



Geographical variation in blindness and sight impairment rates in England, 2008-09: Analysis of national register data

Journal:	<i>BMJ Open</i>
Manuscript ID:	bmjopen-2012-001496
Article Type:	Research
Date Submitted by the Author:	16-May-2012
Complete List of Authors:	Malik, Aeesha; Moorfields Eye Hospital, Bunce, Catey Wormald, Richard; Moorfields Eye Hospital, Suleman, Mehrunisha; Oxford Radcliffe Trust, Stratton, Irene; University of Warwick Clinical Sciences Research Institute, Gray, Muir; Department of Health,
Primary Subject Heading:	Public health
Secondary Subject Heading:	Ophthalmology, Health policy
Keywords:	PUBLIC HEALTH, OPHTHALMOLOGY, Health policy < HEALTH SERVICES ADMINISTRATION & MANAGEMENT

SCHOLARONE™
Manuscripts

1
2
3 Geographical variation in blindness and sight impairment rates in England, 2008-09: Analysis of
4 national register data
5 Aeesha NJ Malik, Catey Bunce, Richard Wormald, Mehrunisha Suleman, Irene Stratton, J.A.
6 Muir Gray.
7

8 An analysis and report of national register data
9

10 Corresponding Author:
11

12 Miss Aeesha NJ Malik
13 Ophthalmology Specialist Registrar
14 Work Address: Moorfields Eye Hospital, 162 City Road, London EC1V 2PD
15 Correspondance address and contact details: aeeshamalik@gmail.com
16 24 Carmichael Court, Grove Road, London, SW13 0HA
17
18

19 Catey Bunce
20 Senior Statistician
21 Moorfields Eye Hospital, 162 City Road, London EC1V 2PD
22
23

24 Mr Richard Wormald
25 Consultant Ophthalmologist and Director Cochrane Eyes and Vision Group
26 Moorfields Eye Hospital, 162 City Road, London EC1V 2PD
27

28 Dr Mehrunisha Suleman
29 FY2 doctor Oxford Radcliffe Trust
30 Cranbrook House, 287-291 Banbury Road, Oxford, Oxfordshire, OX2 7JQ
31
32

33 Irene Stratton
34 Senior Statistician (Honorary Associate Professor, University of Warwick Clinical Sciences
35 Research Institute)
36 English National Diabetic Retinopathy Screening Programme
37 Cheltenham General Hospital, Sandford Road Cheltenham GL53 7AL
38

39 Professor Sir Muir Gray
40 Co-lead QIPP Right Care Programme, Department of Health
41 Cranbrook House, 287-291 Banbury Road, Oxford, Oxfordshire, OX2 7JQ
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

Article Summary

Article Focus

1. To examine and interpret the variation in the incidence of blindness and sight impairment in England by PCT, as reported by the Certificate of Visual Impairment (CVI).
2. To assess whether there was any evidence of association between CVI rates with IMD and the Programme spend for Vision

Key messages:

1. The wide geographical variation we found raises questions both about the quality of the data and whether there is genuine unmet need for prevention of sight loss.
2. The Certificate of Visual Impairment (CVI) will form the basis of the 'preventable sight loss' indicator in the new 'Public Health Outcomes Framework'
3. Poor quality data and inadequate interpretation will only create confusion if not addressed adequately from the outset. However unmet need will lead to avoidable sight loss and not address the WHO VISION 2020 goals, to which the UK is a signatory.

Strengths and Limitations of this Study:

1. prospective national routinely collected dataset analysis
 2. limitations of the Certificate of Visual Impairment as proxy for visual impairment and blindness rates discussed
- no comparison as no previous similar studies

Abstract

Objectives: To examine and interpret the variation in the incidence of blindness and sight impairment in England by PCT, as reported by the Certificate of Visual Impairment (CVI).

Design: Analysis of national register data

Setting: All Primary Care Trusts, England

Participants: 23,773 CVI certifications issued from 2008-9

Main Outcome measures: Crude and Age standardised rates of CVI data for blindness and sight loss by PCT

Methods: Crude and age standardised CVI rates were calculated with 95 % confidence intervals using Byar's method. Spearman's rank correlation was used to assess whether there was any evidence of association between CVI rates with evidence of association between CVI rates with Index of Multiple Deprivation (IMD) and the Programme spend for Vision.

Results: There was high level variation, almost 11 fold (Coefficient of Variation 38%) in standardised CVI blindness and sight impairment rates across PCTs. We found little evidence of any association between the rate of blindness and sight impairment with either the IMD or Programme Spend on Vision.

Conclusions: The Department of Health recently published a 'Public Health Outcomes Framework', which included 'preventable sight loss' as one of the indicators. The Certificate

1
2
3 of Visual Impairment (CVI) will form the basis of this new indicator. The wide geographical
4 variation we found raises questions both about the quality of the data and whether there is
5 genuine unmet need for prevention of sight loss. It is a concern for public health practitioners
6 who will be interpreting this data locally and nationally. Poor quality data and inadequate
7 interpretation will only create confusion if not addressed adequately from the outset.
8 However unmet need will lead to avoidable sight loss and not address the WHO VISION
9 2020 goals, to which the UK is a signatory. There is an urgent need to address the
10 shortcomings of the current data collection system and to educate all public health
11 practitioners.
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

For peer review only

Introduction

Eye care services have traditionally not featured highly in national health policy or the public health agenda. In the UK there has been no Department of Health led eye care services strategy and there is no mention of eye health in the recent NHS or Public Health White papers, both published last year.^{1,2} The UK however does have a Vision Strategy but this has been produced by a collaboration of Eye care organisations, professionals and patients, not the government, in response to the World Health Assembly Resolution of 2003. This resolution urged the development and implementation of national plans to tackle sight impairment, to which the UK government pledges its support.^{3,4} VISION 2020 was launched by the World Health Organization (WHO) and the International Agency for the Prevention of Blindness (IAPB) in order to bring together governments, eye care professionals and patients to work towards the global goal to eliminate avoidable blindness by the year 2020.

However only this year there has been a major step forward in the UK for the recognition of eye health in the national public health agenda. The new Public Health Outcomes Framework has included an indicator for preventable sight loss, following a united effort by the eye care community and the UK Vision Strategy to support its inclusion.^{5,6} This indicator will be based upon the Certificate of Vision Impairment (CVI) – this being the only routinely collected national measure of blindness and sight impairment. This places a greater responsibility on those involved with ensuring the quality of the data, both in its collection and analysis.

