WORLD VIEW

Prevalence of blindness and low vision in Malaysian population: results from the National Eye Survey 1996

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Background: A national eye survey was conducted in 1996 to determine the prevalence of blindness and low vision and their major causes among the Malaysian population of all ages.
Methods: A stratified two stage cluster sampling design was used to randomly select primary and secondary sampling units. Interviews, visual acuity tests, and eye examinations on all individuals in the sampled households were performed. Estimates were weighted by factors adjusting for selection probability, non-response, and sampling coverage.
Results: The overall response rate was 69% (that is, living quarters response rate was 72.8% and household response rate was 95.1%). The age adjusted prevalence of bilateral blindness and low vision was 0.29% (95% CI 0.19 to 0.39%), and 2.44% (95% CI 2.18 to 2.69%) respectively. Females had a higher age adjusted prevalence of low vision compared to males. There was no significant difference in the prevalence of bilateral low vision and blindness among the four ethnic groups, and urban and rural residents. Cataract was the leading cause of blindness (39%) followed by retinal diseases (24%). Uncorrected refractive errors (48%) and cataract (36%) were the major causes of low vision.
Conclusion: Malaysia has blindness and visual impairment rates that are comparable with other countries in the South East Asia region. However, cataract and uncorrected refractive errors, though readily treatable, are still the leading causes of blindness, suggesting the need for an evaluation on accessibility and availability of eye care services and barriers to eye care utilisation in the country.

Malaysia sits on the South China Sea in the centre of South East Asia. The country consists of two geographically distinct areas, Peninsular Malaysia (West Malaysia), which is attached to the main continent, and East Malaysia, which is located on the island of Borneo. Peninsular Malaysia is divided into 12 states while East Malaysia is divided into two states (Sabah and Sarawak). The total population of Malaysia based on a 1996 projected population report was approximately 20 million. It is a multiracial country with about 53% of its population in rural areas. The Malay race makes up the majority of the population (49%) followed by the Chinese (27%), indigenous people (13%), Indians (8%), and other races (3%). The indigenous groups consist of a diverse mix of various races but are mostly made up of Kadazans, Muruts, Dusuns, Ibans, Bajaus, Bidayuhs, and Orang Asli while "other races" consist of Eurasian and other minorities. Twelve per cent of the population is over 50 years of age while the male:female ratio is 1:1.

According to 1990 World Health Organization (WHO) estimates, the world prevalence of blindness was 0.7%, ranging from 0.3% in the established market economies to 1.4% in sub-Saharan Africa.[1] In South East Asia, the prevalence of blindness has been reported to be 1.2% in Indonesia, 1.1% in Thailand, and 0.8% in Vietnam.[2] In Malaysia, two population based studies on blindness and visual impairment had been conducted in a Malay subpopulation in the same village, 10 years apart. The studies revealed prevalence rates of 4.3% and 1.7% in 1984 (sample size 515)[3] and 5.6% and 0.7% in 1994 (sample size 341)[4] for visual impairment and blindness, respectively. Cataract was the major cause of blindness in both the studies. Although these data were valuable, important information about the country burden of blindness and low vision, and their contributing causes remained unanswered.

Thus, the first Malaysian National Eye Survey (NES) was conducted in a representative sample of the population to determine the prevalence of blindness and low vision and their major causes in the country.

METHODS

Study design and sample

The survey sampling strategy of the NES followed a stratified two stage cluster probability design. The survey target population was all civilian non-institutionalised citizens, of all ages, who reside in Malaysia in 1996. The representative sampling frame for this population was based on the estimates derived from the listing used by the Department of Statistics for its 1995 labour force survey.[5]

For the first stage of the sample design, Malaysia was considered to be a universe composed of 40 362 primary sampling units (PSUs). PSUs were enumeration blocks created by the department of statistics and comprised contiguous geographical areas with natural or artificial boundaries that did not straddle administrative boundaries. These PSUs were clustered into 27 strata, with one urban and one rural stratum from each state (with an exception of the capital state of Federal Territory, which has only an urban stratum). A PSU consisted of 100–120 living quarters. These living quarters were the secondary sampling units.

Eight to 51 PSUs were chosen from each stratum with probability proportional to population size. This gave a total of 837 PSUs selected in the first stage. Within a PSU, 8–10 occupied living quarters were selected. The exact number selected for each PSU was calculated to yield a self weighting sample. The sample was designed so that the NES sample would consist of 6000 living quarters.

