WORLD VIEW

Cataract surgical coverage and outcome in the Tibet Autonomous Region of China

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Series editors: W V Good and S Ruit

Br J Ophthalmol 2005;**89**:5–9. doi: 10.1136/bjo.2004.048744

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Accepted for publication 12 July 2004

Background: A recently published, population based survey of the Tibet Autonomous Region (TAR) of China reported on low vision, blindness, and blinding conditions. This paper presents detailed findings from that survey regarding cataract, including prevalence, cataract surgical coverage, surgical outcome, and barriers to use of services.

Methods: The Tibet Eye Care Assessment (TECA) was a prevalence survey of people from randomly selected households from three of the seven provinces of the TAR (Lhoka, Nakchu, and Lingzhr), representing its three main environmental regions. The survey, conducted in 1999 and 2000, assessed visual acuity, cause of vision loss, and eye care services.

Results: Among the 15 900 people enumerated, 12 644 were examined (79.6%). Cataract prevalence was 5.2% and 13.8%, for the total population, and those over age 50, respectively. Cataract surgical coverage (vision <6/60) for people age 50 and older (85–90% of cataract blind) was 56% overall, 70% for men and 47% for women. The most common barriers to use of cataract surgical services were distance and cost. In the 216 eyes with cataract surgery, 60% were aphakic and 40% were pseudophakic. Pseudophakic surgery left 19% of eyes blind (<6/60) and an additional 20% of eyes with poor vision (6/24–6/60). Aphakic surgery left 24% of eyes blind and an additional 21% of eyes with poor vision. Even though more women remained blind than men, 28% versus 18% respectively, the different was not statistically significant (p = 0.25).

Conclusions: Cataract surgical coverage was remarkably high despite the difficulty of providing services to such an isolated and sparse population. Cataract surgical outcome was poor for both aphakic and pseudophakic surgery. Two main priorities are improving cataract surgical quality and cataract surgical coverage, particularly for women.

Particular concern about the prevalence of cataract in the Tibet Autonomous Region (TAR) of the People's Republic of China first emerged in 1987, following the findings from a population based cataract survey of Duilong-Deqing County adjacent to Lhasa.[1] Hu *et al* reported a strikingly elevated cataract prevalence of 11.8% (95% confidence interval not available) among people over 40 years of age. The prevalence of cataract among the Tibetans near Lhasa (altitude 4000 metres) was 60% higher than an age and sex matched population concurrently surveyed in a county near Beijing (altitude 50 metres). Of particular interest was the role of ultraviolet light exposure to cataract development, because most people in the TAR live at extremely high elevation and low latitude.

Hu *et al* raised important questions regarding the prevalence of cataract among Tibetans of a relatively young age. The researchers sampled only a small portion of the Tibetan population. In the mid-1990s, public health officials in the TAR, who recognised the extraordinary need for eye care services, requested that a comprehensive survey of eye diseases and use of eye care services be undertaken in their region.

During 1999 and 2000, we conducted the Tibet Eye Care Assessment (TECA), a cross sectional prevalence study of blindness and visual impairment, as well as cataract surgical coverage and outcome, throughout in the TAR.[2] The crude prevalence of blindness according to the Chinese Ministry of Public Health guidelines (better eye presenting visual acuity of less than 6/60) was 2.3%; and the age and sex adjusted blindness prevalence was 1.4% (95% CI 1.3 to 1.5). Cataract was the primary cause of blindness (50.7%). Using the World Health Organization definition of blindness (<3/60, or <20/400, or <0.05), the age and sex adjusted prevalence of blindness was 0.89% (95% CI: 0.84 to 0.94). Women had a significantly higher prevalence of blindness at 1.02% (95% CI. 0.95 to 1.09), compared to men at 0.76% (95% CI. 0.72 to 0.80). As part of our study we also determined cataract surgical coverage and the visual outcome of cataract surgery.

This paper presents detailed findings from that survey regarding cataract, including prevalence, cataract surgical coverage, surgical outcome, and barriers to use of services.

METHODS

Methods used in this study have been reported in detail elsewhere.[2] In brief, TECA was a cross sectional prevalence study of three of the seven prefectures (provinces) of the TAR, selected to represent its three main environmental regions. The study population was selected using a random multistage cluster sampling method.