The NHS Atlas of Variation has highlighted the variations in healthcare activity, expenditure, quality and outcomes in the UK.⁷ This brought to attention the need to address unwarranted variation, focussing on the appropriateness of the clinical services and their outcomes. The most recent edition of the Atlas published last year included the rate of sight impairment and blindness due to diabetes (as measured by CVI), which showed a high level of variation (8 fold), and raised concerns, particularly as there is a diabetic eye screening programme already in place. There is a growing incidence of diabetes in the UK and with an aging population the prevalence of sight loss has also been predicted to increase significantly over the next decade.^{9,10} The total costs of sight loss in the UK were estimated at £6.5 billion in 2008 with¹¹ £40 million per million population being spent on eye care services last year in England. With rising costs from expensive medications for Age Related Macular Degeneration (AMD) and other diseases there will be huge pressures on the eye care budget in the coming years. The adoption of an indicator for preventable sight loss will be a vital part of monitoring eye care outcomes. However public health practitioners will need to know that the quality of the data is adequate and how to interpret the CVI rates. An examination of the variation in blindness and sight loss in the CVI data is an important step in order to understand and address sight loss and blindness across England. In this paper we examine, for the first time, the geographical variation of blindness and sight impairment, as measured by the CVI.

Methods

CVI data collection

The CVI form is discussed in the hospital clinic with patients who are eligible and is completed with patient consent by a consultant ophthalmologist. Currently, a paper version is completed which is sent to the local authority social services who use this to update their visual impairment register. Every three years, the Social Service departments complete an

1
2
3 annual return which is sent to the Information Centre (IC) for health and social services
4 reporting the number of new registrations and the total number of registrations in their
5 register. This return is mandatory. Another copy of the CVI form is sent to the Certifications
6 Office, Moorfields Eye Hospital NHS Foundation Trust for epidemiological analysis. This
7 return is voluntary but there is a good rate of compliance.¹² Data held by the Certifications
8 Office has more detailed information on the causes of registration and allows incidence data
9 calculation. For this study the data from the 2008/9 CVI forms collected by the Certifications
10 Office was used.
11

12 Calculation

13
14
15 Two rates were used for the analysis, the crude rate and the directly standardised rate (DSR).
16 The crude rate is the number of CVI forms divided by the population of that PCT. The DSR
17 was determined using age specific CVI rates with ONS 2008 mid-year population figures by
18 PCT with 95 % confidence intervals computed using Byar's method. The standard deviation
19 and coefficient of variation were then calculated.
20

21
22 Standardisation was used as a means of ensuring that any differences seen between PCT
23 populations were not as a result of differing age structures. As the numbers of CVI forms in
24 each PCT were relatively small, standardisation was conducted using three age bands (0-15,
25 16-64 and 65 plus).
26

27
28 The coefficient of variation is calculated by dividing the standard deviation of the rates by the
29 mean rate.¹³ As it is relatively insensitive to population size, it provides a more powerful
30 measure of variation than the standard deviation when there are variable population sizes in
31 the data set. One disadvantage is that it may overestimate the amount of variation if rates are
32 low or if it is applied to small populations.
33

34
35 To eliminate the possibility of artefact from outliers in the data sets, the degree of variation
36 was calculated as the range within the data after exclusion of the five PCTs with the highest
37 and the five with the lowest values. Fold variation was determined as the upper limit of the
38 trimmed range divided by the lower limit of the trimmed range.
39

40
41 A funnel plot was constructed to examine whether or not the rate of certification was related
42 to the size of the population and to examine whether there was a relationship between the
43 estimate size and the precision of that estimate.
44

45 Comparison with Index of Multiple Deprivation (IMD)

46
47 The Indices of Deprivation (ID) is a measure of social deprivation prepared by the
48 Department of Communities and local Government (DCLG). The English Indices of
49 Deprivation measures relative levels of deprivation in small areas of England.¹⁴ The English
50 ID2010 use 38 separate indicators, organised across seven distinct domains of deprivation,
51 including income, employment and health. The latter can be combined, using appropriate
52 weights, to calculate the Index of Multiple Deprivation 2010 (IMD 2010). The IMD is used
53 to help decide the allocation of resources to PCTs. Scatter plots of the CVI rates with the
54 index of multiple of deprivation were drawn and correlation coefficients calculated.
55

56 Comparison with Spend on Vision

57
58 In the UK each PCT receives its healthcare budget allocated by programme area. There are
59
60

23 main programmes, broadly corresponding to the chapters in the WHO ICD-10 e.g. Cancers and tumours, Mental Health Disorders. The eye care services budget comes under the Vision programme budget. This includes NHS sight tests as well as all primary care prescribing, community services, inpatients and outpatients expenditure. Scatter plots of CVI rates against spend on vision were examined and correlation coefficients calculated to assess whether there was any evidence of association between spend versus CVI blindness and sight impairment rates.

Converting Data to Maps

The data is shown as a map of England with London shown as an inset on the PCT maps so that the details of the small areas are not lost. The PCTs have been grouped into ranges to allow comparison of areas on the map with ease. The method used to group the data into ranges is quantiling. Quantile's build ranges (in this case five were chosen) to display the distribution of the variable. This is calculated by ranking the data values from highest to lowest and then splitting the values into five ranges (quintiles). The quintiles do not necessarily contain equal numbers. Each quintile includes a range of values that is within each fifth of the cumulative total of all values. The quintile ranges from the lowest value (light blue) to the highest (dark blue). The map was produced in Adobe Illustrator.

Results

There were 23,773 CVI certifications for 2008/9 in England. Table 1 summarises the degree of variation, standard deviation and co-efficient of variation. It shows that after standardisation there is approximately an 11-fold variation in the number of CVIs. A coefficient of variation of 0.38 or 38% indicates marked variation in CVI registration.

Table 1: Summary of the CVI rates with the mean, standard deviation, coefficient of variation and degree of variation

	Mean	Standard deviation	Coefficient of variation	Fold Variation
CVI Crude Rate	42.97	18.10	0.42	12.47
CVI Directly Standardised Rate	43.69	16.69	0.38	10.79
Programme Spend on Vision	32.55	6.16	0.19	2.13
Index of Multiple Deprivation	23.63	8.40	0.36	3.67

Figure 1: Map of Geographical Variation of in blindness and sight impairment rates in England (Attached as PDF)

Figure 1 shows the directly standardised rates of sight impaired and blindness directly per 100,000 in England, in 2008-09 in the form of a map, as detailed in the methods.