However, of these 6000 living quarters, only 4365 (72.8%) were contactable or responded. The non-contactable or non-response living quarters (1365 or 28.2%) were either vacant or their occupants refused to participate. There were 18 957 residents in the sampled and responsive living

quarters. Out of these 18 957 individuals, 18 027 individuals (95.1%) completed the survey. Thus, the overall response rate was 69% (0.951 × 0.728). Unfortunately, the information on the non-response living quarters and individuals was not available.

Field procedure

The field work, including the diagnostic criteria and recording of specific diseases and the selection criteria for the principal causes of blindness, was carried out in accordance with the WHO protocol (WHO/PBL/88.1). The data were collected using the WHO/PBL Eye Examination Record Form (Version III), with modifications to adjust for the local spectrum of expected eye disorders.

The fieldwork consisted of enumeration followed by eye examinations. The enumerators were junior public health assistants who visited all sampled living quarters within the selected PSU to identify potential respondents and to notify them on the date of arrival of eye examination teams. They made repeated trips to a living quarter when a respondent was not immediately found. The list of eligible residents of the living quarter was then prepared.

There were 40 eye examination teams. Each team consisted of an ophthalmologist, an ophthalmic resident, an ophthalmic assistant, a staff nurse, and a driver. The ophthalmic assistants or the staff nurses checked the vision while the ophthalmologists and ophthalmic residents performed eye examinations and recorded the findings. All the team members underwent training for their respective tasks, which include practical sessions on eye examination and filling in the data collection forms. Training was based on the survey protocol and manual of operation to ensure standardisation. The five principal investigators supervised and monitored the fieldwork and were responsible for the quality of the records.

The eye examination teams began the household visits with gathering of demographic data from the respondents, which included age, date of birth, sex, race, family income, level of education, and occupation. History of diabetes mellitus, hypertension, eye trauma, or previous eye surgery was also inquired about.

Presenting visual acuity was assessed using a standard metric Snellen chart of E type or alphabets (both of non-illuminating type) at 6 metres. If the participant had his or her own eye glasses, measurement was done with their eye glasses. If visual acuity was worse than 6/18 in the measured eye, it was retested with pinhole correction and pinhole improvement until 6/18 or better was noted. Whenever possible the visual acuity was assessed in bright sunlight, outdoors with the respondents' backs facing the sun.

Young children, usually those less than 3 years of age, who could not read the alphabet or comprehend E optotype, and babies had their vision assessed subjectively based on their ability to follow light and objects or their ability to walk around independently. Whenever possible, a picture chart was used to estimate their visual acuity. Parents were asked for a history of visual impairment. External eye examination and pupillary light reaction were performed. From these subjective observations, a conclusion was made as to whether the child was blind or not.

All participants received a basic eye examination of the anterior segments by the team doctors using torchlight and magnifying loupes. Detailed examination of media and fundus was performed with dilated pupil on those whose visual acuity did not improve to 6/18 on pinhole, those with a history of diabetes, or those who were 50 years and older. Participants with an enlarged cup-disc ratio of more than 0.4 had their intraocular pressure measured with a Perkins hand held applanation tonometer.

The causes of low vision or blindness were recorded for each eye, together with its underlying aetiology such as congenital factor, infection, trauma, etc. The principal disorder for the person was then marked. When there were two disorders in the same eye, one being secondary to the other, the primary disorder was recorded as the principal cause of the visual loss. When there was more than one primary disorder or the disorders causing blindness or low vision were different in the two eyes, the most readily curable or preventable one was selected as the principal disorder. Finally, the current action required was indicated and referral letter given to the person for further treatment at the nearest hospital.

A field edit was performed on all completed case record forms on the same day to identify recording errors, such as inconsistencies and missing data. If there were queries about the information collected, the participants were contacted to clarify the problem. Thereafter, completed case report forms were sent to a central collection point in every state. State coordinators double checked data for errors and then forwarded the data forms to the research secretariat in the department of ophthalmology, Universiti Kebangsaan Malaysia, for coding and editing. Data entry was carried out manually, followed by data validation and cleaning.