Two teams conducted the survey in each prefecture, Lhoka during May 1999, Nakchu during June 1999, and Lingzhr during May 2000. One of the authors (CT) acted as the lead ophthalmologist, maintaining quality control and conducting clinical examinations during the survey in all three prefectures. Clinical examination usually occurred in a central village building. Visual acuity testing, clinical examination, and interviewing all occurred at the central site.

Ophthalmologists conducted basic eye examinations, which included visual inspection of the lid and globe, and examination of the cornea, anterior chamber, and lens, using a slit lamp. Ophthalmologists dilated pupils if presenting

Abbreviations: TAR, Tibet Autonomous Region; TECA, Tibet Eye Care Assessment

Table 1 Prevalence of cataract (%) by age and sex (visual acuity <6/18); including previous operated patients

Age group	Popululation (10^3)	Male		Female		Total	
		Prevalence	95% CI	Prevalence	95% CI	Prevalence	95% CI
<40	538.0	0.41	0.22 to 0.71	0.14	0.05 to 0.33	0.27	0.16 to 0.42
40–49	64.7	2.61	1.43 to 4.34	0.89	0.03 to 1.92	1.65	1.01 to 2.53
50–59	51.2	5.43	3.64 to 7.74	4.83	3.23 to 6.90	5.09	3.87 to 6.56
60–69	35.0	12.02	8.97 to 15.66	11.84	9.02 to 15.17	11.91	9.81 to 14.28
⩾70	19.2	34.72	28.39 to 41.48	39.53	34.33 to 44.92	37.68	33.65 to 41.84
Overall	708.1	3.69	3.18 to 4.26	4.06	3.56 to 4.61	3.88	3.52 to 4.27

visual acuity was <6/18 and was not the result of corneal disease or phthisis bulbi, and assessed the cause of vision loss with ophthalmoscopy. In all cases of cataract surgery, the eye was assessed for cause of a failure to reach a visual acuity of 6/18 or better.

For data analysis and reporting, we sorted individuals into three categories according to better eye presenting visual acuity: good vision (vision 6/18 or better); visual impairment (6/24–6/60); and blind (vision <6/60. Blindness was defined as a presenting visual acuity (in the better eye) of less than 6/60 (<20/200 or <.10) according to Chinese Ministry of Public Health guidelines. Visual impairment or low vision was defined as a presenting visual acuity (in the better eye) of 6/24 to and including 6/60.

Cataract was defined as a white or grey pupil and a visual acuity of <6/18 without a central corneal opacity, in a person who was examined with a slit lamp. For the purposes of this study, a patient with a history of cataract surgery in either or both eyes was also defined as a cataract patient.

Estimates of the prevalence of cataract blindness included operated and unoperated individuals. Unoperated cataract blind patients were defined as bilaterally visually impaired (<6/18) or blind individuals (<6/60) with cataract as the principal cause of blindness in at least one eye. Operated cataract blind patients were assumed bilaterally blind at the time of operation if both eyes had undergone surgery.

Cataract surgical coverage was defined as the ratio of people with cataract surgery to the total number of people who need, or who have needed, cataract surgery. We defined need at three different levels of visual acuity: <6/18, <6/60, and <3/60. Historical cataract surgical cases were assumed to have had a visual acuity <6/60 before surgery. To facilitate comparison with other population based surveys, cataract surgical coverage was calculated for people age 50 years and older.

People who had cataract surgery and a presenting vision close to 6/18 were tested with a pinhole to determine whether their vision could be improved to that level with refraction. The presence of spectacles was noted for aphakic patients.

Data were entered twice by two different people into a specialised database. The results of these entries were matched against each other to detect and correct any data entry errors. Data were analysed by employing Stata for Windows version 6.0 (Stata Corp, Austin, TX, USA).