Figure 2: CVI directly age-standardised rate per 100,000 vs Index of Multiple Deprivation 2010 by Primary Care Trust, 2008/9

1
2
3 Figure 2 displays the CVI standardised rates per 100,000 versus the IMD 2010 by PCT. The
4 figures illustrate little evidence of any association between the rates and IMD 2010.
5 (correlation coefficients 0.11, $p=0.15$).
6
7

8 **Figure 3:** CVI directly age-standardised rate per 100,000 vs Spend per Head by Primary Care
9 Trust, 2008/9
10

11
12
13
14
15
16 Figure 3 displays the CVI standardised rates per 100,000 versus the spend per head by PCT.
17 Again, there is little evidence of any association seen (correlation coefficient 0.0329,
18 $p=0.69$).
19

20 **Figure 4**
21

22
23
24 This funnel plot shows that many rates lie outside the limits showing much variability. This is
25 likely to be both due to real differences between PCTs but also unmeasured covariates that
26 alone impact by small amounts but together impact greatly. The lines shown are two and
27 three standard deviation limits.
28

29 Discussion

30
31
32 The rates of blindness and sight impairment differ widely amongst PCTs with an 11 fold
33 difference between the highest and lowest rate. There is little association seen with the Index
34 of Deprivation or Spend on Vision. This is a high level of variation and understanding the
35 data collection is important. The completion of a CVI form requires a consultant
36 ophthalmologist to offer registration to a patient who is attending a hospital eye clinic and the
37 patient to accept that offer. Therefore there are a number of factors which can influence both
38 the offering and acceptance of the registration. The registration process is also limited by the
39 fact that it takes place mostly in the hospital setting by a consultant ophthalmologist, as there
40 may be many more patients in the community who may be eligible but are not offered
41 registration. There should still however not be such a magnitude of variation between those
42 being offered and accepting registration between PCTs in England, and it raises questions
43 about the consistency of the process around the country and the quality of the data.
44
45

46 It is recognised that the reported numbers of CVI registrations of blindness and sight
47 impairment have decreased significantly in the last 10 years, at a time when, for demographic
48 reasons, they should be increasing.¹⁵ The reasons for this are not entirely clear but there are a
49 number of possible factors. The number of blind people in England has been counted since
50 1851. From the mid 1930s registration was initiated by completion of a designated certificate,
51 the BD8. The decrease has coincided with the introduction of the new CVI form which has
52 replaced the previous BD8 form. It has been expressed that the new form is more complex to
53 complete and any change in routine may lead to an initial loss of compliance. Traditionally,
54 registration was delayed until it was felt nothing more could be done to help. However, the
55 new form was intended to be accompanied by a change in culture where it is now an
56 indication that the person may benefit from the support and rehabilitation in the community,
57
58
59
60

1
2
3 which registration can trigger. This was supposed to trigger increased certification being
4 offered, which may be done more in certain areas or by certain individuals than by others,
5 The change in form was also accompanied by a change in the payment system.
6 Ophthalmologists were entitled to a fee for completion of the BD8 – entitlement to a CVI fee
7 is variable depending on whether a consultant is on a new contract or old and depending on
8 whether or not, the certification process is seen as an additional examination. Being offered
9 certification can be a highly emotive experience for patients and in order to expedite
10 registration, additional social questions are asked of the patient. For this reason and to ensure
11 high coverage of certification, modest payment seems acceptable but this should be
12 standardised to reduce variation across the UK. The sustainability of CVI data collection and
13 analysis has also been in question since 2007. First, it was not included in the National
14 Indicator Set, which lists those data collections that would remain mandatory for local
15 authorities.¹⁶ Then an NHS information centre review concluded that the collection and
16 publication of the data should cease. The support by eye care organisations and professionals
17 for the data collection led to a further government review, which concluded the data
18 collection was essential but that the system needed improvement. These conclusions were
19 further supported by a Law Commission's report, published in May 2011.¹⁷ These issues
20 have slowed progress in improving and updating the process of data collection including the
21 development of an electronic collection system. Continuing uncertainty may have affected
22 the quality of data collection. Certainly, the data could be improved – the CVI could be
23 streamlined to reduce the burden of data collection, hospitals could adopt an electronic
24 version which could mandate some data entry and auto-populate demographic information by
25 linking to local EPRs. Raising understanding of CVI figures is also of merit – a CVI for
26 diabetic eye disease means that a patient has lost sight due to a preventable eye condition.
27 Hospitals should be encouraged to examine their own CVI figures to ensure that all that could
28 have been done was done and regular audits could be conducted to ensure that patients who
29 are eligible for certification are offered a CVI. This also may raise the profile and perceived
30 value of the certification process, as lack of awareness by those collecting the data of its
31 importance.

32
33
34
35
36 It may also be that as the CVI data for PCTs contains relatively smaller numbers so that the
37 coefficient of variation may have overestimated the level of variation.¹¹ Increasing the local
38 areas to larger geographical areas of England may improve the accuracy, though such a
39 measure would be less relevant to commissioners and healthcare professionals. This level of
40 variation may mean that people with blindness and sight impairment are not getting equitable
41 access to registration across the country. This has implications for access to the social service
42 benefits that are associated with registration for patients. There is certainly a need to explain
43 the observed variation and, notably, to look at how much of this variation is in preventable
44 causes of blindness. An analysis of one London PCT found significantly higher levels of
45 certification due to glaucoma and diabetic retinopathy, both preventable causes of
46 blindness.¹⁸ This has potential implications for those responsible for planning healthcare in
47 those areas on how to improve early access to eye care services for those at higher risk.

48
49
50 There have been, to our knowledge, no other studies on geographical variation in sight loss
51 conducted. This may be partly due to the fact that reliable collection of national data on sight
52 loss is an issue throughout developed as well as developing countries. In a Danish population
53 based study of prevalence and causes of blindness they noted there was no accurate and up-
54 to-date data for Denmark, therefore they conducted their own population cross-sectional
55 survey for Copenhagen.¹⁹ The figures used in the WHO database for Europe are based in
56 some cases on data collection from over 15 years ago.²⁰ Population based surveys, often
57
58
59
60

1
2
3 focussed exclusively on the elderly, have been done in many European countries but these
4 types of surveys have their own limitations.⁹ This lack of comparable data highlights the
5 importance of the work being done in the UK with this routine data collection on sight loss
6 and its causes, and serves as an example for other countries.
7

8
9 The inclusion of the public health indicator of 'preventable sight loss' in the Public Health
10 Outcome Framework is a landmark decision in the inclusion of eye health into the wider
11 public health agenda. However this highlights the importance of improving the quality of
12 this important data collection, if it is to be used to monitor the number of people with
13 preventable sight loss. Our results show that there is a wide level of variation between PCTs
14 and it is likely that much of this is due to factors including variation in levels of offering of
15 certification, care pathways, perceived value of certification and payment for CVI forms. It is
16 vital that these are now addressed with a more streamlined process, and locally and nationally
17 awareness is raised in the importance of the data. The analysis of the number of people losing
18 sight due to conditions which may be preventable is vital. There is an additional need for
19 accurate data to see whether the introduction of new (and costly) interventions for diseases
20 (such as Lucentis for Age related Macular Degeneration and possibly Diabetic Macular
21 Oedema) are reducing sight loss nationally. Further research on the causes of sight
22 impairment amongst those registered and its variation will be important. Variation of sight
23 loss registration is a concern if patients are not gaining access to social service support. It is
24 vital for those who plan and manage services to determine if there is more that can be done to
25 improve services to prevent avoidable sight loss and improve eye health outcomes.
26
27

28 **Word Count 3001**

29
30 **What this paper adds**

31
32 **section 1:**

- 33
34
35
36
37
38
39
- The number of certifications for blindness and sight impairment have been falling, despite estimates due to demographic changes of rising rates.
 - There has been no previous study looking at the geographical variation in blindness and sight impairment rates.