Definition

This survey used the WHO definition on blindness, low vision, and visual impairment. Blindness was defined as presenting visual acuity of less than 3/60 or inability to count fingers at a distance of 3 metres in the better eye using available means of correction (with spectacles when available). Low vision was defined as presenting visual acuity of less than 6/18 but equal to or greater than 3/60 in the better eye using available means of correction (with spectacles when available). Visual impairment was defined as presenting visual acuity of less than 6/18 in the better eye using available means of correction (with spectacles when available). Refraction was not performed to determine the best corrected vision.

Cataract was defined as the presence of lens opacity giving a grey or white appearance to the pupil when examined with an oblique light in a shaded or darkened area. Refractive errors were defined as visual impairment which improved to 6/18 or better with a pinhole, with no evidence of cataract by torchlight examination. Retinal diseases were defined as retinal abnormalities caused by dystrophy, degeneration, or acquired metabolic causes such as diabetes mellitus. Glaucoma was defined as the presence of the horizontal cup-disc ratio of 0.4 or more along with an intraocular pressure of more than 22 mm Hg. Corneal diseases were defined as loss of normal corneal transparency due to whatever causes involving the central cornea.

Statistical methods

Prevalence estimates and standard errors were calculated by a method appropriate to the complex sampling design.[6 7] The sampling weights were adjusted for household non-response using adjustment cells formed by state and urban/rural residence. Post stratification[8] was used to adjust the weighted sample totals to known population totals for age, sex, and ethnicity based on 1996 census population projection. Prevalence estimates were standardised by the direct method to the age distribution of the 1996 Malaysian population. STATA[9] software package was used for analysis.

RESULTS

A total of 18 027 individuals were interviewed and examined from June 1996 to March 1997. The age range of the respondents was 1 month to 96 years, with the mean age of 26 years. Fifteen per cent of the respondents were older than 50 years. Table 1 shows the characteristics of the respondents compared with the total population of Malaysia. The sex, age group, ethnic, and urban/rural distributions of the respondents were

Table 1 Characteristics of respondents compared with total population of Malaysia in 1996

Characteristics	Respondents No (%)	Malaysia population (1000s) No (%)
Age (years)		
0–9	4690 (26)	4841.2 (24)
10–19	3814 (21)	4281.2 (22)
20–29	2341 (13)	3305.9 (17)
30–39	2477 (14)	2823.8 (14)
40–49	2081 (11)	2046.7 (11)
50–59	1263 (7)	1238.5 (6)
60–69	840 (5)	754.2 (4)
70+	521 (3)	446.4 (2)
Sex		
Male	8476 (47)	9947.2 (50)
Female	9551 (53)	9790.7 (50)
Ethnicity		
Malay	9700 (54)	9679.2 (49)
Chinese	4305 (24)	5365.9 (27)
Indian	1154 (6)	1518 (8)
Indigenous	1740 (10)	2503.2 (13)
Others	1128 (6)	67106 (3)
Residence		
Urban	8916 (49.4)	9336.0 (47.3)
Rural	9111 (50.6)	10401.9 (52.7)
All	18027 (100)	19737.9 (100)

comparable to the national distributions. Because of their heterogeneous nature the "other races" were excluded from the analysis.

Of the 18 027 people examined, 17 449 (96.79%) had normal vision with presenting visual acuity equal to or better than 6/18 in the worse eye. The crude and age adjusted prevalence of bilateral blindness was 0.28% (95% CI 0.18 to 0.32%) and 0.29% (95% CI 0.19 to 0.39%) respectively. Applying these rates to the total Malaysian population, we estimated that 54 000 Malaysians were bilaterally blind. The mean age among the survey participants who were blind was 60 years. Although the prevalence of blindness in females was 1.2 times that of the males, this difference was not statistically significant. The prevalence rates of blindness among the different ethnic groups and urban/rural residence were not significantly different (Table 2).

The crude and age adjusted prevalence of low vision was 2.42% (95% CI 2.09 to 2.75%) and 2.44% (95% CI 2.18 to 2.69%) respectively. This gave an estimation of 464 000 Malaysians who had low vision (Table 2). The mean age among the survey participants who had low vision was 53 years. The age adjusted prevalence of low vision appeared to be higher in females (2.80%, 95% CI 2.43 to 3.17%) than male (2.10%, 95% CI 1.73 to 2.47%) (Table 2), particularly so for Malay females (Malay females 2.95%, 95% CI 2.42 to 3.48%, Malay males 1.88%, 95% CI 1.43 to 2.33%) (Table 3). Among the females in the different ethnic groups, Chinese females had a significantly lower rate of low vision compared to females of indigenous and Malay origins (Table 3). The prevalence rates of low vision among the different ethnic groups and urban/rural residence were not significantly different (Table 2).