Prevalence estimates were calculated, with 95% confidence intervals (not adjusted for cluster random sampling). Prefecture specific and overall prevalence estimates were calculated. Tibet census data were used to adjust the overall prevalence estimates for age and sex.[3]

RESULTS

All randomly selected clusters were identified and examined in Lhoka and Nakchu, 23 and 25 clusters, respectively. However, in remote areas in both prefectures, a degree of substitution of villages occurred because the survey team faced considerable difficulty identifying individual villages by name. In Lingzhr, the survey team substituted three of the seven counties (constituting 43% of the sampled population) because of heavy rains and poor road conditions. They substituted randomly selected clusters from the remaining available areas to achieve the targeted number of enumerated people.

Of the 15 900 enumerated people, 12 644 were examined for an overall response rate of 79.6%; highest in Nakchu (81.4%) and lowest in Lingzhr (76.9%). The response was

Table 2 Cataract surgical coverage (%) by age, sex, and prefecture

Age group (years)	Lhoka			Nakchu			Lingzhr			Total		
	Male	Female	Both	Male	Female	Both	Male	Female	Both	Male	Female	Both
Presenting VA <6/18												
50–59	63.6	50.0	57.1	70.0	45.5	57.1	42.9	57.1	50.0	60.7	50.0	55.4
60–69	44.4	36.0	39.5	54.5	40.9	47.7	42.9	42.9	42.9	48.9	38.9	43.6
⩾70	47.6	29.8	35.3	56.3	26.0	37.8	36.4	33.3	34.4	48.0	29.4	36.0
Total	50.0	34.1	40.2	57.8	32.5	43.5	38.9	37.7	38.2	50.7	34.4	41.0
Presenting VA <6/60												
50–59	77.8	71.4	75.0	87.5	55.6	70.6	60.0	66.7	63.6	77.3	63.6	70.5
60–69	88.9	60.0	70.8	75.0	52.9	63.6	50.0	60.0	54.5	74.2	56.8	64.7
⩾70	66.7	41.2	49.0	62.1	32.5	44.9	66.7	46.4	52.5	64.3	39.2	48.1
Total	75.8	50.0	59.6	69.8	40.9	53.8	60.9	51.3	54.8	69.7	46.6	55.9
Presenting VA <3/60												
50–59	77.8	83.3	80.0	100.0	71.4	85.7	60.0	80.0	70.0	81.0	77.8	79.5
60–69	88.9	69.2	77.3	80.0	69.2	75.0	60.0	75.0	66.7	79.3	70.0	74.6
⩾70	76.9	56.0	63.2	66.7	37.1	50.0	72.7	61.9	65.6	70.6	49.4	57.6
Total	80.6	63.6	70.7	75.5	49.1	61.5	66.7	66.7	66.7	75.2	58.1	65.7

Table 3 Type of surgery by prefecture and sex (number fo eyes)

	Lhoka			Nakchu			Lingzhr			Total		
	M	F	Both	M	F	Both	M	F	Both	M	F	Both
Pseudophakic	14	14	28	21	16	37	10	15	25	45 (50%)	45 (50%)	90
Aphakic	25	25	50	29	20	49	14	13	27	68 (54%)	58 (46%)	126
Aphakic with spectacles	5	3	8	5	2	7	3	1	4	13 (68%)	6 (32%)	19

highest among women (82.7%) versus men (75.7%) and among people age 50 years and older (86%).

Table 1 provides cataract prevalence by age and sex (visual acuity <6/18). Cataract prevalence rose steeply with age from 2% for people aged 40–49 to 38% for people over age 70. The age adjusted cataract prevalence was higher in women than men, 3.69 (95% CI 3.18–4.26) versus 4.06 (95% CI 3.56 to 4.61) respectively, although the difference was not statistically significant.

In total, 72 people were identified with unilateral cataract blindness (vision <6/60); 221 people with bilateral cataract blindness (VA <6/18) and 177 people who had received previous surgery (presumed originally with a visual acuity <6/60). The TECA survey did not record the time interval between surgery and the time of examination.

People blind (<6/60) because of cataract had a mean age of 65 years, with 54% women and 46% men. They were predominantly farmer/herders who lived at extreme altitude (4000 metres) far from healthcare facilities of any kind. They did not differ significantly from the remainder of the study population, except in terms of age and distance from a healthcare facility (both $p < 0.05$). Cataract prevalence was not significantly associated with the altitude of their village of residence.

