Objective: To establish the prevalence and causes of low vision and blindness in children aged 0 to 15 years in Fiji using existing data and new surveys.

Method: Childhood visual impairment data on both low visual acuity (<20/60-20/400) and blindness (<20/400) were obtained from existing records at hospital clinics, the school, an outreach service for visually impaired children, primary school screening records, and surveys in high schools and schools for children with multiple disabilities. Crude prevalence was derived and, using 5-year age range and age at onset of vision loss, the probable prevalence per 1000 children was calculated.

Results: A total of 81 children were identified; causes were established for 70 children, showing that 69% had unavoidable causes of vision loss (retinal, 39.7% and cortical, 15.5%), with the avoidable cause of low vision and blindness mainly being cataract (15.5%). Probable prevalence was 1.134 per 1000 children (95% confidence interval [CI], 1.115-1.153), with low vision, 0.774 per 1000 children (95% CI, 0.758-0.790) and blindness, 0.36 per 1000 children (95% CI, 0.349-0.371). The rate of severe visual impairment (<2/200) was 0.522 per 1000 children (95% CI, 0.509-0.535), only half of the total vision loss.

Conclusions: Both the low to moderate prevalence and mainly unavoidable causes of visual impairment indicated that Fiji, a developing country, has prevalence and causes of visual impairment similar to more resourced, industrialized countries.

Methods

Low vision (VA < 20/60 to 20/400) and blindness (VA < 20/400) were defined according to the WHO International Classification of Diseases, Tenth Revision (ICD-10) definition for best-corrected VA. A disability in addition to visual impairment was documented if observed by the researcher during examination of children in the schools or at the clinic including hearing, physical, intellectual, or multiple disabilities.

Study Area

The Central Medical Division (CMD) in Fiji was the study area with results extrapolated to the whole country given the good demographic data available; however, some relatively minor differences in the demographic data limited this extrapolation. The CMD is 1 of 4 medical divisions in the country that is located on the southeastern part of Viti Levu, the largest island in Fiji, with a population of 340,843; an estimated 29% of its population is younger than 15 years. The population in Fiji is equally divided between urban (50.7%) and rural (49.3%) locations. The largest proportion of the CMD’s population lives in rural areas, whereas most persons in the other divisions live in urban areas (all > 60%). The 2 main ethnic groups are Fijian (37%) and Indo-Fijian (37%), with Fijians making up 64% of the rural and 50% of the urban sectors. The 2 largest divisions, Central and Western, contain 77% of the total population. The Central, Western, and Northern Divisions each have a divisional hospital with eye care departments; in CMD, eye care is provided at the Colonial War Memorial (CWM) and in the private sector through optometrists and ophthalmologists.

Study Design, Eligibility, and Data Collection

Approval from the ethics committees of Royal Victorian Eye and Ear Hospital Human Research and Ethics Committee in Melbourne, Australia, the Fiji National Research and Review Committee, and the Fiji Ministry of Education were obtained. Data collection was from June 2006 through September 2007 and adhered to the tenets of the Declaration of Helsinki. Children were eligible to participate if they were aged 15 years or younger, were residents of the CMD during the period of data collection, and had best-corrected VA of less than 20/60.

Data were obtained from 4 existing and new sources: informal registers for the visually impaired, school vision screening programs, key informants, and new cases seen at the CWM eye clinic (Table 1).

Records accessed were the registers and files kept by the following organizations:

- Community Based Rehabilitation Program (run by the Fiji Society for the Blind), which includes early intervention, integrated education, case finding, and referrals
- Fiji School for the Blind
- Persons registered as having low vision at the CWM eye clinic; all patients seen at the low-vision clinic; either hospital-based or outreach clinics.

Records were obtained from existing screening programs and 2 new ones conducted for this study:

- Project HEAVEN (Hearing and Vision Enhancement) is a nongovernment organization that carries out vision and hearing screening of all primary and secondary school students in Fiji once every 5 years. Students identified as having a vision or hearing problem are referred to the appropriate service for follow-up.
- Government school health teams: each subdivision has a school health team that makes annual visits to all primary schools within their areas for immunization, eye care, and general health care.
- Special school screenings: students who attend one of the 6 schools for children with hearing, physical, and mental disability were screened by Dr Cama. The 3-m letter and Lea Symbols charts were used with matching cards if needed; best-corrected VA was measured with a pinhole, and students with suspected low vision were referred to a CWM eye clinic for further ophthalmic assessment.