Cataract was the major cause of bilateral blindness, accounting for 39.11% of the total estimated cases of bilateral blindness. Retinal diseases were responsible for 24.54% blind. Uncorrected refractive errors were the cause for blindness in 4.10%. Corneal diseases (3.42%) and glaucoma (1.77%) were the other notable causes of blindness (Table 4). Of the 64 blind survey participants, 36 (56.25%) had avoidable or treatable causes (29 cataract, two uncorrected refractive errors, four uncorrected aphakia, and one diabetic retinopathy).

Uncorrected refractive errors were found to be the major cause of low vision (48%) (Table 4). The second major cause of low vision was cataract (35.93%). Of the 514 people with low vision, 442 (85.99%) had preventable or treatable causes (223 cataract, 208 uncorrected refractive errors, five uncorrected aphakia, and six diabetic retinopathy).

Prevalence of visual impairment due to cataract was higher in older people, females, and the indigenous ethnic group (Table 5). Prevalence of visual impairment due to uncorrected refractive errors by age appeared to have two peaks, among young adults and older people (Table 5 and Fig 1). Females had

Table 2 Prevalence of blindness and low vision by age, sex, ethnicity, and residence

		Prevalence of blindness			Prevalence of low vision		
	Respondents	Crude % (SE)	*Age adjusted % (SE)	Estimated population (SE)	Crude % (SE)	*Age adjusted % (SE)	Estimated population (SE)
Age (years)							
0–9	4690	0.05 (0.03)	–	2233 (1197)	0.40 (0.09)	–	18 881 (4706)
10–19	3814	0.13 (0.07)	–	5502 (2931)	1.63 (0.32)	–	67 667 (13 886)
20–29	2341	0.20 (0.11)	–	6410 (3691)	1.38 (0.26)	–	44 541 (8755)
30–39	2477	0.16 (0.16)	–	4380 (4380)	0.89 (0.19)	–	24 597 (5514)
40–49	2081	0.31 (0.16)	–	6159 (3235)	2.22 (0.34)	–	43 780 (6999)
50–59	1263	0.50 (0.23)	–	5872 (2712)	4.80 (0.78)	–	56 874 (9679)
60–69	840	0.69 (0.36)	–	4859 (2579)	12.26 (1.47)	–	86 507 (11 718)
70+	521	4.77 (1.12)	–	18 844 (4624)	30.59 (2.62)	–	120 851 (13 743)
Sex							
Male	8476	0.25 (0.06)	0.26 (0.07)	24 180 (6160)	1.98 (0.19)	2.10 (0.19)	190 743 (20 427)
Female	9551	0.32 (0.07)	0.30 (0.07)	30 079 (7294)	2.88 (0.24)	2.80 (0.19)	272 955 (27 265)
Ethnicity							
Malay	9700	0.21 (0.05)	0.23 (0.06)	20 110 (4977)		2.42 (0.19)	220 125 (26 535)
Chinese	4305	0.33 (0.11)	0.29 (0.11)	17 399 (5938)	2.53 (0.28)	2.11 (0.22)	134 979 (17 696)
Indian	1154	0.13 (0.10)	0.24 (0.18)	1837 (1400)	2.42 (0.52)	2.85 (0.52)	34 629 (7772)
Indigenous	1740	0.57 (0.24)	0.64 (0.22)	13 668 (5928	2.88 (0.49)	3.32 (0.46)	68 829 (13 537)
Residence							
Urban	8922	0.29 (0.05)	0.29 (0.07)	25 973 (6833)	2.23 (0.23)	2.27 (0.18)	202 371 (24 142)
Rural	9015	0.28 (0.07)	0.28 (0.06)	28 286 (7548)	2.59 (0.23)	2.61 (0.19)	261 327 (29 415)
All	18027	0.28 (0.05)	0.29 (0.05)	54 259 (10 289)	2.42 (0.17)	2.44 (0.13)	463 698 (40 422)

Definition: 1, Blindness: presenting visual acuity of worse than 3/60 in the better eye with available means of correction; 2, Low vision: presenting visual acuity of worse than 6/18 but equal to or better than 3/60 in the better eye with available means of correction.
*Age adjusted to the 1996 Malaysian population.