Table 2 provides the cataract surgical coverage in the three Tibetan prefectures for people 50 years of age and older. The cataract surgical coverage ranged from 41% to 56% to 66% for presenting visual acuity of <6/18, <6/60, and <3/60, respectively. The cataract surgical coverage was significantly lower among women than men at presenting visual acuity of <6/18 ($p = 0.046$) and <6/60 ($p = 0.048$). There was no statistically significant difference in cataract surgical coverage between the three prefectures. Cataract surgical coverage (presenting vision <6/60) decreased with age ranging from 70% for people age 50–59, to 48% for people over age 70. This trend was not statistically significant ($p > 0.05$).

Cataract surgical outcome was assessed for 216 eyes, 126 (60%) aphakic, and 90 (40%) pseudophakic, surgery. Of the aphakic patients, 19/126 (15%) were wearing spectacles, approximately two thirds of who were men. There was no significant difference by age, sex, or prefecture in the proportion of cases who were aphakic (table 3).

Cataract surgery resulted in a presenting vision 6/18 or better in 55% of eyes (table 4). Eyes with pseudophakic and aphakic surgery had remarkably similar visual outcome. Pseudophakic surgery left 19% of eyes blind (<6/60) and an additional 20% of eyes with poor vision (6/24–6/60). Aphakic surgery left 24% of eyes blind and an additional 21% of eyes with poor vision. Even though more women remained blind than men, 28% versus 18%, respectively, the different was not statistically significant ($p = 0.250$).

Among the pseudophakic patients the primary reasons for blindness could not be determined retrospectively by the survey ophthalmologists.

DISCUSSION

We studied three of the seven prefectures (provinces) of the Tibet Autonomous Region, selected to represent its three main environmental regions. Lokha (population 281 738 in the 1990 census) is characterised by a lower elevation (around 3000 metres) farming communities, and plains. Lingzhr (population 110 616) is at similar elevation to Lokha but with farming communities and forests. Nakchu (population 296 023) is an area of high elevation, primarily populated by nomadic herders.

Cataract surgical coverage in the TAR (56% for presenting vision of <6/60) seemed remarkably high, considering Tibet's historical isolation and the extreme difficulties of travel and service delivery. Cataract surgical coverage for people age 50 years and older in Tibet resembles Doumen[4] (40%) and Shunyi[5] (46%) counties, more prosperous areas in eastern China. Studies from geographically close countries found

Table 4 Outcome of cataract surgery by eye (n,%)

	Lhoka			Nakchu			Lingzhr			Total		
	M	F	Both	M	F	Both	M	F	Both	M	F	Both
All eyes												
6/18 +	26 (66.7)	19 (48.7)	45 (57.7)	26 (52.0)	20 (55.6)	46 (53.5)	17 (70.8)	17 (60.7)	34 (65.4)	69 (61.1)	56 (54.4)	125 (57.9)
6/24–6/60	7 (17.9)	5 (12.8)	12 (15.4)	13 (26.0)	11 (30.6)	24 (27.9)	3 (12.5)	5 (17.9)	8 (15.4)	23 (20.4)	21 (20.4)	44 (20.4)
<6/60	6 (15.4)	15 (38.5)	21 (26.9)	11 (22.0)	5 (13.9)	16 (18.6)	4 (16.7)	6 (21.4)	10 (19.2)	21 (18.6)	26 (25.2)	47 (21.8)
Total	39 (100)	39 (100)	78 (100)	50 (100)	36 (100)	86 (100)	24 (100)	28 (100)	52 (100)	113 (100)	103 (100)	216 (100)
Aphakic												
6/18 +	17 (68.0)	11 (44.0)	28 (56.0)	15 (51.7)	8 (40.0)	23 (46.9)	11 (78.6)	8 (61.5)	19 (70.4)	43 (63.2)	27 (46.6)	70 (55.6)
6/24–6/60	5 (20.0)	4 (16.0)	9 (18.0)	5 (17.2)	8 (40.0)	13 (26.5)	1 (7.1)	3 (23.1)	4 (14.8)	11 (16.2)	15 (25.9)	26 (20.6)
<6/60	3 (12.0)	10 (40.0)	13 (26.0)	9 (31.0)	4 (20.0)	13 (26.5)	2 (14.3)	2 (15.4)	4 (14.8)	14 (20.6)	16 (27.6)	30 (23.8)
Total	25 (100)	25 (100)	50 (100)	29 (100)	20 (100)	49 (100)	14 (100)	13 (100)	27 (100)	68 (100)	58 (100)	126 (100)
Pseudophakic												
6/18 +	9 (64.3)	8 (57.1)	17 (60.7)	11 (52.4)	12 (75.0)	23 (62.2)	6 (60.0)	9 (60.0)	15 (60.0)	26 (57.8)	29 (64.4)	55 (61.1)
6/24–6/60	2 (14.3)	1 (7.1)	3 (10.7)	8 (38.1)	3 (18.8)	11 (29.7)	2 (20.0)	2 (13.3)	4 (16.0)	12 (26.7)	6 (13.3)	18 (20.0)
<6/60	3 (21.4)	5 (35.7)	8 (28.6)	2 (9.5)	1 (6.3)	3 (8.1)	2 (20.0)	4 (26.7)	6 (24.0)	7 (15.6)	10 (22.2)	17 (18.9)
Total	14 (100)	14 (100)	28 (100)	21 (100)	16 (100)	37 (100)	10 (100)	15 (100)	25 (100)	45 (100)	45 (100)	90 (100)

