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The Effect of Socioeconomic Deprivation on Severity of Glaucoma at Presentation

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Abstract

Objective: To evaluate the influence of socio-economic factors on severity of glaucoma at presentation

Methods: All newly diagnosed glaucoma patients at the University Hospitals-NHS, Aberdeen, and South Glasgow University Hospitals-NHS, in 2006, were included. Glaucoma was severe at presentation if there was a repeatable visual field loss with a Mean Deviation index greater than 12 dB in the Humphreys visual fields test or an absolute paracentral scotoma within the central 5 degrees of the visual fields. Home address was used to determine the Scottish Index of Multiple Deprivation (SIMD) rank. The SIMD rank, demographics and severity of glaucoma at presentation was investigated using general linear modelling.

Results: There were 48 patients with severe glaucoma and 74 patients with non-severe glaucoma. In four the severity could not be determined. Severity of glaucoma at presentation was significantly associated with SIMD rank, being most severe in patients from areas with the lowest ranks ($p=0.026$). Age was a significant factor ($p=0.024$) with severe glaucoma being more common in elderly patients.

Conclusions: Age and socio-economic deprivation were associated with severity of glaucoma at presentation, with patients from areas of higher socio-economic deprivation presenting with more advanced glaucoma.

Introduction

In the developed world, glaucoma treatment is widely available and yet glaucoma is one of the leading causes of blindness.[1] In the UK, glaucoma is the second most common cause of visual impairment after age related macular degeneration.[2] As we approach an expanding aging population in the UK it will undoubtedly pose greater challenges to the national health service. It is well recognised that severity of glaucoma at presentation is a major factor in the development of glaucoma blindness. [3] Due to the asymptomatic nature of the disease, early diagnosis followed by treatment initiation is essential to prevent blindness from advanced glaucoma.

The adverse impact of socioeconomic deprivation on health and mortality is well recognised and Scotland's poorer health indicators within the UK have been attributed to higher levels of deprivation. [4,5] With regards to visual disorders, socioeconomic deprivation has been linked with late presentation of glaucoma in England in a case-control study performed 10 years ago. [6] Severe amblyopia has also been associated with poor socioeconomic background. [7]

The goal of this study was to evaluate the effect of socioeconomic deprivation on severity of glaucoma at presentation in newly diagnosed glaucoma patients.

Methods

A one-year hospital-based cross-sectional study was performed on all newly diagnosed patients with glaucoma (either primary open angle glaucoma[POAG], or primary angle-closure glaucoma, [PACG]) seen at the Aberdeen Royal Infirmary and the South Glasgow University Hospitals, NHS Trusts, Glasgow from the 1st of January 2006 to the 31st of December 2006.

Newly diagnosed patients were retrospectively identified and case notes were reviewed by two experienced clinicians for presence of glaucomatous damage in both eyes. All patients with glaucoma presenting to the two units were included in the study. Patient age and gender, highest recorded intraocular pressure (IOP), blindness, other ocular morbidity, visual field tests (each subject

had at least two visual fields), and optic disc findings were noted. Blind patients did not have visual fields performed.

Diagnosis of glaucoma was based on optic disc and visual field findings [8]. The criteria was reproducible visual field defects at presentation characteristic of glaucomatous damage (i.e. abnormal glaucoma hemi-field test, or two or more contiguous points on the pattern standard deviation (PSD) plot with $P < 0.01$ loss or greater, or three or more contiguous points with $P < 0.05$ loss or greater, or a 10-dB difference across the nasal horizontal midline at two or more adjacent points in the total deviation plot) in reliable tests and corresponding glaucomatous optic disc damage (absence or thinning of the rim, notching and cup-to-disc ratio asymmetry of more than 0.2 in similarly sized discs and eyes). Reliability of visual fields was based on a false positive or negative of less than 25%.

The severity of glaucoma in both eyes was recorded but only one eye was chosen for analysis (see below). The presence of severe glaucoma was pre-defined before data collection as a visual field loss of either (1) mean deviation (MD) index > 12 dB or (2) absolute paracentral scotoma within the central 5 degrees of visual fields. If visual fields were unreliable, presence of severe disc damage (cup-to-disc ratio of more than or equal to 0.9) was used to determine severe glaucoma. Visual field testing was done with Humphrey SITA fast 24-2 (Humphrey Instruments, San Leandro, California).

Patients with ocular hypertension (i.e. with no glaucomatous damage) or glaucoma suspects, those with secondary glaucoma, other co-morbidity such as cataract, age-related macular degeneration, or history of previous intraocular surgery (other than uncomplicated cataract surgery) were excluded.

The SIMD 2006 was used to assess socioeconomic status. It records seven domains (Current Income, Employment, Health, Education Skills and Training, Geographic Access to Services, including public transport travel times for the first time, Housing and Crime Domain). The SIMD data is presented at data zone level. The postcode of each patient was allocated to an SIMD rank. This was obtained by matching them to their data zones, taken from the website www.sns.gov.uk which correspond them to their individual ranks from the SIMD 2006 website

(www.scotland.gov.uk/SIMD2006Data). [9] The SIMD rank ranges from 1 to 6505, 1 being the most deprived.

One eye per patient was used for analysis as the unit of analysis was the patient. The worst eye (according to severity of glaucoma) was chosen for statistical analysis. If both eyes had severe disease, the more severe one was included. Statistical analysis was performed by a senior statistician (John A Townend).

