The Economic Impact and Cost of Visual Impairment due to Cataract in West Nusa Tenggara Province

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Abstract

Blindness and severe visual impairment have a significant impact on quality of life (QOL). This leads to reduced productivity and economic burden for Indonesia. The economic valuation of visual impairment is an important tool for making recommendations and making cost-sharing decisions. Using a cost-benefit analysis (CUA) approach, this study estimates the economic impact of blindness and severe visual impairment, and describes the value of cataract surgery in Indonesia. The aim of this study was to estimate the economic losses due to blindness and severe visual impairment and to describe the cost-benefit analysis of cataract surgery in Indonesia. Prevalence data were collected from Indonesia's Rapid Assessment of Avoidable Blindness (RAAB) survey from 2014 to 2016 and the cost of cataract surgery was averaged across the system. Indonesian case base groups system (INA-CBGs) was approved on the basis of reasonable national surgical costs. The economic evaluation is described using a cost-benefit analysis approach per quality-adjusted life years (QALYs). The following results: The number of QALYs lost to blindness and severe visual impairment in Indonesia is approximately 84,866 QALY and 49,440 QALY, respectively. The total economic loss was 3.38 trillion IDR in a year and is expected to increase to 24.41 IDR trillion in 5 years. As a highly cost-effective procedure, cataract surgery brings about 79,564 QALY profit or economic benefit worth 2.0 trillion IDR for Indonesia.

Keywords: **QALYs, Cost-utility analysis, Cataract blindness, Visual impairment**.

DOI :
ISSN :

INTRODUCTION

The Indonesia Rapid Assessment of Avoidable Blindness (RAAB) survey conducted between 2014 to 2016 in 15 provinces showed a blindness rate in Indonesia of 3.0%. There are 1.6 million blind and 1.3 million severely visually impaired. Cataracts are the leading cause of blindness and visual impairment, accounting for 82.4 % of all visually impaired people (Kementerian Kesehatan RI, 2018; WHO, 2013).

Blindness and visual impairment have a great impact on life and society. The health effects not only affect the eyes and visual system but also affect quality of life (QOL), independence and mobility. An estimated 40% of healthy visually impaired people fall at least once a year, which is a significant cause of morbidity and mortality (Teutsch et al., 2016; Krishnaiah and Ramanathan, 2018; Brown and Barrett , 2011).

In society, visual impairment also affects emotions well-being, social relationships, and comfort. The reported benefits for blind people were similar to those of moderate to severe stroke and were associated with depressive symptoms and dissatisfaction with life. It also affects families, carers and communities, leading to significant productivity losses and economic burdens (Wang et al., 2001; Brown et al., 2001; Eckert et al., 2015).

The economic evaluation of visual impairment is an important public health tool. This includes analyzing the costs of government actions and making recommendations on public health. Economic evaluation of visual impairment has not been established in Indonesia. Therefore, the objective of this study was to quantify and estimate the economic impact of blindness and severe visual impairment, and to explain the growing economic impact of cataract surgery in Indonesia. (Frick, 2012; Nilson, 2014).

METHOD

This study is a descriptive study combining secondary data from the RAAB study with Brown et al. Use a cost-utility analysis (CUA) approach to assess the economic impact of visual impairment and explain it financially.

Data collection on blindness and severe visual impairment

This study focused only on the prevalence of blindness and severe visual impairment. Visual impairment data were obtained from the 2014-2016 RAAB results in West Nusa Tenggara Province. From these data, the total number of cataract patients was also recorded. Blindness was defined as best corrected visual acuity (BCVA) and < 3/60, and visual impairment was defined as best corrected visual acuity (BCVA) < 6/60-3/60 (WHO, 2013).

Measuring the burden of disease

The burden of disease is defined as the gap between the current state of health and the ideal state in which everyone is healthy. To measure disease burden, health interventions must be measured by an organization that assesses the impact between the intervention and its consequences. In this study, the prevalence of blindness and severe visual impairment was the burden of disease,

DOI :
ISSN :

and cataract surgery was used as an intervention to reduce this burden. We use QALY (Quality-Adjusted Years of Life) as a framework to measure the value of health in economic evaluation (Pezzullo et al., 2018; Sassi, 2006).