Table 3 Prevalence of blindness and low vision by sex and ethnicity

		Prevalence of blindness			Prevalence of low vision		
	Respondents	Crude % (SE)	*Age adjusted % (SE)	Estimated population (SE)	Crude % (SE)	*Age adjusted % (SE)	Estimated population (SE)
Ethnicity							
Malay	9700	0.21 (0.05)	0.23 (0.06)	20 110 (4977)	2.28 (0.28)	2.42 (0.19)	220 125 (26535
Male	4638	0.17 (0.07)	0.19 (0.08)	8419 (3474)	1.71 (0.2	1.88 (0.23)	82 727 (13847)
Female	5062	0.24 (0.08)	0.26 (0.08)	11 691 (3698)	2.85 (0.32)	2.95 (0.27)	137 398 (17629)
Chinese	4305	0.33 (0.11)	0.29 (0.11)	17 399 (5938)	2.53 (0.28)	2.11 (0.22)	134 979 (17696
Male	2033	0.27 (0.39)	0.27 (0.14)	7248 (3569)	2.31 (0.41)	2.09 (0.33)	62 503 (11803)
Female	2272	0.39 (0.18)	0.29 (0.16)	10 151 (4858)	2.76 (0.42)	2.20 (0.30)	72 476 (12109)
Indian	1154	0.13 (0.10)	0.24 (0.18)	1837 (1400)	2.42 (0.52)	2.85 (0.52)	34 629 (7772)
Male	505	0.18 (0.18)	0.3 (0.29)	1298 (1298)	2.48 (0.75)	2.85 (0.78)	17 660 (5238)
Female	649	0.08 (0.7)	0.16 (0.17)	539 (539)	2.37 (0.66)	2.86 (0.68)	16 969 (4934)
Indigenous	1740	0.57 (0.24)	0.64 (0.22)	13 668 (5928)	2.88 (0.49)	3.32 (0.46)	68 829 (13537)
Male	771	0.54 (0.27)	0.63 (0.32)	6639 (3373)	2.11 (0.51)	2.54 (0.58)	25 690 (6750)
Female	969	0.60 (0.27)	0.64 (0.30)	7029 (3273)	3.67 (0.82)	4.06 (0.64)	43 139 (1563)

*Age adjusted to the 1996 Malaysian population.

Table 4 Percentage distributions of causes of bilateral blindness and low vision

	Blindness (%)	Low vision (%)
Causes	(n=64)	(n=514)
Refractive errors	4.1	48.3
Cataract	39.1	35.9
Retinal diseases*	24.5	2.8
Corneal diseases	3.4	2.5
Glaucoma	1.8	1.8
Others†	27.0	8.6

Blindness:
*Retinal diseases: ARMD (n=3), macular scar (n=1), retinitis pigmentosa (n=4), retinopathy of prematurity (n=1), optic atrophy (n=1), diabetic retinopathy (n=1).
†Others: phthisis (n=3), albinism (n=1), uncorrected aphakia (n=4), not examined (n=2), undetermined (n=6).
Low vision:
*Retinal diseases: ARMD (n=7), macular hole (n=2), myopic degeneration (n=2), diabetic retinopathy (n=6).
†Others: phthisis (n=1), subluxated lens (n=1), uncorrected aphakia (n=5), optic atrophy (n=11), not examined (n=1), undetermined (n=26).

a significant higher prevalence of visual impairment due to uncorrected refractive errors (1.48%, 95% CI 1.20 to 1.76%) than males (0.90%, 95% CI 0.64 to 1.16%) while there was no significant difference among the four ethnic groups.

DISCUSSION

This survey is the first population based survey on blindness and low vision carried out in the whole of Malaysia. Data across all ages and ethnic groups with appropriate sampling from both rural and urban areas were obtained. Every attempt possible was made to ensure that the sampling was representative for all categories. The frequency distributions in age, sex, ethnicity, and place of residence were similar between the respondents and general population in Malaysia (Table 1).

With a prevalence of blindness of 0.29%, it would appear that the prevalence rate in Malaysia was lower than that of the other countries in the same region, which ranged from 0.8% in Vietnam to 1.2% in Indonesia.[2] However, the prevalence of low vision at 2.4% was higher than the Asia and Pacific Islands region, which had a prevalence of 1.9%.[1] Based on the available global data from 17 countries on low vision, the WHO estimated that for each person blind, there were three people with low vision.[1] This survey showed that for every blind person in Malaysia, there were eight people with low vision. Using presenting visual acuity and not pinhole or refracted vision in the definition of low vision might have overestimated the magnitude of low vision.