Secondary school screening: vision screening, as part of this study, was conducted for best-corrected VA. All students with visual acuity of less than 20/40 were referred to either an optometrist or a CWM eye clinic but only those with best-corrected VA less than 20/60 were included.

Health care workers at the subdivisional level, optometrists, and ophthalmologists in private practice were considered key informants. They were informed of the study and requested to refer all children in their care who were suspected of having low vision to a CWM eye clinic for a full ophthalmic assessment.

All new children with impaired vision seen at the CWM eye clinic during the study period from other referral sources were also included in the study.

Table 1. Sources of Identification of Children With Impaired Vision

<table>
<thead>
<tr>
<th>Source of Patients</th>
<th>No./Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colonial War Memorial</td>
<td></td>
</tr>
<tr>
<td>Existing</td>
<td>18</td>
</tr>
<tr>
<td>New(^a)</td>
<td>11/29 (35.8)</td>
</tr>
<tr>
<td>Fiji School for the Blind</td>
<td>20 (24.7)</td>
</tr>
<tr>
<td>Community-based rehabilitation program</td>
<td></td>
</tr>
<tr>
<td>Existing</td>
<td>12</td>
</tr>
<tr>
<td>New(^a)</td>
<td>5/17 (21)</td>
</tr>
<tr>
<td>Screening program</td>
<td></td>
</tr>
<tr>
<td>Existing (primary-school screening)</td>
<td>2</td>
</tr>
<tr>
<td>New (special schools, secondary schools)(^a)</td>
<td>10/12 (14.8)</td>
</tr>
<tr>
<td>Key informants for new cases</td>
<td>3 (3.7)</td>
</tr>
<tr>
<td>Total</td>
<td>81 (100)</td>
</tr>
</tbody>
</table>

\(^a\) New sources were those resulting from the study.

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would have been identified (Table 1). Similarly, if our study had only focused on children with SVI, only 37 of 81 of the children (45.7%) would have been included (Table 2).

### CAUSES OF VISUAL IMPAIRMENT

The causes of visual impairment were predominantly unavoidable (75.7%; 53 of 70 cases), with macular/retinal causes being the highest single anatomical site cause at 45.3% (24 of 53 cases); cortical, 28.3% (15 of 53 cases); whole globe, 13.2% (7 of 53 cases); optic disc, 9.4% (5 of 53 cases); and cornea and anterior segments, 1.9% each (1 of 53 cases) (Figure). The avoidable causes of visual impairment were predominantly cataracts, both those that had received surgery and those that had not, 52.9% (9 of 17 cases); retinopathy of prematurity, 35.3% (6 of 17 cases); and whole-globe esotropia with amblyopia or refractive error, 11.8% (2 of 17 cases).

The youngest child identified was aged 3 years, despite hereditary and congenital causes of vision loss and blindness making up 71% of causes. Using sensitivity analysis and assuming that 100% of children with visual impairment would have been identified by 11 to 15 years of age, the actual and assumed prevalence figures were calculated (Table 3). Using probable age of onset showed that 126 children are likely to have low vision and blindness in the CMD. Using odds ratios, the likelihood of being identified and referred for children younger than 5 years was very low (odds ratio, 0.17; 95% confidence interval, 0.12-0.21); they were still low for the 6- to 10-year age group (OR, 0.57; confidence interval, 0.49-0.64) compared with the 11- to 15-year age group. The prevalence of 1.13 per 1000 children (blindness, 0.36 per 1000 children) approximates the WHO's estimates for a middle- to high-income country.

When adjusting prevalence for age, ethnicity, sex, and residence, results showed visual impairment to be more prevalent in Indian children and those residing in rural areas (Table 4). However, further analysis showed that only residence was significant ($P < 0.05$) when a higher proportion were from rural areas. Taking into consideration the minor differences in other divisions as a limitation in the extrapolation of data to the whole country, the estimated number of visually impaired children in Fiji is 325. Approximately 40 children attend the School for the Blind and fewer than 10 are supported in integrated education.