similar cataract surgical coverage rates: Nepal (58%),[6] parts of India (53%),[7] as well as more distant Saudi Arabia (54%).[8] Cataract surgical coverage in Tibet is significantly higher than some African countries such as Malawi (36%).[9]

Cataract surgical coverage among women compared to men (34 and 51%, respectively; $p = 0.048$) in the TAR resembles sex differences found in cataract surgical coverage in other populations.[10] This pattern of service utilisation, repeated globally, contributes significantly to the excess burden of blindness borne by women, essentially a ratio of two blind women for each blind man.[11]

Before the TECA survey, cataract surgery in the TAR had primarily occurred in transient eye ''camps'' by joint teams of Tibetan doctors and foreign ophthalmologist, as well as by ophthalmologists from other regions of China. We became aware of seven eye care specialists, trained in a mixture of Western and traditional Tibetan medicine, who conducted cataract surgery on an ongoing basis in hospitals in prefectural capitals, and eight such eye care specialists in Lhasa. However, these local eye care specialists explained that they operated on only a few cases per month in the absence of foreign or Chinese surgeons.

Cataract surgical eye camps have established a reasonable baseline cataract surgical coverage. However, these externally funded camps utilising foreign volunteers may not maintain (and increase) the cataract surgical coverage in the future. Moreover, previous studies of surgical camps noted that they fail to provide adequate quality.[12–14] The TAR Ministry of Public Health and non-governmental organisations plan urban prefectural centres for higher quality cataract surgery, but cataract surgical eye camps seem necessary for the near future for most of the population, which lives in very remote areas.

The TECA survey did not provide comprehensive reporting of barriers to utilisation of cataract surgery. The survey teams did note that several people reported that they had been turned away from cataract surgical eye camps. The patients were told either they had ''adequate vision'' (presumably better than 6/60), there was ''inadequate'' surgical capacity, or they were too old. Turning away patients from cataract surgery has been discouraged in other settings.[15] Patients conclude inappropriately that they are unsuitable for surgery in the future, or become discouraged that future efforts to attend available services will result in actual treatment.

Cataract surgical outcome in the TAR was generally poor. In only a few cases, TECA ophthalmologists concluded that blindness following surgery was the result of co-existing conditions (that is, macular degeneration). In most cases, they reported poor outcomes because of poor refraction or complications of surgery.

Patients who had aphakic surgery had poor presenting visual acuity because only 15% (19/126) of patients had spectacles, two thirds men. Tibetan women may have been given aphakic spectacles, but they do not considered them appropriate to wear. Tibetan women, therefore, may have a particular need for pseudophakic surgery, whenever possible.

We could not determine if visiting or local surgeons operated in individual cases. We know that foreign ophthalmologists visited Lhoka first, the prefecture closest to Lhasa, more than 5 years before the TECA survey. This almost certainly accounts for the higher proportion of aphakic surgery in Lhoka prefecture. In contrast, ophthalmologists were only recently allowed to visited Lingzhr, resulting in the highest proportion of pseudophakic procedures.

