Journal of Health Economics 30 (2011) 730–739

Contents lists available at ScienceDirect

Journal of Health Economics

journal homepage: www.elsevier.com/locate/econbase

A cost-benefit analysis of cataract surgery based on the English Longitudinal Survey of Ageing

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ARTICLE INFO

Article history:
Received 20 November 2009
Received in revised form 20 March 2011
Accepted 16 May 2011
Available online 12 June 2011

JEL classification:
D19
I12

Keywords:
QALY
Cataract surgery
English Longitudinal Survey of Ageing

ABSTRACT

This paper uses the English Longitudinal Survey of Ageing to explore the self-reported effect of cataract operations on eye-sight. A non-parametric analysis shows clearly that most cataract patients report improved eye-sight after surgery and a parametric analysis provides further information: it shows that the beneficial effect is larger the worse was self-reported eye-sight preceding surgery so that those with very good or excellent eye-sight do not derive immediate benefit. Nevertheless, the long-run effect is suggested to be beneficial. Calibrating the results to existing studies of the effect of imperfect eye-sight on quality of life, the impact of cataract operations on Quality Adjusted Life Years is found to be similar to that established in previous studies and well above the costs of cataract operations in most circumstances.

1. Introduction

This paper uses the English Longitudinal Survey of Ageing (Marmot et al., 2009) (ELSA) to determine the expected gain in Quality Adjusted Life Years (QALYs) resulting from cataract surgery. It then compares the costs and benefits of such surgery. The study of cataract surgery is of particular interest because it is so widespread. The number of operations has risen 3.7 times since 1989 (Black et al., 2009) and by 50% since 1999 to reach over 300,000 today (Hospital Episode Statistics, 2009–10).

A comparison of the benefits with the costs of any medical intervention is at the core of an analysis of whether the money used to finance such an intervention is well-spent. Studies which explore the benefits of intervention may focus on the question whether the intervention has achieved its intended effect, or they may attempt to establish how far patients feel that their welfare has been improved as a result of the intervention. Plainly these approaches can both be informative; it is possible that an intervention would achieve its medical purpose without having much influence on welfare. On the other hand it would be questionable to justify an expensive intervention if no medical benefits could objectively be identified.

Benefits of medical interventions are usually measured in QALYs[1]; the information required to assess the gain in QALYs resulting from an intervention is normally collected by means of a specific survey instrument even if the structure of the instrument can be generic (Devlin et al., 2009), perhaps in the form of EQ5-D (Greiner et al., 2003). Such studies have typically examined groups of patients in a particular locality at a particular time. Thus Kobelt et al. (2002) used a subsample of a group of patients participating in a continuing study (the Swedish Cataract Register) of patients before and after surgery. Detailed information was collected from these patients on their eye-sight measured both objectively and as perceived subjectively, their general perceptions of their health state and welfare and their demographic characteristics. Using these data it was possible to explore both how much eye-sight improved as a result of surgery, and how far patients felt their well-being had improved. McGwin et al. (2003) by contrast set up an *ad hoc* study which measured the eye-sight of patients and assessed their visual capacity using the Activities of Daily Vision Scale. This was done before surgery, a year after surgery and also over the same period for patients in whom cataracts had been diagnosed but who declined surgery. Rasanen et al. (2006) car-

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[1] Although the use of QALYs is not without controversy (Dolan et al., 2005). Murphy and Topel (2006) suggest a measure based more directly on utility but its implementation requires parametisation of a utility function.

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doi:10.1016/j.jhealeco.2011.05.008

ried out a similar study, but focused on health related quality of life and visual acuity, rather than on activities of daily vision. More recently, and again using the Swedish Cataract Register, Lundstrom and Pesudovs (2009) compared the answers to a questionnaire on vision (the Catquest questionnaire), and assessed the responses of both a summary measured of the questionnaire findings and visual acuity to cataract surgery. Of course, adverse consequences may follow from poor eye-sight; Sach et al. (2007) investigated the relationship between the need for cataract surgery and the risk of patients falling over. But the general point is that these studies show the effects of cataract surgery on visual acuity and that some of them offer a basis for linking visual acuity to welfare, and thus a means by which the benefits of cataract surgery can be assessed in QALY terms. In these calculations other studies, such as Brown et al. (2003), linking visual acuity to welfare, can be useful even though they do not explicitly consider the effects of cataracts and their removal.

However, the use of specific surveys faces two drawbacks. First of all, they and particularly those which collect a wide range of self-reported and medical data, may be expensive, and secondly, the surveys are typically one-off exercises (Black et al., 2009; Kobelt et al., 2002; Rasanen et al., 2006; McGwin et al., 2003) conducted soon after intervention[2]; it is not generally possible to form any view about the long-run effects of any intervention from most one-off studies. This means it is not possible to assess the life-time gain to patients from intervention except by making very simple assumptions, such as that the effect identified in the survey is permanent, and that the eye-sight of patients would not have changed in the absence of surgery. General-purpose panel surveys, by contrast, offer a means of collecting information from patients before and after intervention and also following them up in the long-term. They also provide information, both on people who have not been told that they have cataracts developing, and on those who have had them diagnosed but have not yet had cataract surgery. Thus, should the data provided by such surveys prove to be satisfactory, they offer a useful additional source of information about the benefits of medical interventions.