The survey revealed that the major causes of blindness in Malaysia differ from patterns seen in many low and medium income nations. Trachoma and vitamin A deficiency were nearly non-existent here. Instead, cataract and retinal diseases were the major causes of blindness. As the Malaysian population ages, it is highly likely that the absolute numbers of people blind from cataract and retinal diseases will increase.

Uncorrected refractive errors were the leading cause of low vision. This pattern is similar to that seen in the United States,[10] India,[11] and Saudi Arabia.[12] Previous myopia studies on Chinese[13] and Malay[14] students in Malaysia found myopia prevalence rates of 42% and 15% respectively. As 88% of the population in Malaysia are younger than 50 years of age and 27% are Chinese, refractive errors will continue to be an important public health problem in the country.

The 1996 NES estimate indicated that up to 50% of 54 000 blind people and 80% of 464 000 of people with low vision were due to cataract and uncorrected refractive errors, which are readily treatable with good visual restoration. The survey also revealed that the target groups for interventions in reducing cataract prevalence were people older than 50 years of age and females, while for uncorrected refractive errors they were young adults, people older than 50 years of age, and females.

The presence of avoidable blindness in the country suggests the need to evaluate the accessibility, availability, and distribution of cataract surgery and refractive services, with the focus on public awareness and attitude on eye care services utilisation. Information on barriers to accessibility and utilisation of eye care services can then be incorporated into the strategies of the national prevention of blindness programme (NPBL). Based on the NES estimate, the NPBL priorities will focus on cataract case detection and cataract surgery provision, vision screening and refractive services as part of primary health care and school services, human resource development with training of primary healthcare workers, optometrists, and cataract surgeons, as well as the development of comprehensive eye care services at the secondary and tertiary level of eye care. We hope avoidable blindness will be efficiently and effectively eliminated with these NPBL interventions by the year 2020.

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Limitation and recommendation

We advise caution in interpreting the results of this survey. Firstly, the sample size of subgroup analysis was too small.

Table 5 Prevalence of visual impairment due to cataract and uncorrected refractive errors by age, sex, and ethnicity

		Prevalence of cataract			Prevalence of uncorrected refractive errors		
	Respondents	Crude % (SE)	*Age adjusted % (SE)	Estimated population (SE)	Crude % (SE)	*Age adjusted % (SE)	Estimated population (SE)
Age (years)							
0–9	4690	0.05 (0.04)	–	2274 (1723)	0.31 (0.09)	–	14 686 (4225)
10–19	3814	0.05 (0.05)	–	1987 (1987)	1. 38 (0.27)	–	57 280 (11 824)
20–29	2341	0.04 (0.04)	–	1436 (1351)	1.24 (0.25)	–	39 909 (8589)
30–39	2477	0.16 (0.16)	–	4380 (4380)	0.63 (0.17)	–	17 471 (4773)
40–49	2081	0.21 (0.13)	–	4240 (2505)	1.71 (0.31)	–	33 808 (6341)
50–59	1263	1.25 (0.43)	–	14 847 (5247)	2.78 (0.60)	–	32 963 (7028)
60–69	840	8.19 (1.22)	–	57 783 (9825)	2.90 (0.63)	–	20 483 (4492)
70+	521	25.54 (2.5)	–	100 897 (12 591)	2.46 (0.75)	–	9703 (2962)
Sex							
Male	8476	0.80 (0.11)	0.88 (0.12)	76 923 (11 229)	0.89 (0.12)	0.90 (0.13)	85 558 (12 789)
Female	9551	1.17 (0.13)	1.10 (0.11)	110 922 (14 620)	1.48 (0.18)	1.48 (0.14)	140 749 (18 292)
Ethnicity							
Malay	9700	0.80 0.10)	0.88 (0.10)	77 003 (10 660	1.20 (0.18)	1.24 (0.15)	11 647 (19 028
Chinese	4305	1.30 (0.22)	0.99 (0.16)	69 096 (13 542)	0.90 (0.15)	0.85 (0.14)	48 099 (8566)
Indian	1154	0.94 (026)	1.28 (0.33)	13 472 (3757)	1.27 (0.39)	1.30 (0.38)	18 218 (5757)
Indigenous	1740	1.13 (0.29)	1.38 (0.27)	27 027 (7309)	1.74 (0.40)	1.92 (0.37)	41 625 (10 760)
All	18027	0.98 (0.09)	1.00 (0.08)	187 845 (21 003)	1.18 (0.12)	1.19 (0.10)	226 306 (26 239)

Definition: Visual impairment: presenting visual acuity of worse than 6/18 in the better eye with available means of correction.
*Age adjusted to the 1996 Malaysian population.