40
41 **section 2:**

- 42
43
44
45
46
47
48
- There is a large geographical variation in the registration of blindness and sight impairment in England
 - This implies both a need to improve consistency in access to certification across the country and investigate further the causes of this variation, particularly as this will now be used to as an outcome in the Public Health Outcomes Framework

49
50
51 The Corresponding Author has the right to grant on behalf of all authors and does grant on
52 behalf of all authors, an exclusive licence (or non exclusive for government employees) on a
53 worldwide basis to the BMJ Publishing Group Ltd to permit this article (if accepted) to be
54 published in BMJ editions and any other BMJPGJL products and sublicences such use and
55 exploit all subsidiary rights, as set out in our licence.
56
57
58
59
60

1
2
3 All authors have completed the Unified Competing Interest form at
4 www.icmje.org/coi_disclosure.pdf (available on request from the corresponding author) and
5 declare that (1) No authors have support for the submitted work; (2) No authors have
6 relationships that might have an interest in the submitted work in the previous 3 years; (3)
7 their spouses, partners, or children have no financial relationships that may be relevant to the
8 submitted work; and (4) No authors have non-financial interests that may be relevant to the
9 submitted work.”
10

11 **Acknowledgements:**

12 We would like to acknowledge the Royal College of Ophthalmologists, Royal National
13 Institute of the Blind and Guide Dogs for the Blind for their help in making this data
14 available.
15
16

17 The CVI data are copyright of the Department of Health. However any views expressed in
18 the publication are those of the author(s) alone and are not necessarily those of the
19 Department of Health.
20
21

22 **Details of contributors:**

23 Aeesha NJ Malik (guarantor): conception, design, analysis and interpretation of data, drafting
24 original article, revision and final approval
25
26

27 Catey Bunce: analysis and interpretation of data, revision of article and final approval
28
29

30 Richard Wormald (guarantor): revision of article and final approval
31
32

33 Mehrunisha Suleman: interpretation of data, revision of article and final approval
34
35

36 Irene Stratton: analysis and interpretation of data, revision of article and final approval
37
38

39 Muir Gray: revision of article and final approval
40
41

42 **Ethical Approval:** not required
43
44

45 **Sources of Funding:** none
46
47

48 **All researchers were independent from funders**
49
50

51 **All authors had full access to all of the data (including statistical reports and tables) in
52 the study and can take responsibility for the integrity of the data and the accuracy of
53 the data analysis**
54
55

56 **References**

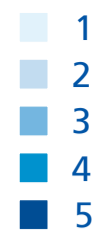
- 57 1. Dept of Health. Healthy lives, healthy people: our strategy for public health in England.
58 [http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAnd](http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_121941)
59 [Guidance/DH_121941](http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_121941), 30 November 2010.
60

- 1
2
3 2. Dept of Health. Equity and excellence: Liberating the NHS.
4 [http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAnd](http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_117353)
5 [dGuidance/DH_117353](http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_117353). 12 July 2010
- 6
7 3. World Health Organization. WHA 56.26 Elimination of avoidable blindness.
8 http://www.who.int/pbd/publications/wha_eb/en/, 28 May 2003.
- 9
10 4. A VISION 2020 UK initiative. UK Vision Strategy: Setting the direction for eye health
11 and sight loss services.
12 [http://www.vision2020uk.org.uk/UKVisionstrategy/page.asp?section=32§ionTit](http://www.vision2020uk.org.uk/UKVisionstrategy/page.asp?section=32§ionTitle=About+the+Strategy#Download%20the%20UK%20Vision%20Strategy)
13 [le=About+the+Strategy#Download%20the%20UK%20Vision%20Strategy](http://www.vision2020uk.org.uk/UKVisionstrategy/page.asp?section=32§ionTitle=About+the+Strategy#Download%20the%20UK%20Vision%20Strategy), April
14 2008.
- 15
16 5. Dept of Health. NHS outcomes framework.
17 [http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAn](http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_122944)
18 [dGuidance/DH_122944](http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_122944), 20 December 2010.
- 19
20 6. Dept of Health. Healthy Lives, Healthy People: transparency in outcomes, proposals for a
21 public health outcomes framework.
22 http://www.dh.gov.uk/en/Consultations/Liveconsultations/DH_122962, 20 December
23 2010.
- 24
25 7. QIPP Right Care programme. Gray M, Da Silva P (ed). The NHS Atlas of Variation in
26 Healthcare. Reducing unwarranted variation to increase value and improve quality.
27 <http://www.rightcare.nhs.uk/atlas/> 2010.
- 28
29 8. Keenan T Rosen P, Yeates D et al. Time trends and geographical variation in cataract
30 surgery in England: study of surgical workload. *Brit J of Ophth* 2007;91:901-4.
- 31
32 9. Evans JR, Fletcher AE, Wormald RPL et al. Prevalence of visual impairment in people
33 aged 75 years and older in Britain: results from the MRC trial of assessment and
34 management of older people in the community. *Brit J of Ophth* 2001;86(7):795-800.
- 35
36 10. Economics A. Future Sight Loss UK 1: Economic Impact of Partial Sight and Blindness
37 in the UK adult population.
38 <http://www.rnib.org.uk/aboutus/Research/reports/prevention/Pages/fsluk1.aspx>:
39 RNIB. , 2009. .
- 40
41 11. Minassian D and Reidy A. Future Sight Loss UK 2: An epidemiological and economic
42 model for sight loss in the decade 2010-2020.
43 <http://www.rnib.org.uk/aboutus/Research/reports/prevention/Pages/fsluk2.aspx>
- 44
45 12. The NHS Information Centre, Adult Social Care Team. Registered Blind and Partially
46 Sighted People Year ending 31 March 2011, England. 1st September 2011.
47 [http://www.ic.nhs.uk/statistics-and-data-collections/social-care/adult-social-care-](http://www.ic.nhs.uk/statistics-and-data-collections/social-care/adult-social-care-information/registered-blind-and-partially-sighted-people--year-ending-31-march-2011-in-england)
48 [information/registered-blind-and-partially-sighted-people--year-ending-31-march-2011-in-](http://www.ic.nhs.uk/statistics-and-data-collections/social-care/adult-social-care-information/registered-blind-and-partially-sighted-people--year-ending-31-march-2011-in-england)
49 [england](http://www.ic.nhs.uk/statistics-and-data-collections/social-care/adult-social-care-information/registered-blind-and-partially-sighted-people--year-ending-31-march-2011-in-england)
- 50
51 13. Diehr P CK, Connell F, Volinn E. What is too much variation? The null hypothesis in
52 small-area analysis. *Heath Ser Res*1990;24(6):741-71.
- 53
54 14. Department of Communities and Local Government. The English Indices of Deprivation
55 2010. <http://www.communities.gov.uk/publications/corporate/statistics/indices2010>,
56 24 March 2011.
- 57
58 15. Bunce C XW, Wormald R. Causes of blind and partial sight certifications in England and
59 Wales: April 2007-March 2008. *Eye* 2010;24(11):1692-9.
- 60
61 16. Department of Communities and Local Government. The New Performance Framework
62 for Local Authorities and Local Authority Partnerships – A Single Set of National
63 Indicators.