Measure Utility value

Utility value is a direct reflection of your opinion. Assess how effectively people manage their lives in relation to their health. Utility metrics are important for calculating QALYs. A utility value 1.0 indicates perfect health and a utility value 0 indicates death. In this study, blind utility was evaluated based on the work of Brown et al. It was 0.47 for blindness and 0.65 for severe visual impairment (Brown et al., 2001; Koberlein et al., 2013).

Calculation of QALYs

QALYs are used to measure the health impacts of medical interventions. 1 QALY considers a year of life to be a perfect life. To determine the exact QALY value, multiply the utility value by 1 year of life (1 year life x 1 utility = 1 QALY). In this study, subjects with normal vision had 1 QALY, while blind individuals had 0.47 QALY and those with severe visual impairment had 0.65 QALY (Brown et al., 2001; Koberlein et al., 2013; Chiang et al., 2006).

Monetary value of QALYs

To account for the economic impact of visual impairment, this study requires that QALYs be calculated as a meaningful monetary value. The monetary value of 1 QALY in Indonesia has not been determined. This study uses gross domestic product (GDP) per capita as an increment per QALY based on WHO recommendations of WHO Choosing Intervention that are Cost Effective (WHO-CHOICE). Indonesia's GDP per capita in 2020 is 56,900,000 IDR or 3,924 USD for 1 QALY. Thus, a person with normal vision in Indonesia has 1 QALY worth 3,924 USD . For the blind and severely visually impaired, the value drops to 1,844.3 USD (0.47 x 1 QALY) and 2,550.6 USD (0.65 x 1 QALY) (Trading Economics, 2020) .

Its GDP per capita in West Nusa Tenggara Province in 2020 is 1736.8 USD or 25,183,560 IDR for 1 QALY. Thus, 1 QALY for a person with normal vision in West Nusa Tenggara Province is worth 1736.8 USD. For blindness and severe visual impairment, this drops to 816.3 USD (0.47 x 1 QALY) and 1,128.9 USD (0.65 x 1 QALY).

Cataract Cost Analysis

Cataract surgery costs were calculated at a national standard rate based on the Indonesian case-based grouping system (INA-CBG). Collect data on cataract surgery costs in Indonesia and use mean values. The fee is 370 USD or 5,363,550 IDR per cataract surgery, based on 14,500 IDR in 1 USD currency. If it is less than 3 times GDP per capita then it is cheap, and if it is less than 1 times GDP per capita it is considered very efficient. In this study, the estimated success rate for cataract surgery was 80%. Next, this study provides a comparison of the total

DOI :
ISSN :

economic costs and benefits of cataract surgery (Wood et al., 2016; Gordois et al., 2012; Permenkes, 2014).

RESULTS AND DISCUSSION

Table 1 below shows the prevalence of blindness and severe visual impairment in West Nusa Tenggara Province. This shows 160,124 blind and 141,257 severe visual impairment. In West Nusa Tenggara province, people with normal vision will have an economic value of 1,736.8 USD or 25,183,560 IDR based on a value of 1 QALY.

Table 1. Prevalence of visual impairment in West Nusa Tenggara Province based on RAAB 2014-2016

	Number of People
Blindness	**160.124**
Severe Visual Impairment (SVI)	**141.257**
Total	**301.381**

