)	(13.5)	(3.2)	
≥80 years:						
Males	30	13	13	11	1	68
	(44.1)	(19.1)	(19.1)	(16.2)	(1.5)	
Females	31	7	16	21	5	80
	(38.8)	(8.8)	(20.0)	(26.3)	(6.3)	
Total						
Males	1 415	289	194	112	78	2 088
	(67.8)	(13.8	(9.3)	(5.4)	(3.7)	
Females	1 712	240	191	92	22	2 257
	(75.9)	(10.6)	(8.5)	(4.1)	(1.0)	
Both	3 127	529	385	204	100	4 345
	(72.0)	(12.2)	(8.9)	(4.7)	(2.3)	

[a] Figures in parentheses are percentages (in the row).

closure glaucoma. A long-term clinical trial for the prevention of CDK with protective sunglasses is also proposed. Extrapolating our results to the national population aged 40 years and over, we see that approximately 22 000 people require cataract surgery and some 50 000 need some kind of eye service or treatment. With 80 ophthalmologists and 60 ophthalmic nurses already trained and available in the country, serving these people is an achievable target.

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Résumé

Prévalence et causes de la cécité et des altérations visuelles en Mongolie: enquête chez les 40 ans et plus

Cette population de 2,1 millions de personnes est disséminée sur un territoire comparable à l'Europe occidentale et est desservie par des services de santé bien développés, alors que le revenu par habitant est assez faible. Une proportion importante de la population a conservé un mode de vie traditionnel d'éleveurs de bétail semi-nomades. Des rapports ont signalé une forte prévalence du glaucome et de la kératopathie en gouttelettes, mais aucune donnée sûre n'est venue confirmer

l'ampleur ni les causes de la cécité et de la baisse de vision.

On a choisi trois des dix-huit régions administratives (*aimaks*) pour représenter les principales zones géographiques du pays: désert de Gobi, steppe et montagne. Chaque *aimak* est subdivisé en *somons* (districts) de 2000 à 4000 habitants. Le but de l'enquête était d'examiner tous les sujets de 40 ans et plus dans 3 à 5 somons de chacun des 3 aimaks choisis. Au total, 4 345 personnes ont été examinées, ce qui représente 95,7% de l'échantillon souhaité. La cécité et la baisse de vision ont été notifiées en fonction de critères de l'acuité visuelle, après tentative de meilleure correction inférieure à 3/60 et comprise entre 6/24 et 3/60, respectivement. On a examiné la cornée des sujets avec une lampe à fente (manuelle) afin d'établir une cotation de la kératopathie en gouttelettes conformément aux critères admis. Pour la cataracte, le degré d'atteinte a été établi à l'aide d'un ophtalmoscope, analysant le reflet pupillaire par observation du cristallin à 20 cm de distance.

La prévalence de la cécité et de la baisse de vision dans la population échantillonnée a été de 1,5% (intervalle de confiance à 95%, 0,8–2,3%) et de 8,1% (IC à 95%, 5,5–10,7%), respectivement. Le glaucome (34,8%) et la cataracte non opérée (33,3%) sont des causes importantes de cécité. Avec 8,7%, les atteintes cornéennes constituent la troisième cause de cécité, les kératopathies en gouttelettes représentant 7,2% de ces dernières. Les causes de baisse de vision sont la cataracte (45,1%) et les atteintes cornéennes (24,2%, dont 19,3% de kératopathies en gouttelettes). Un traumatisme est à l'origine de 41% des cas de cécité monoculaire. On n'a observé aucun cas de trachome, de xérophtalmie ni de lèpre.

La kératopathie en gouttelettes est commune, alors que la cataracte est moins fréquente qu'on ne le pensait. Les éleveurs sont, du fait de leur mode de vie, exposés au rayonnement intense du soleil, reflété par la neige jusqu'à 6 mois par an. Il y a 260 jours de soleil par an en Mongolie et le climat y est sec. On pense que la forte exposition potentielle aux UV explique le taux élevé de cas de kératopathie en gouttelettes. Si l'on projette le résultat de cette petite enquête chez les 40 ans et plus au plan national, il apparaît qu'environ 22 000 personnes devraient être opérées de la cataracte et que quelque 50 000 personnes ont besoin de soins ou de traitements oculaires. Avec les 80 ophtalmologistes et 60 infirmières en ophtalmologie qualifiées dont il dispose, ce pays devrait être en mesure de prendre en charge tous ces cas.

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