The effect of SIMD rank on the number of patients who presented with severe glaucoma was investigated using binary logistic regression. We also investigated the effect of SIMD rank on visual field MDs by using linear regression. MD values were square root transformed (using the absolute value of MD) prior to analysis to meet the requirement of normally distributed residuals. Regression analyses were adjusted for patient age and the effects of highest intraocular pressure and area (Aberdeen and Glasgow) were tested as possible confounding factors using forward selection. Analyses were carried out using SPSS Ver 15.0 (SPSS Inc, Chicago). P-values < 0.05 were taken as statistically significant. The study was approved by both local ethics committees.

Results

In the period under study, 126 patients, 64 (50.8%) females and 62 (49.2%) males were included in the study. The mean age of patients was 71.6 (S.D = 12.5) years. There were 48 patients diagnosed as severe glaucoma, 74 as non-severe glaucoma and four in whom severity could not be determined due to absence of reliable visual field data. In these four patients, one had severe glaucomatous optic disc damage. Thirteen patients had PACG and 113 had POAG. Seventy patients had bilateral glaucoma and eleven had severe glaucoma. Two patients were registered blind due to glaucoma at the time of diagnosis. Table 1 illustrates SIMD ranks and number of patients with severe glaucoma.

The number of patients presenting with severe glaucoma was significantly associated with SIMD rank, being most common in patients from areas with the lowest ranks (most deprived areas) (p

= 0.026). Age was also a significant factor ($p = 0.024$) with severe glaucoma being more common in older patients. Highest intraocular pressure and city of residence were not significant factors.

Increasing age was significantly associated with more negative visual field MD values ($p = 0.001$). To evaluate whether more elderly patients were living in areas of low ranking SIMD, the analyses was stratified and found that the effect of age independently played a part in determining whether a person is likely to have severe glaucoma at presentation. SIMD rank, IOP and city of residence showed no significant association with MD scores.

Table 1

Scottish Index of Mean Deprivation Ranks and number of patients

Scottish Index of Mean Deprivation Ranks	Number of Patients	Patients with severe glaucoma (%)
0-1000	20	9(45.0)
1001-2000	12	4(33.3)
2001-3000	19	8(42.1)
3001-4000	9	6(66.7)
4001-5000	22	9(40.9)
5001-6000	24	6(25.0)
6001-6505	20	2(10)
Median SIMD 4208		

Discussion

Several scores have been utilized to classify socioeconomic deprivation, including Carstairs, Jarman, Townsend and the Scottish Index of Multiple Deprivation (SIMD). The SIMD records seven domains (Current Income, Employment, Health, Education Skills and Training, Geographic Access to

Services, including public transport travel times for the first time, Housing and Crime Domain) of which there are 37 indicators of deprivation which allows for a more complete assessment of deprivation. On the other hand, Jarman, Townsend and Carstairs have fewer indicators of deprivation with ten, four and four respectively. [10,11,12] The SIMD data is presented at data zone level with a median population size of 769, enabling small pockets of deprivation to be identified. Hence, this results in a comprehensive picture of relative area deprivation across Scotland. The SIMD has been extensively used in studies on mortality, cardiovascular disease as well as patient literacy. [13,14,15]

Our study suggests patients who reside within areas of socioeconomic deprivation presented more frequently with severe glaucoma. This agrees with a previous case-control study done in England a decade ago, which found an association between lower socioeconomic status and late presentation with glaucoma.[6,16] Poverty has also been linked to blindness in a Pakistan study.[17] Lower socioeconomic status has been linked to late presentation in several diseases such as breast, colorectal and skin cancer. [18,19,20]

Presentation with advanced glaucoma has been associated with a poor visual prognosis and blindness. [21,22,23] Our finding highlights the need to recognise socioeconomic deprivation as a risk factor for late presentation of glaucoma and probable increased risk of blindness. [3] Upon diagnosis response to treatment depends on patient compliance, requiring education on glaucoma and its treatment. As the SIMD includes educational skills, it may be relevant that low literacy have been associated with low compliance to glaucoma therapy. [24]

Unsurprisingly, there was a statistically significant association between severity of glaucoma at presentation and the elderly as POAG is known to be an age-related disease. [25] It is possible that these elderly patients were not regular attendees at their optometrists as suggested by the General Household Survey which showed a reduction in (free) sight testing in those aged more than 65 years in the United Kingdom. [26] On the other hand, the possibility of having suboptimal detection services in the community also arises. Currently in the United Kingdom, the optometrist plays a major role in glaucoma detection.

In addition, not only are the deprived and elderly more likely to present late with severe glaucoma, but evidence suggests that they are more likely to lack awareness for the benefits of blind registration and support. [27] This inevitably compounds onto their disability and serves to emphasize the importance of identifying such patients.

To date, literature linking severity of glaucoma and socioeconomic deprivation is scarce. Fraser et al. have conducted a case control study in 1996 to 1997 to identify risk factors for advanced glaucoma as well as socioeconomic risk factors and late presentation of glaucoma. [6,16] They used Jarman's underprivileged area score to classify deprivation which only uses three factors (occupational class, housing tenure and access to a car) to measure individual deprivation. Fraser et al. reported a strong association between socio-economic deprivation and late presentation of glaucoma. [16] They also found also a strong association between IOP and advanced visual field loss at presentation but age was not a statistically significant factor. Our study offers an up-to-date report with a more complete assessment of deprivation using the SIMD for which we are the first to apply to glaucoma patients.

Screening of the UK adult population for glaucoma does not appear to be cost-effective from the point of view of the NHS although in Finland a recent cost-effectiveness analysis suggested that screening could be cost-effective. [28,29] Lower socioeconomic status is associated with lower uptake of screening programmes such as mammography and cervical screening. [30] However, in light of our findings, targeted surveillance at high risk patients such as in areas of high deprivation and the elderly might need to be considered to help in early identification, preventing severe glaucoma and eventual disabling blindness.

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