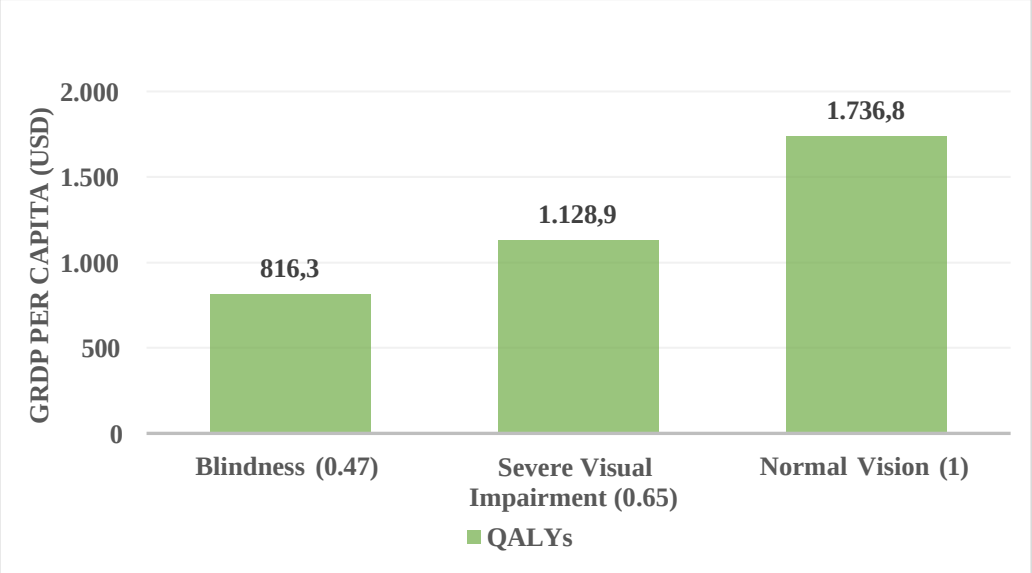

Figure 1. Economic Value Per Person for Different Visually Impaired Groups in West Nusa Tenggara Province

Figure 1 shows the economic value per person in different blind groups based on the QALY calculation. Blind people with 0.47 QALY will be worth 816.3 USD or 11,836,350 IDR. This decrease in QALYs for the blind would result in an economic loss of 13,347,210 IDR. This condition also applies to people with severe visual impairment. The value is 1,128.9 USD or 16,369,050

DOI :
ISSN :

IDR, so it can be calculated that the economic loss is 8,814,510 IDR for the severely visually impaired.

Table 2. Economy impact due to blindness and severe visual impairment

	Number of People	QALYs [a]	QALYs Loss	Economic Loss (USD)[b]	Economic Loss (IDR)[c]
Blindness	160.124	75.258	84.866	147.394.747,8	2.137.223.843.100
SVI	141.257	91.817	49.440	85.867.392	1.245.077.184.000
Total	**301.381**	**167.075**	**134.306**	**233.262.139,8**	**3.382.301.027.100**

[a] Utility weight of blindness 0,47 and severe visual impairment 0,65
[b] 1 QALYs as worth as 1 GRDP per capita (1.736,8 USD)
[c] 1 USD as worth as 14.500 IDR

From Table 2, it can be concluded that if the total number of blind people in West Nusa Tenggara Province is 160,124 persons, the loss of QALY due to blindness is 84,865.7 QALYs worth 147,394,747.8 USD or 2,137,223,843,100 IDR . Table 2 also shows that the total number of people who lost QALYs due to severe visual impairment of 141,257 people was 49,440 QALYs, worth 85,867,392 USD or 1,245,077,184,000 IDR. From these data we can describe the total cumulative economic loss in one year due to blindness and severe visual impairment as 233,262,139.8 USD or 3,382,301,027,100 IDR as shown in Figure 2.

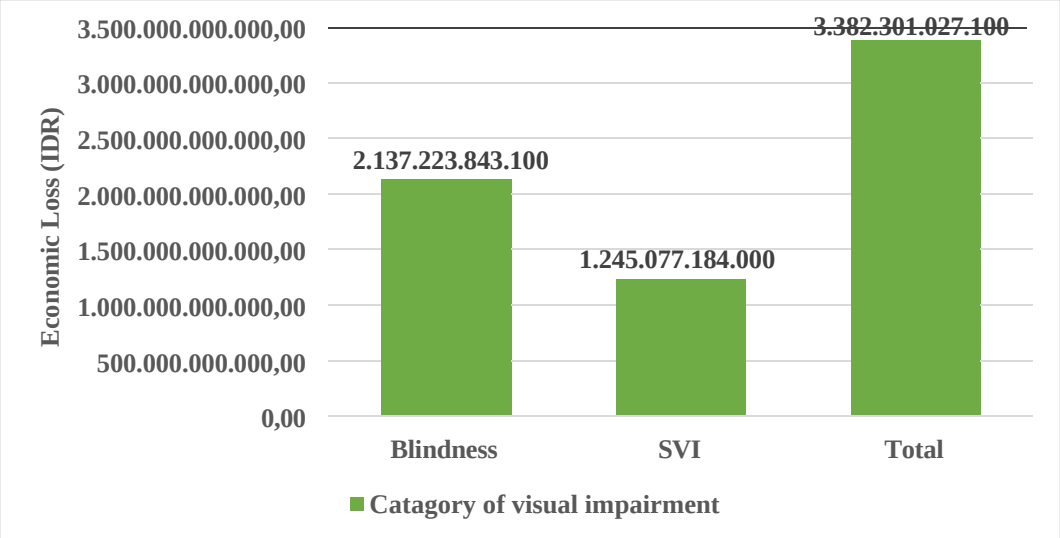

Figure 2. Economic loss due to visual impairment in in West Nusa Tenggara Province (IDR)

With the annual incidence of cataracts, the economic loss from blindness and the burden of visual impairment is expected to increase further 20% per year. Estimated economic losses due to blindness and severe visual impairment will

DOI :
ISSN :

amount to 25,169,731,323,268 IDR in 5 years. Figure 3 also shows the final estimated economic loss after discounting 3% of the range QALYs. Economic loss will amount to 24,414,639,383,570 IDR in 5 years.

