ORIGINAL ARTICLE

# Reprint of: Relationship between cataract severity and socioeconomic status

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## ABSTRACT • RÉSUMÉ

**Objective :** To determine the relationship between cataract severity and socioeconomic status (SES).

**Design :** Retrospective, observational case series. A total of 1350 eyes underwent phacoemulsification cataract extraction by a single surgeon using an Alcon Infiniti system. Cataract severity was measured using phaco time in seconds. SES was measured using area-level aggregate census data: median income, education, proportion of common-law couples, and employment rate. Preoperative best corrected visual acuity was obtained and converted to logarithm of the minimum angle of resolution values. For patients undergoing bilateral surgery, the generalized estimating equation was used to account for the correlation between eyes. Univariate analyses were performed using simple regression, and multivariate analyses were performed to account for variables with significant relationships ($p < 0.05$) on univariate testing. Sensitivity analyses were performed to assess the effect of including patient age in the controlled analyses.

**Results :** Multivariate analyses demonstrated that cataracts were more severe when the median income was lower ($p = 0.001$) and the proportion of common-law couples living in a patient's community ($p = 0.012$) and the unemployment rate ($p = 0.002$) were higher. These associations persisted even when controlling for patient age.

**Conclusion :** Patients of lower SES have more severe cataracts.

**Objet :** Établissement de la relation entre la gravité de la cataracte et le statut socioéconomique (SSÉ).

**Nature :** Observation rétrospective d'une série de cas : 1 350 yeux qui avaient subi une extraction de la cataracte par phacoémulsification effectuée par un seul chirurgien utilisant un système Alcon Infiniti. La gravité de la cataracte a été mesurée en utilisant le temps de la phaco en secondes. Le SSÉ a été mesuré selon l'ensemble des données recueillies au niveau de l'aire de recensement : revenu moyen, éducation, proportion des conjoints de fait et taux d'emploi. La meilleure acuité visuelle (AV) corrigée avant la chirurgie a été obtenue et convertie en valeurs logMar. Pour les patients subissant une chirurgie bilatérale, l'équation de l'estimation généralisée (ÉEG) a été utilisée pour rendre compte de la corrélation entre les yeux. Les analyses à variable unique ont été appliquées avec simple régression et celles à variables multiples ont servi à rendre compte des variables ayant des relations significatives (p=0,05) sur les tests à variable unique. Les analyses de sensibilité avaient pour objet d'évaluer l'effet de l'inclusion de l'âge du patient dans les analyses de contrôle.

**Résultats :** Les analyses à variables multiples ont démontré que les cataractes étaient plus graves lorsque la moyenne de revenu était inférieure (p=0,001), et où la proportion des conjoints de fait vivant dans une communauté de patients (p-0,012) et le taux de chômage (p=0.002) étaient plus élevés. Ces associations persistaient, que l'âge soit contrôlé ou pas.

**Conclusions :** Les patients ayant un SSÉ inférieur ont des cataractes plus graves.


There is increasing evidence that one's socioeconomic status (SES) affects one's health[1–7]; education, income, family status, and social environment all play a role in determining the likelihood of developing a medical problem and what the prognosis might be. However, it is unclear whether low SES is causative of poor health or simply a modifier; studies have demonstrated a positive correlation between lower SES and longer wait times for surgery,[8] decreased utilization of diagnostic testing,[9,10] and decreased angiography use after myocardial infarction.[11]

In ophthalmology, low SES is associated, in particular, with cataract. The Baltimore Eye Study[6] found a strong correlation between SES and the presence of cortical cataracts.[5] Similarly, the Singapore Malay Eye Study found that patients with lower SES have higher odds of nuclear and posterior subcapsular cataract.[12] However, these studies examined the presence of cataract, as opposed to visually significant cataracts requiring surgical removal.[1,3–5,12,13]

To the best of our knowledge, there are no data on how SES relates to cataract severity. In Alberta, where there is publicly provided health care, there was a negligible financial cost to a patient when they decided to undergo cataract surgery before the introduction of premium (toric, multifocal) intraocular lenses (IOLs). Therefore, a patient's decision to have surgery should not be biased by their financial (socioeconomic) situation. The purpose of this article is to determine what the relationship is between cataract severity and SES.

