Economic Cost of Visual Impairment in Japan

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Objective: To quantify the total economic cost of visual impairment in Japan.

Methods: A prevalence-based approach was adopted using data on visual impairment, the national health system, and indirect costs to capture the economic impact of visual impairment in 2007.

Results: In 2007, visual impairment affected more than 1.64 million people in Japan and cost around ¥8785.4 billion (US $72.8 billion) across the economy, equivalent to 1.7% of Japan’s gross domestic product. The loss of well-being (years of life lost from disability and premature mortality) cost ¥5863.6 billion (US $48.6 billion). Direct health system costs were ¥1338.2 billion (US $11.1 billion). Other financial costs were ¥1583.5 billion (US $13.1 billion), including productivity losses, care takers’ costs, and efficiency losses from welfare payments and taxes. Community care was the largest component of other financial costs and was composed of paid and unpaid services that provide home and personal care to people with visual impairment. The findings of this study are in line with those of similar studies in Australia and the United States.

Conclusions: Visual impairment imposes substantial costs on society, particularly to individuals with visual impairment and their families. Eliminating or reducing disabilities from visual impairment through public awareness of preventive care, early diagnosis, more intensive disease treatment, and new medical technologies could significantly improve the quality of life for people with visual impairment and their families, while also potentially reducing national health care expenditure and increasing productivity in Japan. The results of this study should provide a first step in helping policymakers evaluate policy effects and to prioritize research expenditures.

plus other financial and nonfinancial costs from their vision loss in that year. Understanding cost components is crucial for appropriate allocation of health care resources.

All costs were originally calculated in Japanese yen (¥) and are presented with United States dollar equivalents based on the Organization for Economic Cooperation and Development’s purchasing parity 2007 rate of ¥120.66 per US dollar.

PREVALENCE

Prevalence of visual impairment (best-corrected visual acuity <6/12) was calculated as the sum of low vision (best-corrected visual acuity between 6/12 and 6/60) and blindness (best-corrected visual acuity <6/60). Visual impairment was defined as <6/12 (<20/40) because this is a well-accepted international definition, thus enabling cross-country comparisons, and because these data were available in Japan.

Prevalence rates by age were based on data from the Japanese Ministry of Health, Labour and Welfare, presented by the National Committee of Welfare for the Blind in Japan, and a major epidemiological study. Sex and severity splits were based on epidemiological data sets by cause of visual impairment. Prevalence rates were multiplied by Japanese census data to estimate the number of people with visual impairment.

DIRECT HEALTH COSTS

Health costs were based on Japanese health expenditure data, which concord with the World Health Organization’s International Statistical Classification of Diseases, 10th Revision (ICD-10). In the absence of more granular data, the ICD-10 code VII for “diseases of the eye and adnexa” was used. These expenditures were related to all eye health costs and may include some conditions that are not potentially visually impairing. However, data are not available on the total, as in other studies in which data do not support separation of visually impairing conditions. Health expenditures were converted to 2007 values using official health inflation data.

OTHER FINANCIAL COSTS

Other financial costs are composed of productivity losses, costs of care outside the health system, vision aids, and efficiency losses from government transfers and expenditure. People with visual impairment may work less than otherwise, retire early, or die prematurely, representing real productivity losses to the economy. A human capital approach was used to measure productivity losses, as is appropriate in countries with low unemployment like Japan. Age- and sex-standardized employment rates, absenteeism, and mortality rates were estimated for people with visual impairment using official estimates and government survey data. Productivity costs were estimated, assuming that in the absence of visual impairment, people would have worked at the same rate as the general population. Productivity costs from increased absenteeism were calculated as the average number of days absent per year owing to visual impairment × the total number of people employed with visual impairment × average annual wages. Production losses arising from premature mortality from falls and depression associated with visual impairment were calculated as a net present value using World Health Organization data for Japan on retirement age, average life expectancy, average age of death, and an estimated discount rate of 1.5%, calculated as long-term nominal bond rates minus expected inflation and growth in productivity.

Additionally, any taxation foregone requires equivalent revenue raising, imposing real efficiency costs on the economy, known as deadweight losses (DWLs). Internationally, DWLs are estimated to be in the range of 9, 16, and 50 cents (9%, 16%, and 50%, respectively) for every additional tax dollar raised by the government. The parameter estimate of 16% was used, since no Japanese studies were found to provide a local estimate.

To estimate the cost of community care services, an opportunity cost method valued time devoted to care giving responsibilities that cannot be spent in the paid workforce. This was calculated as the estimated number of people with visual impairment who require some level of care × the average number of hours of care required by an average hourly rate for the wage foregone by the caregiver, and weighted by age, sex, and the probability of alternative employment.

LOSS OF WELL-BEING

Loss of well-being from visual impairment was measured in disability-adjusted life years (DALYs). Disability-adjusted life years have 2 components: the years of life lost as a result of premature death (the mortality burden) and the years of healthy life lost as a result of disability (the morbidity burden).