A methodology for the use of a survey, such as ELSA, to estimate the benefits of cataract surgery is set out here, and the paper suggests that, at least in the context of procedures such as cataract surgery which are widespread, such surveys can be a useful means of measuring the benefits flowing from medical interventions. Thus use of ELSA can form a valuable complement to specific instruments such as the Patient Reported Outcome Measures (PROMs), developed by the Department of Health to explore the benefits of common medical procedures.[3] As the number of waves of ELSA rises, its value as a means of identifying the benefits of interventions will increase. It may, for example, also be possible to use it to establish the benefits of hip replacement, since there are around 90,000 of these each year. On the other hand with only just over 20,000 coronary bypass operations annually, it is unlikely that enough will be found in the sample to estimate the benefits of such a procedure.

The paper proceeds to a more detailed summary of the findings of studies of the effects of cataract surgery. This is followed by presentation of the data from ELSA, showing how the self-reported eye-sight of people aged sixty and over changes over time. Respondents who have cataract surgery between waves of the survey are distinguished from those who do not. This non-parametric analysis is followed by a parametric one which identifies more precisely the effects of untreated cataracts and cataract surgery on respondents who report them. However, in order to interpret the results in terms of their effects on welfare, it is necessary to calibrate them against existing studies of (i) the connection between self-reported eye-sight and quantified measures of eye-sight, and (ii) the link between eye-sight and welfare. A section is devoted to this, followed by one which balances an evaluation of the financial benefits against the costs of cataract surgery. Finally conclusions are presented.

Table 1
Effects of cataract surgery shown in specific studies.

Study	Country	LogMAR units	
		Eye-sight before surgery (first eye)	Eye-sight after surgery
Kobelt et al. (2002)[a]	Sweden	0.70	0.0
McGwin et al. (2003)	USA	0.52	0.20
Lundstrom and Pesudovs (2009)	Sweden	0.59	0.15

[a] These data are taken from a subgroup of the Swedish Cataract Register. The authors report mean eye-sight of 0.60 for the whole population before surgery but do not provide a figure for mean eye-sight after surgery.

2. Existing research on cataract progression and the effects of cataract surgery

Here we bring together the work described in the studies on cataract surgery discussed above. We show in Table 1 that there is quite a range of values both for average eye-sight before surgery and for the improvement which results from surgery. These differences may well arise from different practices in the different countries (Sweden and the United States) to which the studies relate. Cataract surgery seems to be offered to people with better eye-sight in the United States than in Sweden.

The results here are presented in LogMAR units, while those of other studies we draw on later use the more familiar Snellen fraction.[4] We quote results in the original form in which they were presented and, where necessary, we convert from Snellen to logMAR as logMAR value = $\log_{10}$(Snellen fraction).

In assessing the benefits of cataract surgery one needs to take into account not only the improvement to eye-sight achieved by the operation, but also the fact that, without surgery, eye-sight would continue to deteriorate. Fewer studies of this were found, but the differences shown in Table 2 are nevertheless striking. No progression is found on average in the untreated American patients, while substantial and statistically significant progression is found with the Finnish patients. Nevertheless, Leinonen and Laatikainen (1999) record that over the period of one year, half the patients showed no deterioration in their eye-sight.

One further study, also carried out in the United States, should be mentioned Gloor and Farrell (1989) suggested that a patient typically moves up the Snellen Chart at 1.5 lines per annum, approximately equivalent to just under 0.25 logMAR units per

[2] Moenstam and Lundqvist (2005) do examine patients five years after intervention, but focus specifically on ability to drive.

[3] PROMs are to be compiled for hernia repair, hip and knee replacement and treatment for varicose veins. It was originally planned to collect information on cataract surgery in addition, but substantial doubts arose about the validity of the data which were being collected (Devlin et al., 2009).

[4] The Snellen fraction is drawn from the alphabetic charts familiar from sight tests conducted by opticians. It compares what can be read at 6 m with the distance that the same text could be read by someone with normal vision. Thus a Snellen fraction of 6/9 means that someone can read at 6 m what can be read with normal eye-sight at 9 m. The logMAR measure is the log (base 10) of the reciprocal of the Snellen fraction. Thus logMAR of 1 is equivalent to a Snellen fraction of 6/60 and indicates that the patient can read at 6 m what can be read with normal eye-sight at 60 m. This relationship is used to convert Snellen fractions to logMAR and *vice versa*.