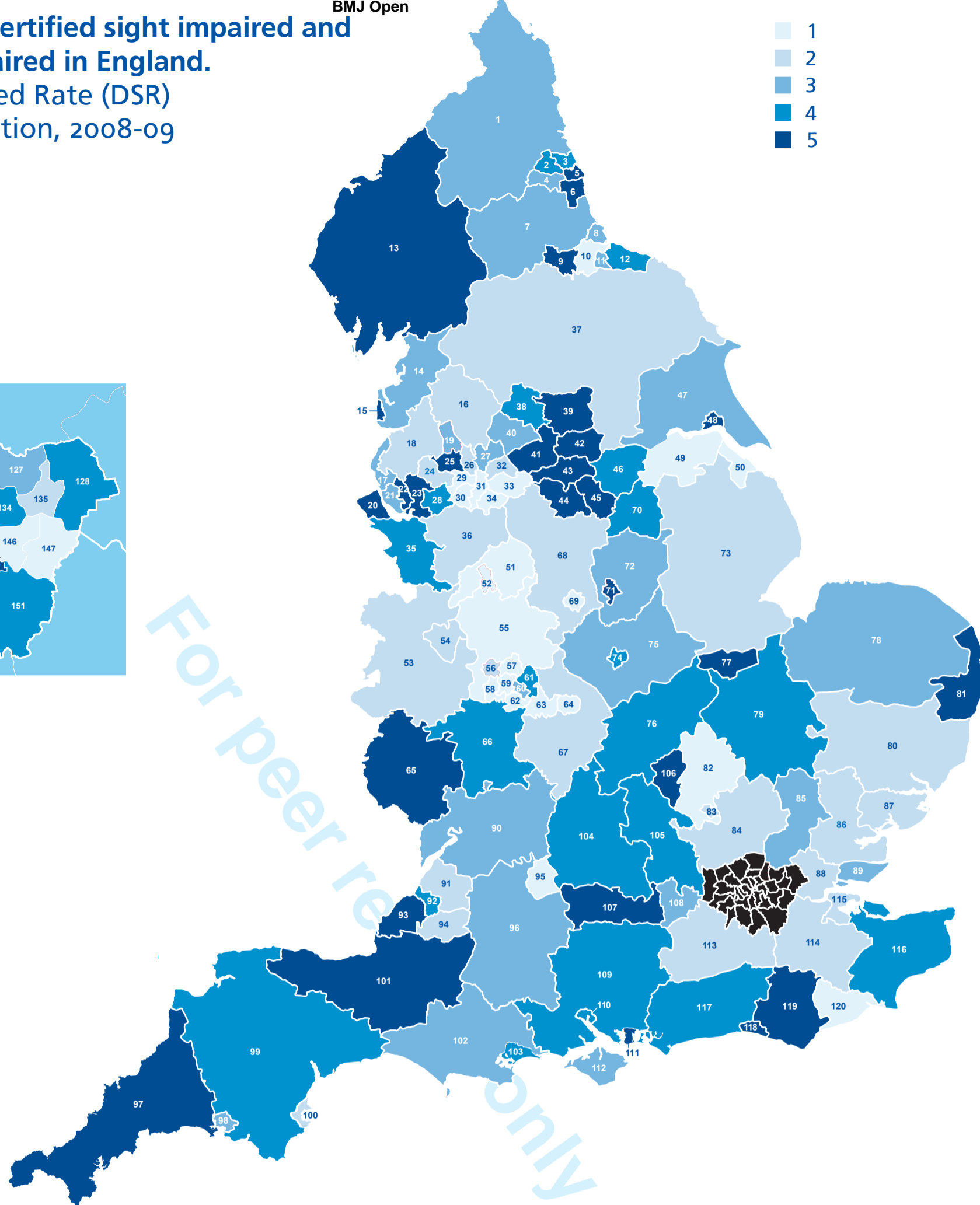
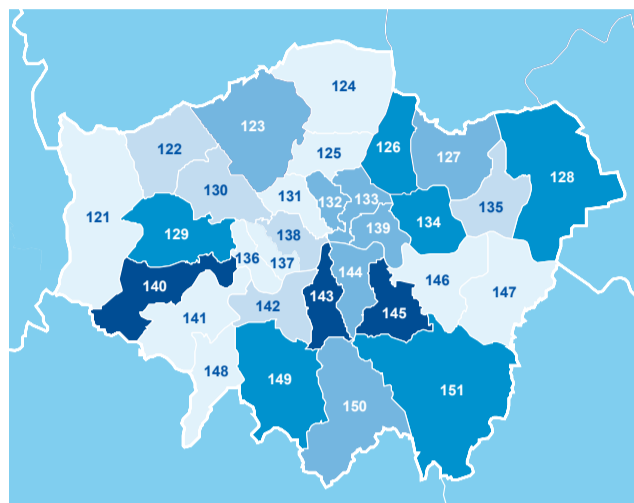
- 1
2
3 <http://www.communities.gov.uk/publications/localgovernment/nationalindicator>,
4 2007.
- 5 17. Commission TL. Adult Social Care.
6 <http://www.justice.gov.uk/lawcommission/publications/1460.htm>, 11 May 2011.
- 7 18. Royal National Institute of the Blind. An Internal Report: CVI data update
8
- 9 19. Buch H, Vinding T, La Cour M et al. The prevalence and causes of bilateral and
10 unilateral blindness in an elderly urban Danish population. The Copenhagen City Eye
11 Study. *Acta Opth Scan* 2001; 79: 441-9
- 12 20. Thylefors B, Negrel AD, Pararajasegaram R et al. Available data on blindness (update
13 1994). *Ophth Epidemiol* 1995; 2: 5–39.
- 14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

Number of newly certified sight impaired and severely sight impaired in England.