Years of healthy life lost as a result of disability from visual impairment were calculated by multiplying prevalent cases by disability weights for mild, moderate, and severe visual impairment (0.02, 0.17, and 0.43, respectively) based on the global burden of disease study. These disability weights represent losing 2%, 17%, and 43%, respectively, of a year of healthy life. Years of life lost were calculated from the age when a person dies from comorbid conditions attributable to visual impairment and the life expectancy for people of that age and sex. To calculate the burden of disease, Japanese prevalence rates for low vision were subdivided into mild and moderate visual impairment using weights from Australian prevalence data. The loss of well-being in DALYs was converted into a monetary value using an estimate of the value of a statistical life. The value of a statistical life in Japan has been valued between ¥675.9 million (US $5.6 million) and ¥1783.5 billion (US $14.8 million). The lower bound of US $5.6 million was used with a discount rate of 3.0% during 40 years to generate an estimate for the value of a statistical life year (VSLY) of ¥28.3 million (US $234 552).

SENSITIVITY ANALYSIS

The effects of 20% changes in health care costs, the number of people requiring informal care, and earnings for men and women were examined. The effect of reducing the DWL parameter estimate to the lower bound of 9% was tested. We also assessed the effects of a 20% change in the value of a statistical life used for Japan and in the distribution of low-vision severity.

RESULTS

PREVALENCE

There were 1.64 million people with visual impairment in Japan in 2007; almost 188 000 were blind. Of those with visual impairment, 93.2% were aged 40 years or older, 61.2% were aged 65 years or older, and 33.5% were aged 75 years or older (Table 1).

DIRECT HEALTH COSTS

The direct financial costs in Japan for the treatment of all disorders of the eye and adnexa were estimated to total ¥1338.2 billion (US $11.1 billion) in 2007 (Table 2) and
may include some conditions that are not visually impairing. However, the cost overestimation is expected to be slight as a result of this data constraint and is countered in that costs of screening programs and eye health promotion are not included, so health cost coverage was not exhaustive. The largest component of health costs for visual impairment related to general medical expenditure (¥977.5 billion [US $8.1 billion]), of which outpatients represented 77.7% (¥759.4 billion [US $6.3 billion]).

**OTHER FINANCIAL COSTS**

Other financial costs of visual impairment were estimated as ¥1583.5 billion (US $13.1 billion) in 2007 (Table 3). Productivity losses from visual impairment (¥563.1 billion [US $4.7 billion]) reflected the lost earnings from lower employment participation (¥510.4 billion [US $4.2 billion]) and worker absenteeism costs (¥46.4 billion [US $384 million]). There are also additional costs totaling ¥6.4 billion (US $53.0 million) associated with premature mortality due to comorbid consequences.

As a substantial component of overall costs, the cost of community care represented both unpaid and paid home care for people with visual impairment. Using the opportunity cost method, the cost of community care in 2007 was estimated as ¥797.3 billion (US $6.6 billion).

The DWL resulting from raising additional taxation revenue to pay for costs borne by the government in relation to visual impairment was composed of losses from health care costs (¥130.9 billion [US $1.1 billion]), lost-
taxation (¥33.8 billion [US $280 million]), welfare payments (¥24.8 billion [US $205 million]), and other costs associated with providing institutional care and vision aids (¥4.6 billion [US $38.4 million]).

Expenditure on other institutional care and rehabilitation for people with visual impairment in Japan was based on the average cost of institutional care per person per year (derived from long-term care insurance facilities, estimated at ¥7,445,863 [US $61,711.63]) and multiplied by the number of people admitted (3857 people, minus the adjustment to account for the 30% overlap in the data with long-term care insurance facilities). In total, it was estimated that expenditure for institutional services (over and above that provided by long-term care insurance facilities) for the visually impaired was ¥28.7 billion (US $238 million) in 2007.

LOSS OF WELL-BEING

In 2007, the years of healthy life lost as a result of disability and years of life lost attributable to visual impairment in Japan were estimated as 220,022 DALYs and 9063 DALYs, respectively. In total, the burden of disease was 229,085 DALYs.

The gross value of the burden of disease (DALYs multiplied by the VSLY) was ¥6503.1 billion (US $53.9 billion). However, the gross value includes some costs borne by the individual—notably, lost earnings and out-of-pocket health expenditures, for example, which have already been captured. As such, these costs were subtracted and the net cost of the loss of well-being in Japan was calculated as ¥5863.6 billion (US $48.6 billion) for 2007. Costs by item and bearer are summarized in Table 4.

INTERNATIONAL COMPARISONS

The cost methodology used here for Japan has also been applied in Australia in 2004 and in the United States in 2005. The estimates can be compared by inflating those costs to 2007 values using domestic inflation data and to US dollars using purchasing power parity. Table 5 shows the economic costs per person with visual impairment.

