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Analysis of Excess Direct Medical Costs of Vision Impairment in Taiwan

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ABSTRACT

Objectives: To quantify the annual excess direct medical costs of vision impairment from the perspective of the Bureau of National Health Insurance in Taiwan and to examine whether the costs vary by severity and duration of vision impairment. **Methods:** A retrospective matched cohort analysis was conducted by using data from the Longitudinal Health Insurance Databases between January 1, 2000, and December 31, 2008. All patients newly diagnosed with vision impairment were categorized as having moderate vision loss, severe vision loss, or blindness. Each patient with vision impairment was matched to one randomly selected patient with normal vision by age (±1 year) and sex. At each level of vision impairment, generalized linear models were used to quantify the total annual excess costs and component costs incurred in the first and second years. **Results:** Vision impairment was associated with significantly higher crude excess medical costs. At each level of vision impairment, the total crude medical costs were attributable to different resource utilization and dominated by non–eye-related medical care. After adjusting for covariates, the first-year annual excess costs increased with escalating severity of vision impairment: New Taiwan (NT) $9894 for moderate vision loss, NT $22,760 for severe vision loss, and NT $52,687 for blindness. Similarly, the second-year adjusted costs were estimated as NT $3477, NT $19,532, and NT $28,272 for moderate vision loss, severe vision loss, and blindness, respectively. **Conclusions:** Consistent with Western countries, vision impairment is associated with significantly increased health care costs in Taiwan. The excess costs seem to increase with severity of vision impairment and decrease in the second year.

Keywords: claims database analyses, direct medical costs, matched cohort study, vision impairment.

Introduction

Vision impairment is a serious health problem, currently affecting more than 285 million people worldwide [1]. Vision impairment not only causes damaged visual capability but also increases the risk of injuries [2,3], hip fractures [4,5], falls [3,6], accidents [7,8], depression [9,10], and mortality [11,12]. The economic burdens of vision impairment on health care systems have been found to be substantial in Asia [13] and Western countries [14–16].

The incremental annual medical costs of vision loss were also estimated to be significant [15,17]. Javitt et al. [17] analyzed a 5% random sample of all Medicare beneficiaries in the United States, reporting that patients with blindness incurred the highest annual costs, US $4680 more than did those with normal vision, followed by those with severe and moderate vision loss. Similarly, another US study observed escalating excess costs by increased severity of visual impairment among individuals aged 40 years and older [15]. The two studies, however, were either limited by their inclusion of patients aged 69 years or older [17] or subject to the use of self-reported data [15].

Few studies have evaluated whether annual excess medical costs vary by time since the occurrence of blindness. The annual health care cost of blindness was estimated to increase by US $7356 in the first year in comparison with nonblind patients, while the excess costs decreased to US $1329 in the following years [18]. Nevertheless, the reported subsequent annual medical costs were confined to blindness and were estimated from patients with diverse follow-up durations.

Furthermore, annual component expenditures for vision impairment were observed to be different among studies in the literature [15,19]. Total medical costs of vision impairment were reported to be dominated by inpatient care in the Medicare program [19], as opposed to be outweighed by home health care from examining the Medical Expenditures Panel Survey data [15]. The discrepancy might be due to the analyses of only a special segment of the overall population [19] or the inclusion of subjects enrolled in different private or public health programs [15]. Accordingly, assessment of the medical costs from nationwide claims data could overcome these drawbacks.

Roberts et al. [13] adopted a prevalence-based approach to estimate the costs of visual impairment in Japan. However, the direct health costs associated with visual impairment might be overestimated because of the inclusion of conditions that were not vision impairing. In addition, the costs were estimated

Conflict of Interest: Mr. Ng is an employee of Allergan, Singapore, Pte. Ltd. Dr. Yeh was employed by Allergan, Inc., when the study was conducted. Dr. Sheu is an advisor for Allergan, Taiwan, Co., Ltd. The other authors declare no potential conflict of interest.

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in the presence of a mixed duration of visual impairment. Furthermore, severity of vision impairment was not considered, which might threaten the generalizability. As a result, the use of a different approach to address the above-mentioned issues for the estimation of the excess direct medical costs of vision impairment is needed in Asia.

This study aimed to quantify the total and component direct medical costs of vision impairment by analyzing the claims data of the Taiwan universal National Health Insurance (NHI) program, and to examine whether the medical costs vary by severity or differ in the first and second years following occurrence of vision impairment.

