

Visual Acuity Thresholds for Cataract Surgery and the Changing Australian Population

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Objective: To examine the relation between visual acuity thresholds for cataract surgery for the changing Australian population.

Methods: Population-based 5-year incidence data for 2594 people were used to calculate age-specific prevalence of incident cataract and existing cataract backlog. The cataract surgery rates (CSRs) per million people were estimated for different acuity thresholds for the Australian population at different times.

Results: In 2005, after adjusting by age, the estimated CSRs for Australia were 1470, 3110, 5080, and 6440 for visual acuities of less than 6/60, less than 6/18, less than

6/12, and less than 6/9, respectively, whereas the actual CSR was 9000. Although the acuity threshold had the greatest impact, the CSR for less than 6/12 increased 3-fold from 2300 in 1950 to 7210 in 2020 because of demographic changes.

Conclusions: Demographic changes, with an increasing proportion of older people, will continue to increase the need for cataract surgery, as will a reduction in the visual impairment threshold. Plans for the future for eye care services should take these factors into account.

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RESTORING SIGHT TO THE blind has biblical roots and cataract surgery of one type or another has been practiced for millennia. However, the introduction of modern small-incision cataract surgery with intraocular lens implantation has revolutionized cataract surgery and dramatically changed its indications and the frequency with which it is performed.

The amount of cataract surgery performed is usually termed the *cataract surgery rate* (CSR), which is the number of cataract operations performed per million people per year. The World Health Organization has set a CSR of 3000 as being the minimum necessary to eliminate cataract blindness.¹ However, this rate is greatly exceeded in many developed countries, including Australia.² The higher CSR in developed countries is explained in large part by the reduced threshold of visual impairment used as an indication for surgery. As the results of modern cataract surgery have improved, the threshold level of visual acuity has dropped progressively from legal blindness (<6/60) some 30 or 40 years ago to driving vision (<6/12) or even "on change" (<6/6).

Although the change in visual threshold has a major impact on the CSR, we were interested in exploring the impact that the changing demographic structure may also have. The demographic structure, and especially the proportion of older people, is changing quite markedly with increased life expectancy and a decreased birth rate. If we assume that there is no significant change in the age-specific rates of cataract, then the change in the proportion of older people in a population will increase the need for cataract surgery and so alter the CSR.

METHODS

The Melbourne Visual Impairment Project is a population-based study of residents of Victoria, Australia, aged 40 years or older. The detailed methods have previously been published.³ Briefly, in 1992-1994, a door-to-door household census was conducted in 9 randomly selected pairs of adjacent census collector districts in urban Melbourne, Australia, to identify eligible residents who had lived in their homes for at least 6 months and were 40 years or older in the year of examination. A 5-year follow-up examination was conducted in 1997-1999.⁴

In both surveys, participants underwent a standard ophthalmic examination at a local ex-

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amination center and completed a standardized questionnaire covering sociodemographic characteristics, symptoms of eye disease, medical history, and medication use. Home visits were conducted for participants who were unable to attend the local examination center. The Human Research and Ethics Committee of the Royal Victorian Eye and Ear Hospital approved the protocol, and all participants gave written informed consent.

The ophthalmic examination included initial visual acuity and photography of the lens; best-corrected visual acuity was measured with an objective refraction refined by subjective refraction for those with a visual acuity less than 6/6. The cortical and posterior subcapsular cataract opacities were photographed with a retroillumination camera, and a slitlamp was used to photograph nuclear opacities. Lens opacities were graded clinically and from photographs by the Wilmer cataract photograph grading system, and clinical grades were used only if corresponding photographic grades were missing.^{5,6} Two observers graded photographs separately, and an independent reviewer adjudicated discrepancies. Cortical cataract was defined as a cortical opacity of 4/16 or greater, posterior subcapsular cataract was defined as opacity of 1 mm² or greater, and nuclear cataract was defined as opacity of Wilmer standard 2.0³ or greater.

Participants were divided into 5-year age groups except for those 85 years or older who were all included in the 85 years and older age group. The age-specific prevalence of incident cataract and backlog cataract was derived using the presence of cataract as defined earlier and the visual acuity thresholds of less than 6/6, less than 6/9, less than 6/12, less than 6/18, less than 6/36, less than 6/60, and less than 3/60. The baseline visual acuity was used for eyes that underwent cataract surgery between the 2 examinations. For each age group, the denominator was the number of participants in that age group who had cataract gradings in the follow-up survey. For a given threshold of visual acuity, the numerators were the number of eyes with either true incident cataract or backlog cataract for that threshold from participants in the same age group.

For incident cataract, an eye diagnosed with cataract at the follow-up survey contributed to the numerators for all thresholds worse than or equal to its visual acuity at the follow-up survey if it had no cataract at the baseline survey. Such an eye contributed to the numerators for thresholds not only worse than or equal to its visual acuity at the follow-up survey but also worse than its visual acuity at the baseline survey. For backlog cataract, an eye diagnosed with cataract at the baseline survey contributed to numerators for all thresholds worse than or equal to its visual acuity at the follow-up survey.

