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

K L Bassett, K Noertjojo, L Liu, F S Wang, C Tenzing, A Wilkie, M Santangelo, P Courtright

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 Lingzhi), 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 difference 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.

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 Lingzhi 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 signs were present.

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

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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 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 using 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). Prevalence specific and overall prevalence estimates were calculated. Tibet census data were used to adjust the overall prevalence estimates for age and sex.1

### 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

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

<table>
<thead>
<tr>
<th>Age group (years)</th>
<th>Population</th>
<th>Male</th>
<th>Female</th>
<th>Both</th>
<th>Prevalence</th>
<th>95% CI</th>
<th>Male</th>
<th>Female</th>
<th>Both</th>
<th>Prevalence</th>
<th>95% CI</th>
<th>Male</th>
<th>Female</th>
<th>Both</th>
<th>Prevalence</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>50–59</td>
<td>538.0</td>
<td>0.41</td>
<td>0.22 to 0.71</td>
<td>0.14</td>
<td>0.05 to 0.33</td>
<td>0.27</td>
<td>0.16 to 0.42</td>
<td>1.65</td>
<td>1.01 to 2.53</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60–69</td>
<td>51.2</td>
<td>5.43</td>
<td>3.64 to 7.74</td>
<td>4.83</td>
<td>3.23 to 6.90</td>
<td>5.09</td>
<td>3.87 to 6.56</td>
<td>11.91</td>
<td>9.81 to 14.28</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;70</td>
<td>35.0</td>
<td>12.02</td>
<td>8.97 to 15.66</td>
<td>11.84</td>
<td>9.02 to 15.17</td>
<td>11.91</td>
<td>9.81 to 14.28</td>
<td>37.68</td>
<td>33.65 to 41.84</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall</td>
<td>708.1</td>
<td>3.69</td>
<td>3.18 to 4.26</td>
<td>4.06</td>
<td>3.56 to 4.61</td>
<td>3.88</td>
<td>3.52 to 4.27</td>
<td></td>
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</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Age group (years)</th>
<th>Lhoka</th>
<th>Nakchu</th>
<th>Lingzhr</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Presenting VA &lt;6/18</td>
<td>Male</td>
<td>Female</td>
<td>Both</td>
<td>Male</td>
</tr>
<tr>
<td>50–59</td>
<td>63.6</td>
<td>50.0</td>
<td>57.1</td>
<td>70.0</td>
</tr>
<tr>
<td>60–69</td>
<td>44.4</td>
<td>36.0</td>
<td>39.5</td>
<td>54.5</td>
</tr>
<tr>
<td>&gt;70</td>
<td>47.6</td>
<td>29.8</td>
<td>33.3</td>
<td>56.3</td>
</tr>
<tr>
<td>Total</td>
<td>50.0</td>
<td>34.1</td>
<td>40.2</td>
<td>57.8</td>
</tr>
</tbody>
</table>

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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 people age 50 years and older in Tibet resembles Doumen (40%) and Shunyi (46%) counties, more prosperous areas in eastern China. Studies from geographically close countries found cataract surgical coverage for people age 50 years and older in Tibet resembles Doumen (40%) and Shunyi (46%) counties, more prosperous areas in eastern China. Studies from geographically close countries found

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 difference 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. Lhoka (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 Lhoka 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 (40%) and Shunyi (46%) counties, more prosperous areas in eastern China. Studies from geographically close countries found

<table>
<thead>
<tr>
<th>Table 3</th>
<th>Type of surgery by prefecture and sex (number of eyes)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lhoka F  M</td>
</tr>
<tr>
<td>Pseudophakic</td>
<td>14 (100)</td>
</tr>
<tr>
<td>Aphakic</td>
<td>25 (100)</td>
</tr>
<tr>
<td>Aphakic with spectacles</td>
<td>5 (100)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 4</th>
<th>Outcome of cataract surgery by eye (n, %)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lhoka</td>
</tr>
<tr>
<td>All eyes</td>
<td></td>
</tr>
<tr>
<td>Aphakic</td>
<td></td>
</tr>
<tr>
<td>6/18+</td>
<td>17 (68.0)</td>
</tr>
<tr>
<td>6/24-6/60</td>
<td>5 (20.0)</td>
</tr>
<tr>
<td>&lt;6/60</td>
<td>3 (12.0)</td>
</tr>
<tr>
<td>Total</td>
<td>25 (100)</td>
</tr>
<tr>
<td>Pseudophakic</td>
<td></td>
</tr>
<tr>
<td>6/18+</td>
<td>9 (64.3)</td>
</tr>
<tr>
<td>6/24-6/60</td>
<td>2 (14.3)</td>
</tr>
<tr>
<td>&lt;6/60</td>
<td>3 (21.4)</td>
</tr>
<tr>
<td>Total</td>
<td>14 (100)</td>
</tr>
</tbody>
</table>
similar cataract surgical coverage rates: Nepal (58%),
parts of India (53%), as well as more distant Saudi Arabia (54%). Cata- 

crat surgical coverage in Tibet is significantly higher than 

some African countries such as Malawi (36%).

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. 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.

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. The TAR Ministry of Public 

Health and non-governmental organisations plan urban pre-

fectural 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 

d 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. 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 ophthal-

mologists 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)

and Shunyi 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. In two, 

population based cross sectional studies of aphakic/pseudo-

aphakic surgery in India, researchers found presenting visual 

acuity of 6/18 or better in 45%, and less than 6/60 in 25% of 

eyes. 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 present-

ing vision in the operated eye of <3/60 while 38% had vision 

between 3/60 and <6/18. 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 exam-

ined (> 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 

counts (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 data on the current 

status of visual acuity in patients who had cataract surgery. 

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. 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.
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