Directly Standardised Rate (DSR) per 100 000 population, 2008-09



London



Key

1	Northumberland	42.7	24	Ashton, Leigh & Wigan	33.1	50	North East Lincolnshire	26.5	76	Northamptonshire	55.8	101	Somerset	60.1	126	Waltham Forest	52.1
2	Newcastle	52.4	25	Bolton	57.8	51	North Staffordshire	8.1	77	Peterborough	58.1	102	Dorset	42.7	127	Redbridge	43.1
3	North Tyneside	52.3	26	Bury	41.4	52	Stoke on Trent	4.4	78	Norfolk	48.5	103	Bournemouth & Poole	52.5	128	Havering	52.6
4	Gateshead	46.7	27	Heywood, Middleton & Rochdale	48.3	53	Shropshire County	36.4	79	Cambridgeshire	49.5	104	Oxfordshire	52.3	129	Ealing	49
5	South Tyneside	61.3	28	Warrington	51.9	54	Telford & Wrekin	33.2	80	Suffolk	40.9	105	Buckinghamshire	55.5	130	Brent	40.1
6	Sunderland	63.3	29	Salford	31.1	55	South Staffordshire	13.1	81	Great Yarmouth & Waveney	64.5	106	Milton Keynes	75.6	131	Camden	26.1
7	County Durham	48.6	30	Trafford	6.1	56	Wolverhampton City	35.1	82	Bedfordshire	24.2	107	Berkshire West	58	132	Islington	44.6
8	Hartlepool	43.6	31	Manchester	4.2	57	Walsall	26.7	83	Luton	40	108	Berkshire East	48.5	133	City & Hackney	46.5
9	Darlington	58.7	32	Oldham	39.4	58	Dudley	9.1	84	Hertfordshire	36.5	109	Hampshire	52.3	134	Newham	56.3
10	Stockton-on-Tees	31.7	33	Tameside & Glossop	5.8	59	Sandwell	26.7	85	West Essex	42.7	110	Southampton City	55.7	135	Barking & Dagenham	36.1
11	Middlesbrough	43.5	34	Stockport	5	60	Heart of Birmingham	47.4	86	Mid Essex	33	111	Portsmouth City	71.8	136	Hammersmith & Fulham	28.4
12	Redcar & Cleveland	50.7	35	Western Cheshire	52	61	Birmingham East & North	52	87	North East Essex	33.4	112	Isle of Wight NHS	48.5	137	Kensington & Chelsea	28.5
13	Cumbria	65.1	36	Central & Eastern Cheshire	35.7	62	South Birmingham	17.5	88	South West Essex	40.8	113	Surrey	40.9	138	Westminster	36.3
14	North Lancashire	48.6	37	North Yorkshire & York	35.9	63	Solihull	31.6	89	South East Essex	45.1	114	West Kent	35.3	139	Tower Hamlets	47.5
15	Blackpool	51.5	38	Bradford & Airedale	50.9	64	Coventry	21.9	90	Gloucestershire	42	115	Medway	37.4	140	Hounslow	61.7
16	East Lancashire	41.9	39	Leeds	59.7	65	Herefordshire	57.2	91	South Gloucestershire	34.8	116	Eastern & Costal Kent	56.3	141	Richmond & Twickenham	22.8
17	Sefton	46.3	40	Calderdale	43.3	66	Worcestershire	51.2	92	Bristol	53.3	117	West Sussex	52.6	142	Wandsworth	38.4
18	Central Lancashire	37.4	41	Kirklees	59.9	67	Warwickshire	35.5	93	North Somerset	58.2	118	Brighton & Hove City	66.7	143	Lambeth	62.4
19	Blackburn with Dawen	48.1	42	Wakefield District	64.2	68	Derbyshire County	40.4	94	Bath & North East Somerset	32.3	119	East Sussex Downs & Weald	58.7	144	Southwark	42.4
20	Wirral	73.7	43	Barnsley	111.2	69	Derby City	31.9	95	Swindon	31	120	Hastings & Rother	7.2	145	Lewisham	59.4
21	Liverpool	43.8	44	Sheffield	59.3	70	Bassetlaw	53.8	96	Wiltshire	43.2	London		146	Greenwich	27.9	
22	Knowsley	64.5	45	Rotherham	85.01	71	Nottingham City	62.9	97	Cornwall & Isles of Scilly	58	121	Hillingdon	21.7	147	Bexley Care Trust	31
23	Halton & St. Helens	66	46	Doncaster	55.1	72	Nottinghamshire County	42.3	98	Plymouth	44	122	Harrow	33.3	148	Kingston	6.2
			47	East Riding & Yorkshire	45.3	73	Lincolnshire	36.8	99	Devon	50.2	123	Barnet	45.8	149	Sutton & Merton	49.6
			48	Hull	63.4	74	Leicester City	54	100	Torbay	32.8	124	Enfield	24.3	150	Croydon	44.5
			49	North Lincolnshire	7.2	75	Leicestershire County	45.9	101	London	31.9	125	Hammer	31.9	151	Bromley	48.8

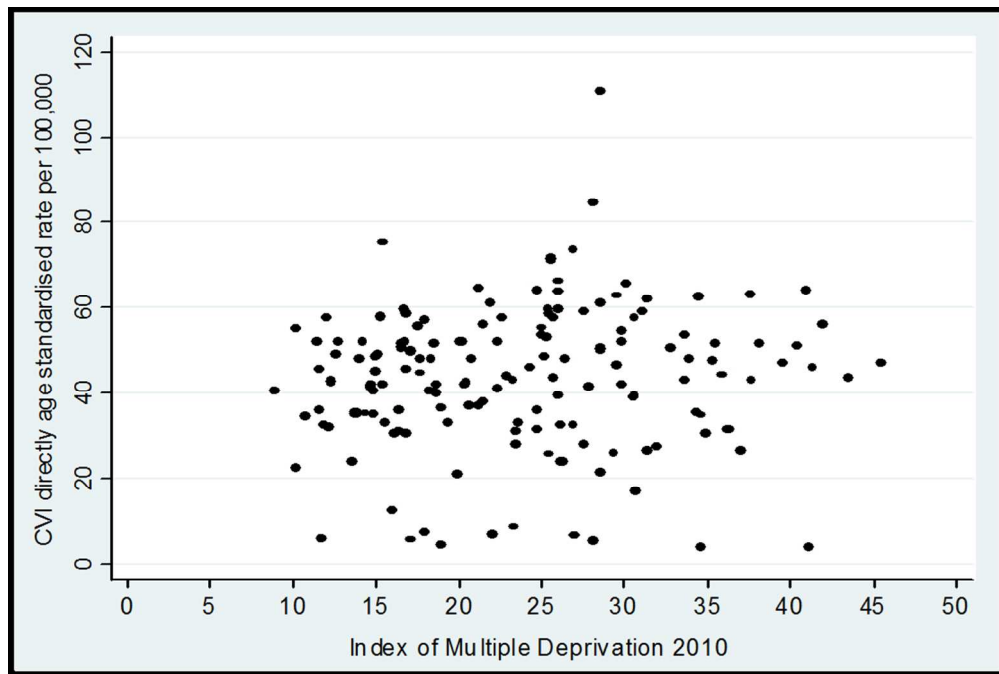


Figure 2: CVI directly age-standardised rate per 100,000 vs Index of Multiple Deprivation 2010 by Primary Care Trust, 2008/9