Cataract surgery rates were calculated for both incident cataract and backlog cataract associated with different levels of visual impairment. The Australian population or its projection was provided by the Australian Bureau of Statistics.⁷ SAS (version 8.2 for Windows; SAS Institute, Cary, NC) was used to carry out all calculations.

The Australian Bureau of Statistics provided the exact populations for 1950, 1960, 1980, and 2000 in 5-year age groups, with all people 85 years or older included in the same age group. We also used the medium projections (series B) of Australian populations in 2005, 2010, 2015, and 2020 provided by the Australian Bureau of Statistics (**Figure 1**). The Australian population in 1950 was 8.2 million; in 2000, 19.2 million; and in 2005, it is projected to be 23.2 million.

RESULTS

Of 3271 urban residents recruited in 1992-1994, 2594 participants (79%) were reexamined in 1997-1999. In all, 2302 participants (89%) had cataract grading in at least



Figure 1. Population pyramids for Australia for 1950, 2000, and 2020.

1 eye at the follow-up survey. Of 4566 eyes with cataract grading at the follow-up surveys, 1372 eyes (30%) had cataract at the follow-up surveys. This included 599 eyes (13%) that had cataract at the baseline survey.

For different levels of visual acuity, we calculated the age-specific prevalence of incident cataract and backlog cataract and used the estimated prevalence to obtain the estimated rates per million people for Australian populations in 1950, 1960, 2000, 2005, 2010, 2015, and 2020 (**Table 1** and **Table 2**) (**Figure 2**). Both incident and backlog CSRs increased with poorer visual acuity and also with increasingly aging Australian populations. Most interestingly, the incident cataract rates were consistently smaller than the backlog rates.

In 2005, the actual CSR in Australia was reported as 9000 (Warwick Kitt, oral communication, January 2006), but the CSR for all prevalent cases (backlog and incident) was 1470 for less than 6/60, 3110 for less than 6/18, 5080 for less than 6/12, and 6440 for less than 6/9 (Table 1 and Table 2).

COMMENT

This analysis shows 3 things. First, the CSR increases almost 5-fold as the visual acuity impairment threshold for surgery goes from less than 6/60 to less than 6/9. Second, it shows that the demographic change in Australia from 1950 to 2020 would lead to an almost 3-fold increase in the CSR. Third, it suggests that backlog cataract numbers exceed those of incident cataract in Australia. This may be surprising given the estimates of the cataract backlog in Australia being about 45 000,⁸ or less than 3 months of the current surgical volume. It seems likely to reflect the fact that early lens opacity may be present for some time before it causes sufficient disability for the individual to seek eye care and decide to proceed to cataract surgery. This is consistent with the finding that almost half (51%) of people with visually significant cataract (visual acuity <6/12) had had an eye examination in the previous year but had not been scheduled for cataract surgery.⁹

This study has as strengths its population basis, the standardized assessment of cataract status and visual acuity

Table 1. Cataract Surgery Rate for Incident Cataract (Operations per Million People)

Year	Visual Acuity Threshold in the Cataract Eye											
	<6/6	<6/7.5	<6/9	<6/12	<6/15	<6/18	<6/24	<6/30	<6/36	<6/48	<6/60	<3/60
1950	8790	1800	890	840	780	610	520	490	470	470	390	230
1960	8690	1820	900	850	790	620	520	500	470	470	390	240
1980	9380	1970	960	910	850	690	580	560	530	530	450	290
2000	11 210	2450	1210	1150	1080	890	760	730	710	710	620	440
2005	11 980	2620	1290	1230	1160	950	830	800	770	770	680	490
2010	13 100	2880	1470	1400	1320	1100	960	930	890	890	790	580
2015	14 460	3210	1630	1550	1470	1250	1080	1050	1010	1010	890	670
2020	15 790	3530	1780	1690	1610	1370	1170	1140	1090	1090	960	720

Table 2. Cataract Surgery Rate for Backlog Cataract (Operations per Million People)

Year	Visual Acuity in the Cataract Eye											
	<6/6	<6/7.5	<6/9	<6/12	<6/15	<6/18	<6/24	<6/30	<6/36	<6/48	<6/60	<3/60
1950	11 490	4460	2090	1460	1120	750	610	610	510	510	270	180
1960	11 890	4660	2200	1520	1160	780	640	640	530	530	290	190
1980	13 810	5730	2800	2010	1540	1080	870	870	710	710	390	290
2000	19 750	9050	4590	3380	2580	1890	1530	1530	1220	1220	690	540
2005	21 550	10 120	5150	3850	2910	2160	1740	1740	1390	1390	790	630
2010	23 670	11 290	5860	4470	3390	2530	2030	2030	1600	1600	930	780
2015	26 160	12 450	6560	5020	3840	2880	2310	2310	1820	1820	1060	900
2020	29 400	13 910	7290	5520	4210	3130	2510	2510	1980	1980	1150	960