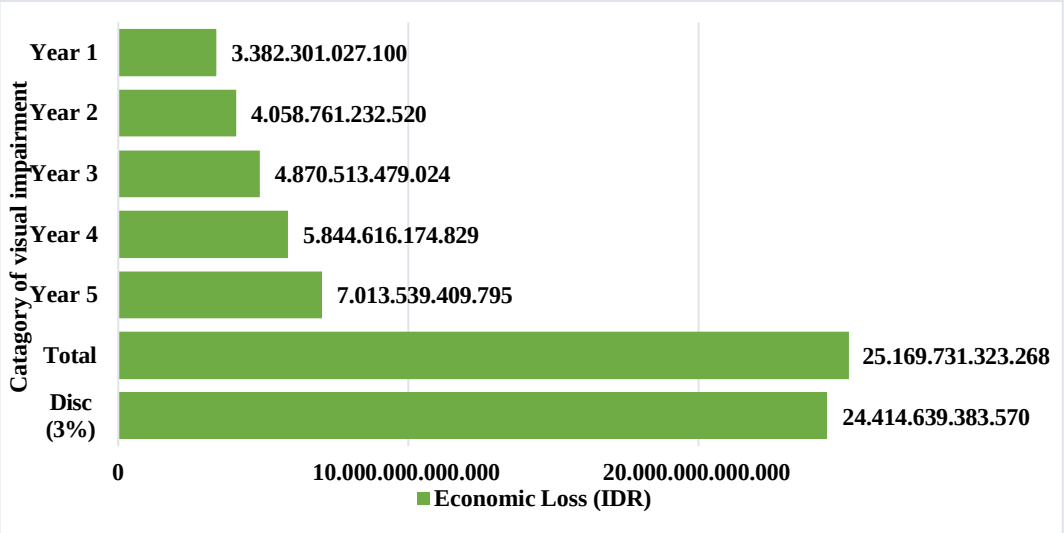

Figure 3. Economic impact of visual impairment in 5 years

With the cataract surgery program in cases of blindness and severe visual impairment, a person's QALY value would increase to 0.8 QALYs, therefore there will be economic benefits. For a blind person, the economic profit would be 8,310,520 IDR after surgery assuming 80% successful surgery. The data in Table 3 show the number of people blinded by cataracts and severe visual impairment. There are 128,099 blind people and 113,006 people with severe visual impairment.

Table 3. Impact of cataract surgeries on economic gain in West Nusa Tenggara Province

	Number of people	QALYs [a]	QALYs Loss	Cost cataract surgery (IDR)[b]	QALYs Gain[c]	Economic Gain (IDR)[d]
Blindness	128.099	60.207	67.892	687.065.391.450	42.272	1.064.561.139.200
SVI	113.006	53.113	59.893	606.113.331.300	37.292	939.146.811.200
Total	241.105	113.320	127.785	1.293.178.722.750	79.564	2.003.707.950.400

[a] Utility weight of blindness 0,47 and severe visual impairment 0,65
[b] The estimation Indonesia cost for cataract surgery is 5.363,550 IDR
[c] 1 USD as worth as 14.500 IDR
[d] Assuming the succesfull rate of cataract surgeries of 80%

DOI :
ISSN :

Table 3 also illustrates the economic benefit of cataract surgery. Using the average of the cost of cataract surgery in Indonesia, the estimated total economic cost for the visually impaired and blind due to cataracts is 1,293,178,722,750 IDR. Investment value will increase 79,564 QALY worth 2,003,707,950,400 IDR.

Cataract surgery is considered a very cost-effective procedure. Figure 4 shows the effect of cataract surgery on the total economic cost and economic benefit.