Review only

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

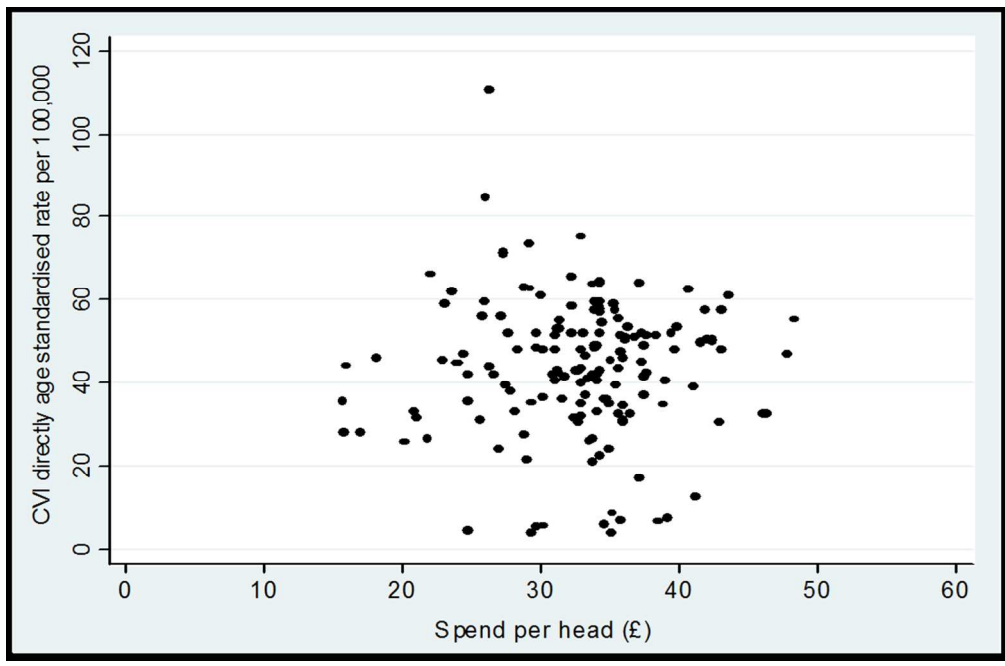
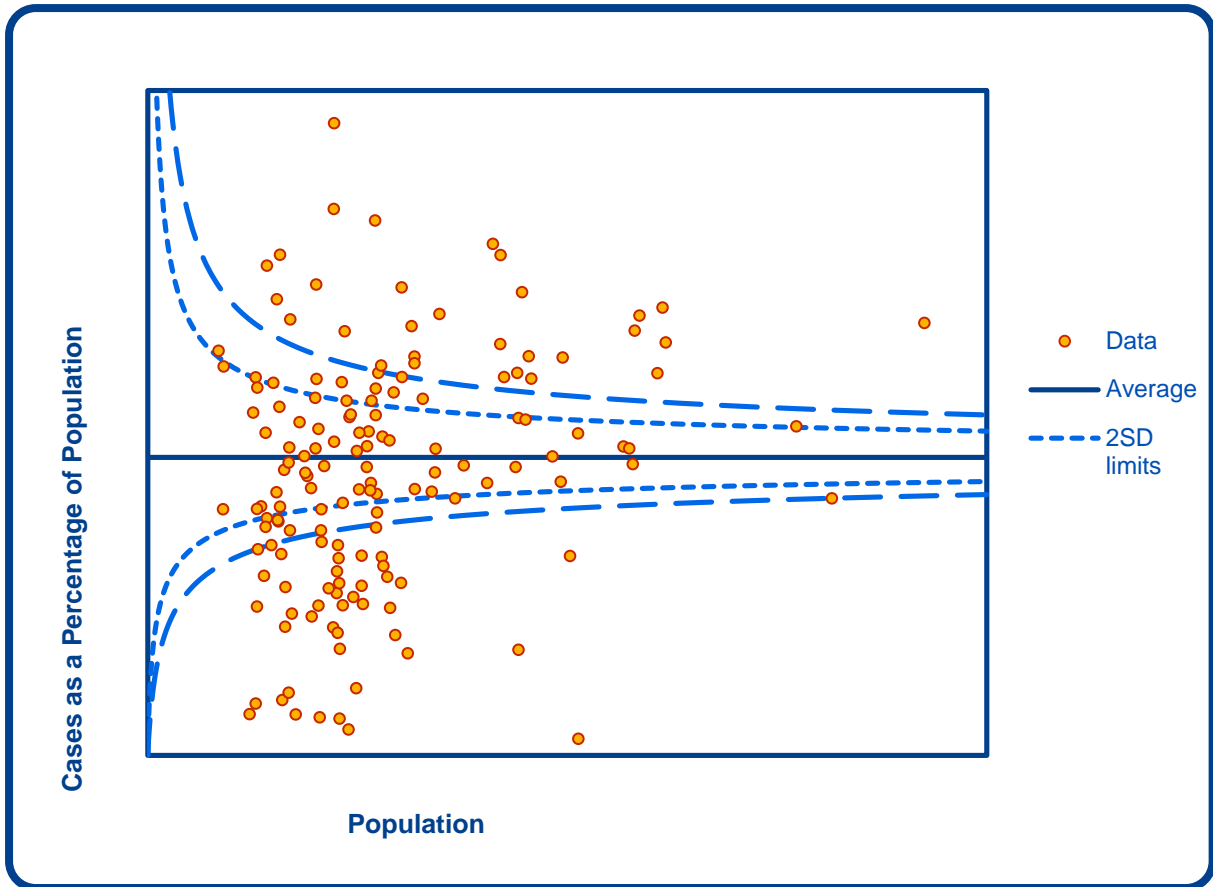


Figure 3: CVI directly age-standardised rate per 100,000 vs Spend per Head by Primary Care Trust, 2008/9



1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

Review only



Geographical variation in blindness and sight impairment rates in England, 2008-09: Analysis of national register data

Journal:	<i>BMJ Open</i>
Manuscript ID:	bmjopen-2012-001496.R1
Article Type:	Research
Date Submitted by the Author:	15-Sep-2012
Complete List of Authors:	Malik, Aeesha; Moorfields Eye Hospital, Bunce, Catey; Moorfields Eye Hospital, Wormald, Richard; Moorfields Eye Hospital, Suleman, Mehrunisha; Oxford Radcliffe Trust, Stratton, Irene; University of Warwick Clinical Sciences Research Institute, Gray, Muir; Department of Health,
Primary Subject Heading:	Public health
Secondary Subject Heading:	Ophthalmology, Health policy
Keywords:	PUBLIC HEALTH, OPHTHALMOLOGY, Health policy < HEALTH SERVICES ADMINISTRATION & MANAGEMENT

SCHOLARONE™
Manuscripts

1
2
3 1 **Geographical variation in blindness and sight impairment rates in England, 2008-09**
4 2 Aeesha NJ Malik, Catey Bunce, Richard Wormald, Mehrunisha Suleman, Irene Stratton, J.A.
5 3 Muir Gray.

