The Economic Burden of Vision Loss and Eye Disorders among the United States Population Younger than 40 Years

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Objective: To estimate the economic burden of vision loss and eye disorders in the United States population younger than 40 years in 2012.

Design: Econometric and statistical analysis of survey, commercial claims, and census data.

Participants: The United States population younger than 40 years in 2012.

Methods: We categorized costs based on consensus guidelines. We estimated medical costs attributable to diagnosed eye-related disorders, undiagnosed vision loss, and medical vision aids using Medical Expenditure Panel Survey and MarketScan data. The prevalence of vision impairment and blindness were estimated using National Health and Nutrition Examination Survey data. We estimated costs from lost productivity using Survey of Income and Program Participation. We estimated costs of informal care, low vision aids, special education, school screening, government spending, and transfer payments based on published estimates and federal budgets. We estimated quality-adjusted life years (QALYs) lost based on published utility values.

Main Outcome Measures: Costs and QALYs lost in 2012.

Results: The economic burden of vision loss and eye disorders among the United States population younger than 40 years was $27.5 billion in 2012 (95% confidence interval, $21.5–$37.2 billion), including $5.9 billion for children and $21.6 billion for adults 18 to 39 years of age. Direct costs were $14.5 billion, including $7.3 billion in medical costs for diagnosed disorders, $4.9 billion in refraction correction, $0.5 billion in medical costs for undiagnosed vision loss, and $1.8 billion in other direct costs. Indirect costs were $13 billion, primarily because of $12.2 billion in productivity losses. In addition, vision loss cost society 215 000 QALYs.

Conclusions: We found a substantial burden resulting from vision loss and eye disorders in the United States population younger than 40 years, a population excluded from previous studies. Monetizing quality-of-life losses at $50 000 per QALY would add $10.8 billion in additional costs, indicating a total economic burden of $38.2 billion. Relative to previously reported estimates for the population 40 years of age and older, more than one third of the total cost of vision loss and eye disorders may be incurred by persons younger than 40 years.

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Disorders of the eye and resulting vision loss impose a significant burden on the United States, both economically and socially. In addition to medical costs, the debilitating nature of vision loss results in major indirect and nonmedical costs because of decreased productivity, quality of life, and independence among those affected. In recent years, several studies have estimated the medical and overall economic costs of vision loss and eye disorders, but in the United States, these studies have been restricted to adults 40 years of age or older.[1–5] Rein et al[3] estimated the 2004 annual Unites States economic cost of four major age-related eye diseases at $35.4 billion, including $19.1 billion in nonmedical costs. Frick et al[2] estimated largely complementary costs, including medical costs attributable to low vision ($5.5 billion per year) and the value of lost quality of life ($10.5 billion per year) in the United States in 2004. A Prevent Blindness America report based on both of these studies estimated the total annual cost of vision problems in United States adults at $51.4 billion per year in 2004.[6] To our knowledge, the economic burden among the United States population younger than 40 years has not been estimated previously.

In this analysis, we estimated the economic burden of vision loss and eye disorders in the United States population younger than 40 years, including children from birth through 17 years of age and adults 18 through 39 years of age. We followed the consensus guidelines for research on the cost of vision loss that were developed under the auspices of the Association for Research in Vision and Ophthalmology in 2010.[7] These guidelines delineate definitions for analysis perspectives and specific cost categories that should be included in economic studies of

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vision loss. We included direct and indirect costs resulting from uncorrectable vision loss, refractive errors, and diagnosed disorders of the eye and ocular adnexa. We also reported the impact of vision loss on quality-of-life losses and estimated the monetized value of this burden.

Materials and Methods

We estimated the prevalence of vision loss and the treated prevalence of diagnosed eye and vision-related disorders. Costs were estimated for each category listed by consensus guidelines. Direct costs include medical care attributable to diagnosed disorders, medical vision aids, undiagnosed vision loss, low-vision aids or devices, special education, school screening, and federal assistance programs. Indirect costs include productivity losses of adults, productivity losses of children's caregivers, transfer payments (not included in total), and deadweight loss from transfer payments. Costs also are reported from the payer's perspective, including government, private insurance, and patient costs. All prices and costs were adjusted to 2012 United States dollars using the Consumer Price Index for nonmedical costs and medical components of the Consumer Price Index for medical expenses. United States population values are based on the 2010 census.