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### STATISTICAL ANALYSIS

Statistical analysis was performed using the Statistical Package for Social Sciences (version 14; SPSS Inc, Chicago, Illinois). Confidence intervals given were at the 95% level, while significance levels were calculated using probability tests ($P < 0.05$).

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### RESULTS

Names and dates of birth were checked to avoid double counting. A total of 81 children were identified by the sources (Table 1). The proportion of children of Fijian and Indian ethnicity was comparable with the population of Fiji (Table 2). In 10 cases, it was noted that identification was from 2 different sources (CBR Program and School Health Team, School Health Team and Project Heaven, and Project Heaven and CWM). For 7 of 10 of these cases, the student did not seek specialist help after the first referral and was reidentified by a different screening team. Identification was then recorded as the initial cause. Causes and onset of visual impairment were complete for 70 medical records (Figure).

If data had only been obtained from clinics and schools for blind children, only 52 of 81 of these children (60.5%)
Our study found that 26% of all children had a disability in addition to visual impairment, and 76.2% of children (16 of 21) with additional disabilities were in special-education (not blind) schools. The remaining children were not enrolled at any school, as 2 were younger than 5 years, 2 were of school age but, owing to severe multiple disabilities, were kept at home in rural villages, and one child with intellectual disability was of school age but was kept at home.

This study has determined the causes and estimated the prevalence of visual impairment in children in Fiji and used more comprehensive methodology than any other study of childhood low vision and blindness. In doing so, it identified many groups of children who have not, or have only partially, been included in other studies, namely those with low vision or multiple disabilities, rural residents, and those who do not attend school. It has demonstrated that studies that use schools for the blind and hospital clinics underestimate the prevalence by about 40% and, similarly, if the definition of SVI is used, fewer than half of children with impaired vision would be counted. To plan eye care, low vision, education, and rehabilitation services, it is imperative that figures used include children with low vision as well as those who are blind or have SVI. Previous surveys have included only SVI for prevalence and causes of visual impairment such as those in China, where 91% of children at schools for the blind had SVI, in Ethiopia, 94.5%; and in India, 91.7%.

A strength of this study was the 5-year age groups for which data were collected. This, in addition to knowledge of the probable age at onset of visual impairment, allowed for sensitivity analysis to recalculate the prevalence data to derive a more accurate estimate of visual impairment in children. This study found the prevalence of low vision to be 0.774 per 1000 children and blindness, 0.36 per 1000. The prevalence of childhood blindness has also been shown to be associated with the mortality rate of children younger than 5 years; in Fiji in 2007, it was 18 per 1000 children. Using these figures, the estimated prevalence of blindness in children in Fiji would be 0.4 per 1000, similar to our results. According to WHO estimates, this figure suggests that the Fijian data are comparable with those in China, 94.5%; and in India, 91.7%.

When adjusting for variables of age, sex, ethnicity, and place of residence, the only significant variable was urban vs rural residence. Interesting but nonsignificant figures were found for ethnicity, with higher proportions in Indo-Fijian children with visual impairment. The higher prevalence in rural areas is likely to be related to the distance to eye care in divisional hospitals. This is evidenced by the fact that most children with visual impairment (36.5%) had been previously examined or were referred during the study to the eye department at CWM; most of these children were from the urban area around Suva. Poor access to services and eye care may contribute to the presence of children with cataract who had not had surgery and the higher prevalence of visual impairment in rural areas. The urban and rural populations are equal (50.3% vs 49.7%) across the country but vary by division, with CMD having a smaller proportion of rural-dwelling people. Extrapolation from CMD to estimate the numbers for the whole country is possible but, because CMD has a smaller rural population, this could lead to underestimation for Fiji as a whole, as the prevalence of low vision and blindness is higher in rural areas.

An important finding was the gap in identification of visual impairment in the preschool-aged group; this was not unexpected, as there are few vision screening programs for this age group. Of children younger than 5 years who were identified as having visual impairment, 86% (6 of 7) from CWM were brought in by their parents while the remaining child was identified by a rural health care worker. This lack of awareness and training of community health workers as key informants to detect children with significant vision loss has resulted in the low rate of identification and referral of preschool-aged children. In Bangladesh, key informants have been shown to be effective in identifying children with impaired vision, as they recruited 63.4% of children who were blind or had SVI. Given the success of using key informants for those who are severely visually impaired, efforts could be made to train village health workers and other community-based health workers to identify blind children and those with low vision. Vision 2020 Fiji should consider training existing community health workers as key informants to identify and refer preschool-aged children, as this method has been shown to be effective in detecting children who are blind or have SVI.