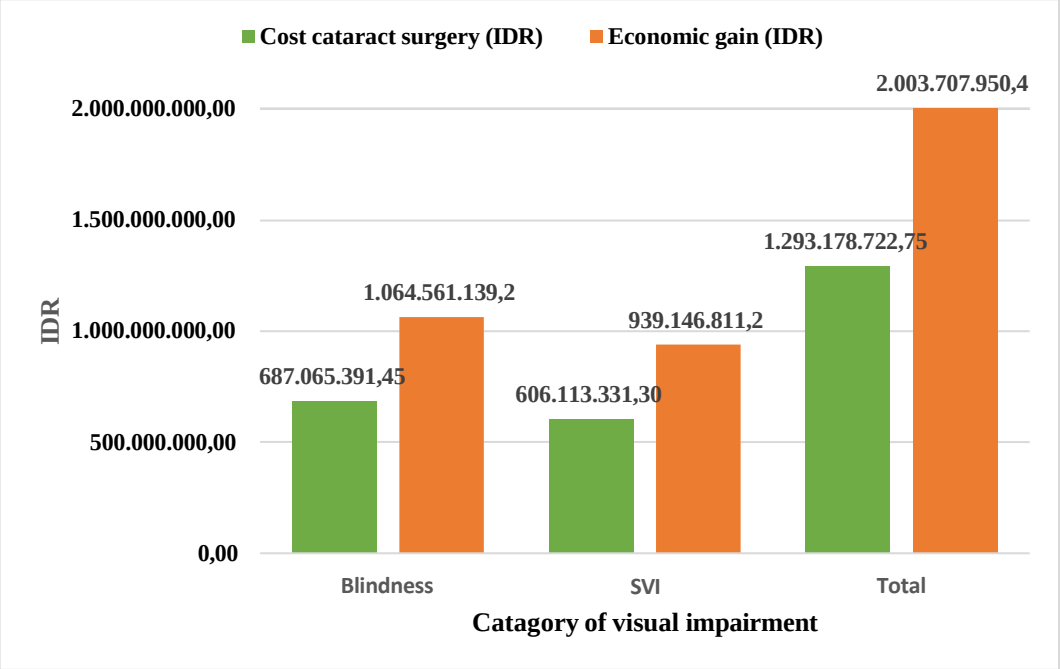

Figure 4. Effect of cataract surgery on economic benefits

With an investment of 687,065,391,450 IDR for people blind from cataracts, it will cost 1,064,561,139,200 IDR in economic benefits. This also applies to cases of severe visual impairment where an investment of 606,113,331,300 IDR will yield an economic benefit of 939,146,811,200 IDR. This figure illustrates the cost savings of cataract surgery where an investment of 1 USD will generate an economic benefit of 1.55 USD.

Econometrics provides a basic model for explaining human and organizational behavior so that it can serve as a guide for recommendations and decision-making. Several reviews have been written on the economic evaluation of blind and visually impaired people. Several methods have been widely used, such as cost-benefit analysis (CBA), cost-utility analysis (CUA), and cost-effective analysis (CEA). In CBA, it measures all costs and benefits and assigns a monetary value, and when the benefits outweigh the costs, the intervention is used. CEA is used when the goals are clear and the country is looking for the most effective way to achieve them. Finally, CUA is a way to analyze impacts without assigning monetary values to all impacts (Frick, 2012; Nilson, 2014).

In this study, we estimated the economic impact of blindness and severe visual impairment in West Nusa Tenggara Province based on the CUA method.

DOI :
ISSN :

We calculate the total loss of QALYs and compare with the monetary value. We also performed the CUA of cataract surgery by comparing the economic costs and the estimated economic benefits after cataract surgery (Sassi, 2006).

QALYs and DALYs are units of measure commonly used in economic analysis. Although this study used QALY instead of DALY, a correlation between these two has been described that 1 DALY is equal to 1 QALY. DALY is mainly used to describe disease burden and these two units are also important for cost-effectiveness analysis of intervention programs (Sassi, 2006).

The monetary value of QALYs has not been standardized, there are several methods to calculate the return of QALYs and one of the most common ways to measure the threshold of QALYs is to use willingness to pay (WTP). The concept of this approach represents the highest value that the community is willing to pay for the health receiver. With this threshold, the government will prioritize interventions based on cost-effectiveness, if costs below the threshold are deemed cost-effective (Baltussen et al, 2004; Sakharhar, 2017).