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## Methods

Approval for this retrospective analysis was obtained from the University of Alberta Health Research Ethics Board before chart review and data collection. Patients who underwent phacoemulsification cataract extraction by a single surgeon between January 1, 2006, and December 31, 2008, were eligible for inclusion in this study. Cataract severity was measured by a surrogate indicator: phaco time. Eyes that had their cataract removed using OZIL (Alcon, Fort Worth, Tex.) handpieces were excluded because their phaco times were significantly shorter than with the standard Infiniti (Alcon) handpiece.

Preoperative best corrected visual acuity (VA) measurements were obtained using a standard Snellen chart viewed from an effective distance of 6 m. They were converted to logarithm of the minimum angle of resolution (logMAR) values for the analysis. VA measurements that had been recorded as counting fingers were converted using the method described by Holladay.[14] Charts were reviewed for surgical covariates, complications, and other cataract severity identifiers such as the use of surgical aids to visualize cataract during surgery, surgical technique (chop vs divide and conquer), and the presence of weak zonules. Surgeon experience over time was considered as well; the duration of time in practice was used as an indicator of surgeon proficiency.

To assign an SES level to a patient, postal code at the time of surgery was recorded; only patients who had a valid Alberta postal code were considered for the study. Statistics Canada conducts a census every 5 years and divides the country into aggregate units: census metropolitan areas (CMA), census tracts (CT), and dissemination areas (DA). Several provinces are in the midst of or have developed indices (deprivation index [DI]) that attempt to connect disparate SES factors into a single component to determine variances in health outcomes.[15–19] The DA level of geographic resolution is the finest aggregate of SES data available, with each DA containing roughly 400 to 700 people. Using 2006 census information, SES was determined by linking study patients via their postal code, providing more than 2000 discrete variables for each patient record. Although many variables have been demonstrated to affect health outcomes in Canada, several broad categories have been shown to be effective predictors: income, education, and household social level.[3,4,20,21] Income was defined as median income per person older than 15 years within a DA. Education level was categorized into strata: (*i*) less than high school, (*ii*) high-school graduation, (*iii*) apprentice or trade certification, (*iv*) college and some post-secondary, and (*v*) and post-secondary graduation. Education levels were summed for the population older than 15 years and divided by the total educated population older than 15 years to obtain a proportion. This proportion was then multiplied by each of the category levels and the resulting values summed to yield a single "unified education" value for each patient. Household social-level indicators, such as the proportion of common-law relationships, single-parent families, rental units, and the unemployed were calculated for each Alberta postal code (and therefore for each study patient).

As a secondary outcome, DIs were used. DIs are sex-adjusted, income-corrected aggregates of several SES indicators,[15] combined into a single value via primary component analysis,[17] which allows many dimensions of data to be reduced to a few based on the weighted variability that each dimension comprises. These indices are useful for health planning and research because they link many well-recognized SES variables, allowing for standardized testing across multiple medical and economic fields. Recently, a DI was created for Alberta using 2006 census variables from the DA level of data, comprising 2 reduced dimension sets: material deprivation and social deprivation.[22]

Data from all eligible patients were entered into a Microsoft Access (14.0.6024.1000; Microsoft Inc, Redmond, Wash.) database. All calculations were performed using SAS statistical software (version 9.2; SAS Institute Inc, Cary, N.C.). Because some patients had both eyes enrolled in the study, analyses used the generalized estimating equation with SAS PROC GENMOD to account for the correlation between 2 eyes of a single patient. Univariate analysis was performed with simple regression, and multivariate analysis was performed to adjust for the effect of factors demonstrating a significant relationship ($p < 0.05$) on univariate testing that were not otherwise known to be related to cataract severity. Although age would be expected to be related to cataract severity, and adjusting for it may adjust for the outcome itself, it was still considered for inclusion in a multivariate model because younger patients can also present with advanced cataracts. In addition, if access barriers existed for patients with low SES, controlling for age would provide a more conservative estimate of the relationship between cataract severity and SES. As such, a sensitivity analysis was performed to determine the impact of the inclusion of age on the results. No imputation of missing data was performed.

## Results

During the study period, 1458 cataract extractions were performed (Fig. 1). Of these, 57 were surgeries performed using OZIL (Alcon) handpieces and were therefore excluded. Eight surgeries were secondary IOL insertions (sulcus or anterior chamber IOL) and were also excluded. Of the remaining 1393 cataract extractions, 43 were missing the primary outcome (phaco time) and were also excluded. Only patients with valid and non-retired Alberta postal codes were used in this study, and no out-of-