Records from school screening programs could also be an important source of data. Our study found limitations owing to the nonstandard methods of screening and reporting of results. While only 15% were identified though school vision screening, this identified children who were in mainstream schools who had not been included in other studies. Another useful source was the CBR field-workers but they only identified school-aged children. These workers have been trained to conduct vision screening, are familiar with referral pathways, and have identified some children with visual impairment. With more training to assess vision in preschool-aged children, the use of these field-workers as key informants may prove beneficial in Fiji.

### Table 4. Prevalence of Visual Impairment Adjusted for Age, Ethnicity, Sex, and Residence

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Children, No.</th>
<th>Prevalence of VI per 1000 Children (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age group, y</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-5</td>
<td>5</td>
<td>0.171 (0.158-0.184)</td>
</tr>
<tr>
<td>6-10</td>
<td>20</td>
<td>0.834 (0.805-0.863)</td>
</tr>
<tr>
<td>11-15</td>
<td>30</td>
<td>1.270 (1.235-1.305)</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fijian</td>
<td>31</td>
<td>0.569 (0.553-0.584)</td>
</tr>
<tr>
<td>Indian</td>
<td>22</td>
<td>0.778 (0.752-0.804)</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>27</td>
<td>0.624 (0.606-0.642)</td>
</tr>
<tr>
<td>Female</td>
<td>28</td>
<td>0.603 (0.585-0.621)</td>
</tr>
<tr>
<td>Residence</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban</td>
<td>35</td>
<td>0.471 (0.461-0.489)</td>
</tr>
<tr>
<td>Rural</td>
<td>20</td>
<td>0.992 (0.961-1.023)</td>
</tr>
</tbody>
</table>

Abbreviations: CI, confidence interval; VI, visual impairment.
The pattern of causes of visual impairment was expected to reflect those of a developing country; however, this study found that causes are more similar to those of a developed country. Only one 15-year-old child had corneal opacity from presumed vitamin A deficiency, and there were no other causes related to nutrition. A possible reason for the low rate of corneal disease is the almost total coverage of measles immunization.\(^9\) While most causes were unavoidable, 9 children were visually impaired owing to cataract. While cataract is not avoidable, the visual impairment is avoidable with timely cataract surgery. The changing pattern of visual impairment to mainly unavoidable causes shows that Fiji is in a transition stage similar to that recently observed in India.\(^20\)

The number of children with multiple disabilities in schools for children with disability who had not previously been identified as having visual impairment and who were not previously treated or referred to low-vision services was significant. It has been reported that up to 60% to 70% of children with multiple disabilities also have visual impairment.\(^21\) In a study by Rahi et al.,\(^22\) 77% of cases were found to have an additional nonophthalmic disability, making them an important group to include in epidemiologic studies. Where causes were known, our study found 30% of visually impaired children (21 of 70) to have an additional disability; 38% of these children were enrolled in a school for children with disability and another 38% in the School for the Blind, while the remaining 19% did not attend any school. The finding of cortical visual impairment further signifies the importance of screening in schools for children with disability.

Culture also plays an important role in that people from developing countries or from poorer regions tend to keep children who are visually impaired at home or they may not be accepted in mainstream schools. In this case, data taken exclusively from schools would underestimate the prevalence. Statements report that 10% of visually impaired children in developing countries have access to education. Our study showed that 14 of 61 children did not attend any school (23%). Of these 14 children, 57% were school aged, 35.7% (5 of 14) resided in rural areas, and 71.4% (10 of 14) were Fijians.

This was not a population-based study, so is likely to still underestimate the prevalence of visual impairment. Despite this shortcoming, the methods used to obtain the prevalence figures in this study are reliable and feasible for any small country. All age groups in all areas within a country can be accessed in a relatively short period of time and with minimal expenses, provided all previously recorded data are standardized and accurate. This method will also give a more reliable estimate than studies that just use schools for children with disability or clinics. The gaps in finding younger children for early intervention need to be addressed in communities. With better data, eye health and education programs can better plan services for children who are visually impaired.

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