While no single data set provided a complete picture of the prevalence of visual impairment in Japan, all surveys provided valuable input. The prevalence of visual impairment was principally based on epidemiological studies of larger sample sizes. These sources were considered representative of the rapid economic development in Japan during the past half century, public awareness of treatable ocular diseases, and the universal medical insurance system in Japan. Additionally, the smaller surveys provided valuable information on prevalence by sex and severity for low vision and blindness.

In the present study, we have shown that in 2007 visual impairment affected more than 1.64 million people in Japan, or 1.3% of the population, and cost an estimated ¥8785.4 billion [US $72.8 billion], or 1.7% of the

Table 4. Cost Summary of Visual Impairment by Item and Bearer in Japan

<table>
<thead>
<tr>
<th>Cost</th>
<th>Individual</th>
<th>Government</th>
<th>Other Society</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health care costs</td>
<td>1.698</td>
<td>6.781</td>
<td>2.612</td>
<td>11.091</td>
</tr>
<tr>
<td>Other financial costs</td>
<td>3.618</td>
<td>1.991</td>
<td>7.515</td>
<td>13.124</td>
</tr>
<tr>
<td>Loss of well-being</td>
<td>48.598</td>
<td>0</td>
<td>0</td>
<td>48.598</td>
</tr>
<tr>
<td>Total Economic Costs</td>
<td>53.914</td>
<td>8.772</td>
<td>10.127</td>
<td>72.813</td>
</tr>
</tbody>
</table>

Table 5. Cost of Visual Impairment per Person With Visual Impairment by Country

<table>
<thead>
<tr>
<th>Cost</th>
<th>Australia</th>
<th>Japan</th>
<th>United States</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health care costs</td>
<td>7614</td>
<td>6776</td>
<td>15,617</td>
</tr>
<tr>
<td>Other financial costs</td>
<td>13,395</td>
<td>8018</td>
<td>6085</td>
</tr>
<tr>
<td>Loss of well-being</td>
<td>20,106</td>
<td>29,690</td>
<td>32,193</td>
</tr>
<tr>
<td>Total Economic Costs</td>
<td>41,116</td>
<td>44,484</td>
<td>53,896</td>
</tr>
</tbody>
</table>
The loss of well-being comprises a large part of the costs of visual impairment in Japan as well as in Australia and the United States. There has been some controversy about placing a monetary value on DALYs, and the value of the VSLY chosen has a large impact on the estimated burden of disease from visual impairment. As a conservative approach, the lower end estimate was used because the VSLY for Japan was already at the high end of estimates of that among comparable countries. Accordingly, the estimated loss of well-being from visual impairment per person per year in Japan was between that in Australia and the United States.

Even in a developed country like Japan, avoidable vision loss is now a major problem and will increase in the future in the absence of policy change. Because prevalence rates of visual impairment increase with each decade of life, the number of Japanese individuals with visual impairment is expected to increase by 23% during the next 20 years. Although specific interventions may increase health costs, they can also bring significant savings in other financial costs. The loss of well-being comprises a large part of the costs of visual impairment in Japan as well as in Australia and the United States. There has been some controversy about placing a monetary value on DALYs, and the value of the VSLY chosen has a large impact on the estimated burden of disease from visual impairment. As a conservative approach, the lower end estimate was used because the VSLY for Japan was already at the high end of estimates of that among comparable countries. Accordingly, the estimated loss of well-being from visual impairment per person per year in Japan was between that in Australia and the United States.

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The method of operation followed the principles laid down by Elliott: a broad conjunctival flap, splitting of the cornea with a broad-bellied miniature scalpel, and a 2 mm trephine. This size was found necessary after experience with soft eyes and where the aqueous escaped prematurely. If the trephine opening is too small, it was found difficult to cleanly divide the attachment of the sclera disk; and through this small opening it was very difficult to fish out the iris. It was soon observed that the buttonhole iridectomy must be large to insure filtration.

The complications may be regarded as three, namely: iritis, hypotony and late infection. The tendency to iritis is unquestionably pronounced, as must be the experience of any one who is performing this operation; and even the early use of atropin does not prevent the proliferation of some uveal pigment and consecutive deposit on the lens capsule. We are in the habit of bringing atropin ointment into the conjunctival sac at the close of the operation. The complication of hypotony is a very serious one. We cannot at the present day state what the outcome of an eye is whose tension is reduced to 5 or 6. It surely must be a pathological condition. The danger of late infection is a particularly real one. Considerable attention has been drawn to this in recent literature. There can be no question that an eye with a cystoid cicatrix is not a sound eye, nor an eye enjoying the benefit of a normal protecting membrane. The sight of a large cystoid cicatrix which we have repeatedly observed measuring 4 or 3 mm is surely one to cause some anxiety. On the other hand, the advantages of a trephining operation seem to me to consist in that the operation is a safer one in hard eyes than any other operation that has been suggested for reducing the tension.


Note: Arnold Knapp (1869-1956) was born the same year as the Archives of Ophthalmology and was its second editor. He was the son of Hermann Knapp, the first editor of the Archives, and served as editor for 38 years.