This study uses the GRDP per capita of West Nusa Tenggara Province as the utility cost threshold. It is worth 1,736.8 USD for 1 QALY. The method is similar to the study in India that used GDP per capita of 4,746 USD per QALY to describe economic blindness, and in other developing countries to use GDP per capita as proposed by the Commission on Macroeconomics and Health, and WHO-CHOICE (Baltussen et al, 2004; Sakharhar, 2017)

In this study, the economic loss due to blindness and severe visual impairment in West Nusa Tenggara Province was 134,306 QALYs, valued at 3,382,301,027,100 IDR. Calculation of QALYs based on utility values for blindness and severe visual impairment was reported by Brown et al. As a direct reflection of patient referrals, utility value ratings measure how well patients can function in their daily living activities. This study does not directly assess the utility value of the people of West Nusa Tenggara Province, but suffices to describe the estimated economic loss due to these conditions (WHO, 2017).

The economic loss caused by blindness and severe visual impairment in West Nusa Tenggara Province is substantial and needs to be addressed by the government. If we compare this loss with APBD for the health sector in 2020, the value of this loss is 125% of the total budget allocation for the health sector with a budget of 2,710,738,220,147 IDR. Furthermore, if West Nusa Tenggara Province does not intervene in this condition, the loss value is expected to increase to 25,169,731,323,268 IDR in 5 years (Brown, 2011; Kementerian Keuangan RI, 2019).

Cataract surgery is the most frequently performed procedure in Indonesia as well as in West Nusa Tenggara Province. Most of the blindness and severe visual impairment are caused by cataracts, causing an economic loss of about 127,785 QALYs worth 3,218,086,326,000 IDR. From this study, we attempt to describe how cataract surgery will impact the economic benefits by comparing the cost and value-effectiveness of cataracts. Cataract costs become a national burden in the economic model. These include direct costs, indirect costs, and intangible costs. Direct costs refer to resources that are consumed directly into services such as operating costs, drugs, staff, and the use of health services.

DOI :
ISSN :

In this study, we characterize the cost of cataracts using the national average cost of cataract surgery based on INA-CBGs. To date, Indonesia has not published any studies explaining the direct and indirect costs of cataracts or vision impairment. Cost in this study refers to the average cost of cataract surgery and is not differentiated by cataract extraction technique. The average cost of cataract surgery in Indonesia is around 375 USD or 5,363,550 IDR per case. This cost is slightly higher when compared to the total economic cost of cataract in India which is around 120 USD and includes both direct and indirect costs. In the United States, the economic cost is 2,526 USD for eye surgery and includes an eye exam, surgeon fees, outpatient surgery center, ultrasound, local antibiotics, anesthesia, and side effects. (Le et al., 2016; Brown et al., 2019).).

Cataract surgery is a very cost-effective procedure with a high return on investment (ROI) for the community. The cost of cataract surgery in Indonesia is less than 1 GRDP value. From this study it is also known that investing 1,293,178,722,750 IDR as the cost of cataract surgery will yield approximately 79,56 QALYs of 2,003,707,950,400 IDR. Typically, this 1 USD investment in cataract surgery will yield 1,55 USD in benefits to society (Brown et al., 2013).

Limitations of this study include that the utility value used to calculate QALYs was not directly measured from the Indonesian population and that the cost of this study was based on the average cost of cataract surgery and doesn't really increase the cost of cataracts. . As the most common cause of blindness and visual impairment, Indonesia should have a study describing the additional costs of cataracts, including both direct and indirect costs, and analyze them. with the efficacy value of cataract surgery.

The economic evaluation of vision and blindness is an important procedure for making insurance recommendations and decisions. Using utility cost analysis, we characterize the economic impact of blindness and severe visual impairment in West Nusa Tenggara Province by calculating QALY. West Nusa Tenggara Province uses 1 GRDP per capita as monetary value per 1 QALY, which means that people with normal vision have a productivity value of 1,818.3 USD and it would cost 963.7 USD for the blind. Cataract surgery as an intervention for blindness and visual impairment is expected to increase QALYs and has been reported to be a highly cost-effective intervention in most countries. . In this study, it was also reported that investing 1 USD in cataract costs would return 1.55 USD to the community.

CONCLUSION

Severely blind and visually impaired people in West Nusa Tenggara Province result in economic losses equal to a quarter of the region's average annual revenue. This loss is expected to grow each year and must be realized quickly. As a highly cost-effective procedure, cataract surgery provides a 1.55 times return on investment for the community of West Nusa Tenggara Province, helping to boost the economy.