Methods

Data Source

This study used a matched cohort study design by analyzing data retrieved from Longitudinal Health Insurance Databases (LHIDs) from January 2000 to December 2008. The Taiwan NHI program is a comprehensive and universal health insurance program in which up to 99% of the 23 million inhabitants of Taiwan are enrolled [20]. The LHID contains all transactions of de-identified and encrypted medical claims of 1,000,000 NHI beneficiaries who were randomly selected from the entire NHI beneficiaries enrolled in the year 2005. Distributions of gender, age, and medical expenditures of the subjects retrieved in LHIDs are similar to those of the entire enrollees [21]. Most importantly, comprehensive medical resource utilizations of each beneficiary from emergency and inpatient/outpatient services are available in LHIDs. In addition, the NHI claims database has been used extensively in evaluating the economic burden of various diseases [22,23]. Performing analyses using LHIDs, accordingly, provides a unique opportunity to estimate the increased medical expenditures associated with vision impairment. Access to and use of LHIDs for this study was approved by the National Health Research Institutes, which manages the databases.

Study Population Identification

All the patients newly diagnosed with vision impairment were identified within the entire beneficiaries in LHIDs between January 2001 and December 2006. These patients were referred as cases and further classified according to the worst vision impairment category attained during the 6-year period by using the *International Classification of Diseases, Ninth Revision, Clinical Modification* (*ICD-9-CM*) codes: blindness (*ICD-9-CM* codes 369.0–369.08), severe vision loss (*ICD-9-CM* codes 369.1–369.4), and moderate vision loss (*ICD-9-CM* codes 369.6–369.9). The above-mentioned *ICD-9-CM* codes have been used in classifying different levels of vision impairment previously [17,19]. The date of the worst diagnosis of vision impairment was defined as the index date. Patients without continuous enrollment in the year before the index date as well as 2 years following the index date were excluded to ensure the availability of all medical resource utilization information. Each case was matched to one randomly selected control from all LHID beneficiaries with normal vision by age (±1 year) and sex. Control patients were assigned the same index date as their corresponding case patients. Cases with vision impairment and their matched controls were followed for 2 years from the index date.

Estimation of Excess Direct Medical Costs

Costs of vision impairment were analyzed from the perspective of the Bureau of National Health Insurance because of the implemented universal health insurance with comprehensive coverage of medical care in Taiwan. Specifically, the direct medical costs of both cases and controls were examined during the first and second years after the index date. These medical costs included all direct medical costs reimbursed to the health care provider, such as physician fees, diagnostic fees, procedure fees, and prescribed medications. Components of the excess direct medical costs were examined and categorized into inpatient, outpatient, and emergency care. In addition, total excess direct medical costs were categorized into eye-related and non–eye-related costs on the basis of information regarding physician specialty. Costs incurred in the different years were adjusted for inflation using the medical care Consumer Price Index and presented in 2010 New Taiwan (NT) dollars [24]. US $1 equated NT $30.16 on August 13, 2012.

Statistical Analyses

The baseline characteristics of the cases and controls, measured during the year before the index date, were compared by using Wilcoxon signed-rank tests for continuous variables and McNemar's tests for categorical variables, respectively.

The proportions of cases and controls with previous ophthalmologic-related diseases including glaucoma, retinopathy, cataract, retinal vascular occlusion, and macular degeneration were examined in the year before the index date at each level of vision impairment. The corresponding *ICD-9-CM* codes are listed in Table 1 in Supplemental Materials found at http://dx.doi.org/10.1016/j.vhri.2013.01.00.

The crude and adjusted annual excess direct costs incurred in the first and second years for the cases over matched controls were quantified by using generalized linear models with a gamma-distribution and log-link function. Neither an ordinary least square regression model with log transformation nor the two-part model was used to estimate the excess costs. Use of Duan smearing estimators for modeling costs by ordinary least square regressions is needed to retransform costs from a log scale to the original scale; however, the estimated costs could be biased [25]. Because of less than 5% of patients with zero medical cost in this study, a logistic regression used in the first part of the two-part model is not expected to obtain a stable estimate of probability of patients with any direct medical cost. Use of a generalized linear model to model the cost data has been viewed as an efficient method because of direct interpretations of the estimated costs and the ability to handle zeros in the costs data [26]. Potential confounders included age, sex, geographical area of health care facilities, any visit to medical centers, preindex medical costs with log transformation, and comorbidities including cardiovascular diseases, diabetes mellitus, central nervous system disorders, dementia, and cancer.

Multivariate analyses were performed separately for each category of vision impairment in which all the covariates were adjusted for. Estimated 95% confidence intervals (CIs) for the crude and adjusted excess medical costs were calculated by using bootstrap methods with 2000 replications. All the analyses were carried out by using SAS version 9.2 (SAS Institute, Cary, NC, USA) and STATA 10.1 (STATA, College Station, TX, USA).

Results

During the study period, a total of 2508 cases of vision impairment were identified, of which 1993, 217, and 298 patients were categorized as moderate vision loss, severe vision loss, and blindness, respectively (Fig. 1). An equal number of matched controls were randomly selected for each category of vision impairment.