Prevalence of Vision Loss and Diagnosed Disorders

We estimated the prevalence of vision loss based on autorefractor-corrected visual acuity in the better-seeing eye as measured in the National Health and Nutrition Examination Survey (NHANES) from 2005 through 2008. Visual acuity thresholds for mild and moderate vision impairment and blindness are worse than 20/40, worse than 20/80, and worse than 20/200, respectively. Respondents who did not have an acuity test because of self-reported blindness were included in the prevalence of blindness. No nationally representative data exist on the prevalence of corrected bilateral vision loss among children younger than 12 years. We estimated the prevalence of vision loss among this population by adjusting the NHANES prevalence for 12 to 17 years using age-specific incidence of severe impairment and blindness as identified in United Kingdom surveillance data.[8] In the sensitivity analysis, we assessed the impact of this assumption for children younger than 12 years by measuring the impact of varying the prevalence between 0 and the full rate observed among children 12 to 17 years of age.

To estimate the treated prevalence of diagnosed eye and vision disorders, we identified International Classification of Diseases 9th Revision (ICD-9) diagnosis codes related to eye and vision conditions.[9] We included a broad range of eye and vision disorders, including disorders and diseases of the eye, visual function disorders, conjunctivitis, eye injuries and burns, and disorders of ocular adnexa, including the eyelids, the orbit, and the lacrimal system. We then estimated the treated prevalence of each code as a primary diagnosis using pooled data from the 2003 through 2008 Medical Expenditure Panel (MEPS) conditions file.

Medical and Other Health Costs

We calculated costs attributable to diagnosed eye-related disorders, costs attributable to self-reported low vision in the absence of a diagnosed eye disorder, and medical vision aid costs, including glasses and contact lenses, using 2003 through 2008 MEPS data. To identify relative costs of individual eye disorder diagnoses, we analyzed private insurance claims for individual ICD-9 codes in MarketScan claims data, which represent a subset of the total costs captured in MEPS data.

We estimated the medical costs attributable to diagnosed disorders of the eye and ocular adnexa and undiagnosed vision loss econometrically on 2003 through 2008 MEPS pooled event file data for persons younger than 40 years. We used a general linear model with γ distribution and log link to achieve the best fit.[10] Because general linear models are multiplicative models, separately estimating costs for individual or groups of conditions may lead to double counting of costs when the presence of one condition increases the treatment costs of another. We controlled for possible double counting by using a process to adjust results such that the model would predict 100% of costs when summing across all possible combinations of chronic conditions in MEPS.[11] The first part of the 2-part model used a logistic equation to estimate the probability of positive medical expenditures. The dependent variable in the second part was total medical expenditures excluding medical vision aid and optometrist visit costs, which we estimated separately. The primary independent variables were the presence of any eye-related, ocular adnexa, or vision-related ICD-9 diagnosis (eye disorders) and self-reported low vision in the absence of a vision diagnosis (undiagnosed vision loss). Other independent control variables included sociodemographic indicators and the comorbidities diabetes and hypertension. We independently estimated costs based on payer: private insurance, public payers (such as Medicaid), and patient out-of-pocket costs.

The MEPS collects self-reported costs for optometry visits and the cost for medical vision aids (including glasses and contact lenses) separately from other medical costs. We found that only a very small proportion of these costs would be predicted by the presence of a diagnosed eye or vision disorder or by self-reported low vision. Therefore, we calculated the total cost of optometry visits and medical vision aids for all respondents younger than 40 years in MEPS regardless of any diagnosis or self-reported low vision. We combined the cost of optometry visits with the cost of diagnosed vision disorders and separately reported the cost of medical vision aids.

Although overall costs are estimated using MEPS, these data could not provide statistically significant estimates of relative costs of individual diagnoses. To estimate these, we analyzed the 2008 MarketScan Commercial Claims and Encounters Database to estimate the annual cost of outpatient claims directly related to each eye disorder diagnosis code. MarketScan data are not nationally representative and do not include claims filed under most vision plans, which may include ophthalmologic services and most optometry and refractive error-related costs, but can provide an accurate measure of private insurance claims for individual medical diagnoses. We multiplied the average per-person, per−ICD-9 cost for each age group by the prevalence of this diagnosis identified in MEPS data and reported the proportion of medical costs filed under each diagnosed condition.

Low-Vision Aids and Devices

Low-vision aids include personal, home, and work devices adapted for use by persons with low vision. We estimated United States—specific low-vision aid device use for children and young adults with vision loss based on the prevalence of vision loss and incremental rates of demand identified in France; to our knowledge, these data are not available elsewhere.[12] We then multiplied these use rates by the estimated United States cost of low-vision aids and devices.[13] We estimated the cost of guide dogs for the blind by allocating a previous estimate of the cost of guide dogs for all ages in the United States based on an assumption of equal allocation of guide dog placement to the blind across all ages and adjusting costs for inflation.[14]