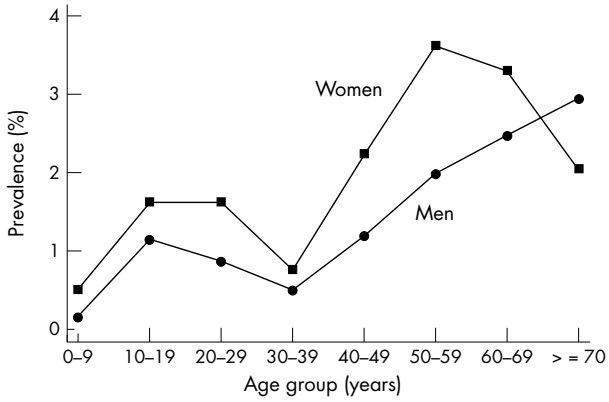

Figure 1 Prevalence of visual impairment due to uncorrected refractive errors by age and sex.

This was especially so in the older age groups in the Indian and indigenous racial subgroups. Since the prevalence of blindness is higher in older people, future surveys should be performed to focus on population older than 50 years in age.

Secondly, the NES was conducted mainly to gather prevalence data. It was carried out in the respondents' houses, and did not include refraction, slit lamp, and visual field examinations. Therefore, the survey was likely to have underestimated the prevalence of glaucoma and possibly other ocular diseases where visual acuity was maintained until the late stage of the diseases. Subsequent surveys should be performed with detail ocular examinations, refraction, and visual field assessment to accurately diagnose ocular disorders. Using pinhole to assess visual improvement and label those respondents to have uncorrected refractive errors might have missed cataracts, which may have visual improvement with pinhole.

Thirdly, the overall response rate of 69% was not ideal. The refusals might have distinct characteristics that differ from the respondents. Unfortunately, information on the refusals was not available. However, we used the non-response adjustment, based on the location of the non-respondent living quarters (state and urban-rural) weighted in the analyses in an attempt to mitigate this potential bias. Future surveys should gather data on non-respondent living quarters and individuals, in order to better access the representativeness of the participating population.

Conclusion

The NES provided important epidemiological data with regard to prevalence and causes of blindness and low vision in Malaysia. It demonstrated that cataract and uncorrected refractive errors, which are readily treatable, were the leading causes of visual impairment, suggesting the need for an evaluation on the accessibility of eye care services and barriers to eye care utilisation in the country.

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ECHO

Unravelling Leber hereditary optic neuropathy

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One in 10 young women, but around half of young men, carrying the genetic mutation for Leber hereditary optic neuropathy (LHON) will become blind. The reasons for this are unclear, but other secondary genetic and environmental factors are likely to be involved.

The disease is transmitted though the mother. And most cases are caused by one of three MtDNA genetic mitochondrial point mutations—G346OA, G11778A, and T14484C. But the frequency varies enormously. G11778A seems to be the most prevalent in Europe, Australia, and South East Asia. Relatively rare, T14484C is the most common mutation among French Canadians. How likely a patient is to regain his or her sight depends on the mutation. G11778A carries the worst prognosis, while those with T14484C are more likely to improve if eyesight fails before the age of 20.

A significant minority of carriers, especially women with the G11778A mutation, will have features that are identical with multiple sclerosis. But the evidence for the "autoimmunity hypothesis" is inconclusive, although accompanying neurological problems have been linked to other mtDNA mutations.

In most LHON pedigrees, every mtDNA molecule harbours the mutation. But not all, and preliminary research suggests that this might explain the incomplete penetrance, with a minimal risk of blindness if the mutations are below 60 per cent. The male bias might be attributable to a recessive X linked susceptibility gene which strengthens the mtDNA mutation. Twin studies point to environmental factors, and there is some evidence to suggest that diet, stress, acute illness, smoking and alcohol intake can all precipitate the blindness.

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