DOI :
ISSN :

REFERENCES

Baltussen R, Sylla M, Mariotti S. (200 4) Cost-effectiveness analysis of cataract surgery: a global and regional analysis. *Bulletin of the World Health Organization*.82(5);338-345.

Brown G, Brown M, Busbee B. (2019). Cost-utility analysis of cataract surgery in the United States for the year 2018. *Journal of Cataract and Refractive Surgery*. 6;927-937.

Brown G, Brown M, Menezes A, Busbee B, Lieske H et al. (2013). Cataract surgery cost utility revisited in 2012 a new economic paradigm. *Journal of Ophthalmology*. 2013;12;356-373.

Brown M, Brown G, Sharma S, Kistler J, Brown H. (2001). Utility values associated with blindness in an adult population. *British Journal of Ophthalmology*. 85;327-331.

Brown R and Barret A. (2011). Visual impairment and quality of life among older adults: an examination of explanations for the relationship. *The Journal of Gerontology*. 66(3);364-373.

Chiang P Et al. (2006). Global burden of disease and visual impairment. *JAMA Ophthalmology*. 365-368.

Eckert K, Carter M, Lansingh V, Wilson D, Furtado J et al. (2015). A simple method for estimating the economic cost of productivity loss due to blindness and moderate to severe visual impairment. Ophthalmic Epidemiology. 22(5); 349-355.

Frick K. (2012). What the comprehensive economics of blindness and visual impairment can help us understand. *Indian Journal of Ophthalmology*. 60(5);406-410.

Gordois A, Cutler H, Pezzullo L,Gordon K, Cruess A et al. (2012). An estimation of the worldwide economic and health burden of visual impairment. *Global PublicHealth*. 7(5);465-481.

Kementerian Kesehatan Republik Indonesia. (2014). *Peraturan Menteri Kesehatan Republik Indonesia nomor 27 tahun 2014 tentang petunjuk teknis system Indonesian case base groups (INA-CBGs)*.

Kementerian Kesehatan RI Pusat Data dan Informasi (2 01 8.). *Situasi Gangguan Penglihatan* In:Indonesia KKR.

Kementerian Keuangan Republik Indonesia. (2019). *Advetorial RAPBN 2020 akselerasi daya saing melalui inovasi dan penguatan kualitas sumber daya manusia*.

Koberlein J, Beifus K, Schaffert C, Finger R. (2013). The economic burden of visual impairment and blindness: a systemic review. *British Medical Journal*, 3.

Krishnaiah S, Ramanathan R. (2018). Impact of blindness due to cataract in elderly fallers: *findings from a cross-sectional study in adhra Pradesh, South India*. BMC Research Notes, 11:773.

Le H, Ehrlich J, Venkatesh R, Srinivasan A, Kolli A et al. (2016). A sustainable model for delivering high-quality, efiicient cataract surgery in Southern India. *Health Affairs*. 10;1783-1790.

DOI :
ISSN :

Nilson A. (2014). *The monetary value of human life-examining the differences between sectors.* Lund University.

Pezzullo L, Streatfield J, SimkissP, Shickle D. (2018). The economic impact of sight loss and blindness in the UK adult population. *BMC Health Service Research.*18;63.

Sakharhar P. (2017). Draft national health policy of India and determining cost-effectiveness threshold. *Journal of Basic and Clinical Pharmacy*.

Sassi F. (2006). *Calculating QALYs, comparing QALY and DALY calculations.* The London School of Hygiene and Tropical Medicine.

Teutsch S, McCoy M, WoodburyR, Welp A. (2016). The Impact of VisionLoss. In: Making Eye Health a Population Health Imperative:*Vision for Tomorrow*. Washington, DC: The National Academies Press.

Trading Economic. (2020) *Indonesia Gross Domestic Product per capita*.

Wang J, Mitchell P, Simpson J, Cuming R, Smith W. (2001). Visual impairment, age-related cataract and mortality. *Arch Ophthalmology*. 119.

Wood B, Revill P, Sculpher M, Claxton C. (2016). Country-level cost-effectiveness thresholds: initial estimates and the need for furtherresearch. *Value in Health Journal*. 19;929-935.

World Health Organization (2013). *Universal eye health: a global action plan 2014-2019*. Spain: WHO.

World Health Organization. (2017*). Analyzing health financing and expenditure*.

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ISSN :