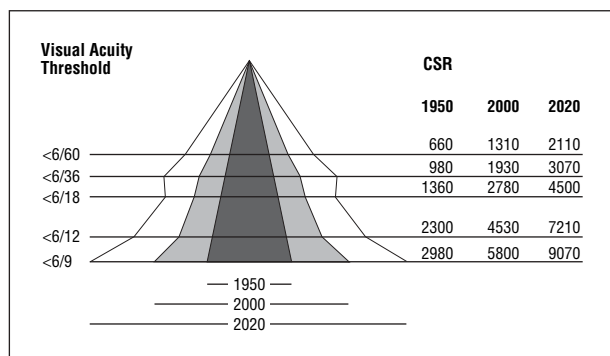


Figure 2. The relation between the prevalent cataract surgery rate (CSR) (incident and backlog) and visual acuity thresholds for the Australian population in 1950, 2000, and 2020.

ity, and its ability to project the derived rates using reliable national census data. Its weaknesses include the fact that not all cataracts with an associated level of visual acuity actually require cataract surgery and that a cataract will not be the only cause of visual impairment. However, today most surgeons would usually recommend cataract surgery for visually significant cataract occurring in an eye that also has significant vision loss for another cause, such as age-related macular degeneration or glaucoma, because of the expected improvement in function. Therefore, even though cataract may not be the only cause of vision impairment, its presence is still likely to lead to surgery in many patients.

What do these observations tell us? In Australia, the number of cataract operations has increased from 130 000 in 2000 to 180 000 in 2005 (Warwick Kitt, oral commu-

nication, July 2005). This gives an increase in CSR from 6500 to 9000. This CSR is higher than the predicted rate for incident and backlog cataract combined for a visual acuity threshold of less than 6/9 (predicted CSR, 6440). This would suggest that a significant number of cataracts with a visual acuity of 6/9 or better are being operated on, in which case some consideration should be given to the allocation of resources and the prioritization of cataract surgery. Second, and more importantly, these observations indicate the need to continue to expand our cataract surgery capacity to enable us to handle the increasing need with the future demographic change.

Data on the CSR in the United States are hard to find. The number of cataract surgeries in Medicare beneficiaries in 2001 would give a rate of about 4400,¹⁰ but other estimates suggest possibly 1.8 million cataract operations were performed in the United States in 2005, which would give a CSR of 6060.

Although our data are specific for Australia, the findings and proportional changes will be highly relevant to other developed areas, including the United States. Our data highlight the need to ensure sufficient capacity is built to meet the continuing growth in both need and demand for cataract surgery. Cataract surgery has been shown to be extraordinarily cost-effective at about AU\$3000 per quality-adjusted life-year.¹¹ We as a community cannot afford to have people with visual impairment from cataract waiting long periods for cataract surgery.¹²

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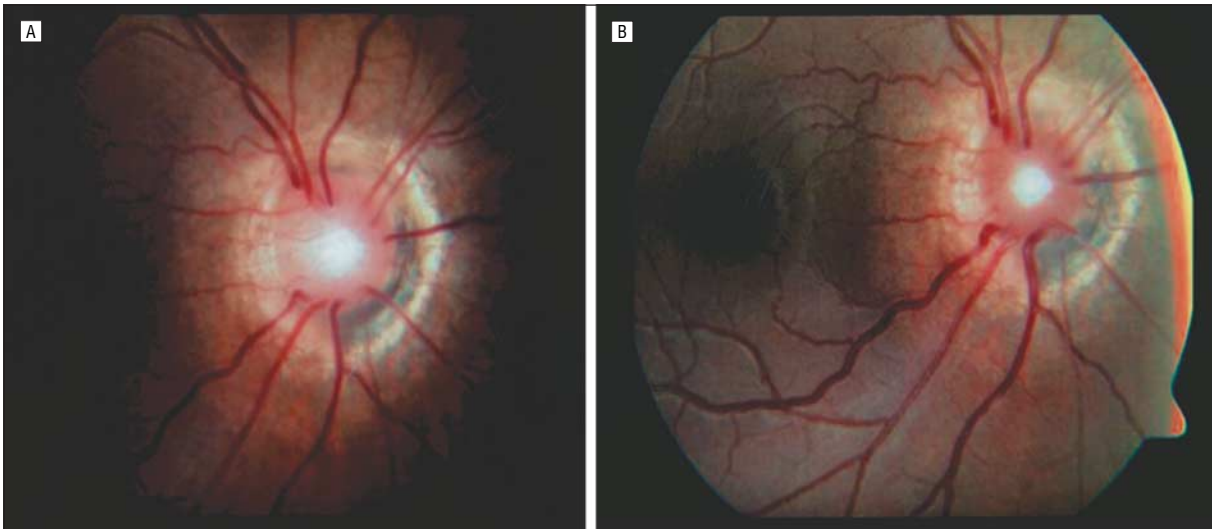
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ARCHIVES Web Quiz Winner

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Congratulations to the winner of our July quiz, Elvis Ojaimi, MBBS, MMed(Ophth), Sydney Eye Hospital, Sydney, Australia. The correct answer to our July challenge was contractile morning glory disc. For a complete discussion of this case, see the Clinicopathologic Reports, Case Reports, and Small Case Series section in the August ARCHIVES (Brodsky M. Contractile morning glory disc causing transient monocular blindness in a child. *Arch Ophthalmol*. 2006;124:1199-1201).



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