The blindness (<6/60) rate following cataract surgery in Tibet resembles findings from Zhongshan (Guangdong Province)[16] and Shunyi[17] in China, with 53% and 45% eyes blind, respectively. Shunyi and the TAR had a similar percentage of aphakic surgery, 61% and 60%, respectively. Zhongshan had 91% aphakic surgery.

The blindness (<6/60) and low vision (<6/18) rates following cataract surgery in the TAR also resembles findings in four other relevant settings outside China. In Nepal, 42% had a presenting visual acuity of better than 6/18 in the operated eye (31% of aphakics and 54% of pseudophakics), with a total of 14% of the 220 eyes pseudophakic.[18] In two, population based cross sectional studies of aphakic/pseudoaphakic surgery in India, researchers found presenting visual acuity of 6/18 or better in 45%, and less than 6/60 in 25% of eyes.[19] In the eyes with pseudophakic surgery, approximately 11% had poor outcome (vision <6/60). In a study in Punjab, India, researchers reported that 17% of patients had presenting vision in the operated eye of <3/60 while 38% had vision between 3/60 and <6/18.[20 21] These latter findings from the Punjab are not differentiated by surgical technique (aphakic versus pseudophakic).

Several limitations may affect the reliability of our study. Approximately 80% of the enumerated sample were examined (> 85% people aged 50 and older). Under-represented were people living in the most inaccessible terrain and/or at the extremes of altitude. These missing people may have a higher prevalence of eye diseases and visual impairment. Also under-represented were younger men working away from their village at the time of enumeration. Family members provided what we considered reliable estimates of the visual function of these absentee household members: all were considered not to have significant visual impairment.

In Lingzhr, the survey team substituted three of the seven counties (constituting 43% of the sampled population) because of heavy rains and poor road conditions. If these travel difficulties were recurrent, the substituted, more available, population could have had a lower prevalence of cataract than the more difficult to access, randomly selected population.

As a single cross sectional study, the TECA survey only gathered data on the current status of visual acuity in patients who had cataract surgery. It was not possible to obtain preoperative information or intraoperative surgical complications. Nor was it possible to gather details regarding surgeon or surgical date. These deficiencies made it difficult, in most cases, to assign a cause of poor vision after surgery.

SUMMARY AND RECOMMENDATIONS

Public health officials in the TAR created a 10 year plan aimed at addressing the primary blinding conditions of Tibet. The plan is in keeping with these TECA findings and the Vision 2020 initiative, a worldwide WHO programme to eliminate avoidable blindness by the year 2020.[22] With regard to cataract, the plan lists the following goals, in order of importance:

- Improve cataract surgical quality through better training and quality assurance programmes
- Strongly discourage aphakic surgery, particularly for women
- Improve the overall eye care infrastructure so patients can have cataract surgery when visual impairment occurs, rather than waiting until they are blind
- Increase community based efforts to identify, educate, and encourage Tibetans (women and the working age group men and women, in particular) to accept cataract surgery. Simply increasing the number of surgeons and cataract surgical services will not be adequate for improving cataract surgical coverage
- Discourage eye care providers from turning away cataract patients complaining of vision loss simply because they do not fit within predefined thresholds.

ACKNOWLEDGEMENTS

We would like to acknowledge the significant contributions of the Tibet Autonomous Region Health Bureau for organisational support, the Tibet Development Fund (particularly Mr Ngapo Jigyuan, Mr Taring Jigme, Mr Tseden Dorjee, Mr Osman) for logistical support, Seva Canada and Seva Foundation for funding support, foreign volunteers (Ken Baum, Stanley Chan, Jane Gardiner, Linda Harth, Grace Li, Karol Mikulash, Peter Nash, Maura Santangelo, Pearl Wieringa, Erik Fleischman, and Laurence Schenk) and collaborating Tibetan ophthalmologists (Dr Tsering Wangdul, Dr Tseden Yangkyi, Dr Chunwa). We are grateful to the Tibetan population for their generous participation in the project.

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