6 4
7 5 An analysis and report of national register data

8 6
9 7 Corresponding Author:

10 8
11 9 Miss Aeesha NJ Malik

12 10 Ophthalmology Specialist Registrar

13 11 Work Address: Moorfields Eye Hospital, 162 City Road, London EC1V 2PD

14 12 Correspondance address and contact details: aeeshamalik@gmail.com

15 13 2 Elm Walk, London, SW20 9ED

16 14
17 15 Catey Bunce

18 16 Senior Statistician

19 17 Moorfields Eye Hospital, 162 City Road, London EC1V 2PD

20 18
21 19 Mr Richard Wormald

22 20 Consultant Ophthalmologist and Director Cochrane Eyes and Vision Group

23 21 Moorfields Eye Hospital, 162 City Road, London EC1V 2PD

24 22
25 23 Dr Mehrunisha Suleman

26 24 QIPP Right Care Programme, Department of Health

27 25 Summertown Pavilion, 18 - 24 Middle Way, Oxford, OX2 7LG, UK

28 26
29 27 Irene Stratton

30 28 Senior Statistician (Honorary Associate Professor, University of Warwick Clinical Sciences

31 29 Research Institute)

32 30 English National Diabetic Retinopathy Screening Programme

33 31 Cheltenham General Hospital, Sandford Road Cheltenham GL53 7AL

34 32
35 33 Professor Sir Muir Gray

36 34 Co-lead QIPP Right Care Programme, Department of Health

37 35 Summertown Pavilion, 18 - 24 Middle Way, Oxford, OX2 7LG, UK

38 36
39 37
40 38
41 39
42 40
43 41
44 42
45 43
46 44
47 45
48 46
49 47
50 48
51 49
52 50
53 51
54 52

55 50
56 51
57 52
58 53 Article Summary

54

Article Focus

1. To examine and interpret the variation in the incidence of blindness and sight impairment in England by PCT, as reported by the Certificate of Visual Impairment (CVI).
2. To assess whether there was any evidence of association between CVI rates with the index of Multiple Deprivation (IMD) and the Programme spend for Vision

60

Key messages:

1. There is a wide geographical variation in certified rates of blindness and sight impairment across England
2. The wide geographical variation we found raises questions both about the quality of the data and whether there is genuine unmet need for prevention of sight loss.
3. The certification (CVI) data forms the basis of the ‘preventable sight loss’ indicator in the ‘Public Health Outcomes Framework’ and improving the quality and interpretation of the data will be vital.

70

Strengths and Limitations of this Study:

1. A prospectively routinely collected national dataset was used for analysis giving accurate data on certification rates across England.
2. There were relatively small numbers of certification for each PCT therefore there is a possibility of over estimation of the variation.

75

76

77

78

Abstract

79

80

Objectives

To examine and interpret the variation in the incidence of blindness and sight impairment in England by PCT, as reported by the Certificate of Visual Impairment (CVI).

83

84

Design

Analysis of national certification data

86

87

Setting

All Primary Care Trusts, England

89

90

Participants

23,773 CVI certifications issued from 2008-9

92

93

Main Outcome measures

Crude and Age standardised rates of CVI data for blindness and sight loss by PCT

95

96

Methods

The crude and age standardised CVI rates were calculated with 95 % confidence intervals using Byar’s method. Spearman’s rank correlation was used to assess whether there was any evidence of association between CVI rates with IMD and the Programme spend for Vision.

100

101

Results

There was high level variation, almost 11 fold (Coefficient of Variation 38%) in standardised CVI blindness and sight impairment annual certification rates across PCTs. The mean rate

103

1
2
3 104 was 43.7 and the standard deviation 16.7. We found weak evidence of any association
4 105 between the rate of blindness and sight impairment with either the IMD or Programme Spend
5 106 on Vision.
6 107

7 108 **Conclusions**
8 109

9 110 The wide geographical variation we found raises questions both about the quality of the data
10 111 and whether there is genuine unmet need for prevention of sight loss. It is a concern for
11 112 public health practitioners who will be interpreting this data locally and nationally as the CVI
12 113 data will form the basis of the public health indicator 'preventable sight loss'. Poor quality
13 114 data and inadequate interpretation will only create confusion if not addressed adequately from
14 115 the outset. There is an urgent need to address the shortcomings of the current data collection
15 116 system and to educate all public health practitioners.
16
17

18 117 Word Count 267
19

20 118
21 119
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

120 Introduction

121 Eye care services have traditionally not featured highly in national health policy or the public
122 health agenda. In the UK there has been no Department of Health led eye care services
123 strategy and there is no mention of eye health in the recent NHS or Public Health White
124 papers.^{1,2} The UK however does have a Vision Strategy produced by a collaboration of Eye
125 care organisations, professionals and patients in response to the World Health Assembly
126 Resolution of 2003. This resolution urged the development and implementation of national
127 plans to tackle sight impairment, to which the UK government pledges its support.³ VISION
128 2020 was launched by the World Health Organization (WHO) and the International Agency
129 for the Prevention of Blindness (IAPB) in order to bring together governments, eye care
130 professionals and patients to work towards the global goal to eliminate avoidable blindness
131 by the year 2020.⁴

132 However this year the new Public Health Outcomes Framework has included an indicator for
133 preventable sight loss, constituting a major step forward for the recognition of eye health on
134 the public health agenda.⁵ This indicator will be based upon the Certificate of Vision
135 Impairment (CVI) – this being the only routinely collected national measure of blindness and
136 sight impairment.

137 The NHS Atlas of Variation has highlighted the variations in healthcare activity, expenditure,
138 quality and outcomes in the UK.⁶ This brought to attention the need to address unwarranted
139 variation, focussing on the appropriateness of the clinical services and their outcomes. The
140 most recent edition of the Atlas published last year included the rate of sight impairment and
141 blindness due to diabetes (as measured by CVI), which showed a high level of variation (8
142 fold), and raised concerns, particularly as there is a diabetic eye screening programme already
143 in place. With an aging population and rising incidence of diabetes the prevalence of sight
144 loss has also been predicted to increase significantly over the next decade.^{7,8} The total costs
145 of sight loss in the UK were estimated at £6.5 billion in 2008 with £40 million per million
146 population being spent on eye care services last year in England.⁹ With rising costs from
147 expensive medications for Age Related Macular Degeneration (AMD) and other diseases
148 there will be huge pressures on the eye care budget in the coming years. The adoption of an
149 indicator for preventable sight loss will be a vital part of monitoring eye care outcomes.
150 However public health practitioners will need to know that the quality of the data is adequate
151 and how to interpret the CVI rates. In this paper we examine, for the first time, the
152 geographical variation of blindness and sight impairment, as measured by the CVI.

153 Methods

154 CVI data collection

155 The CVI form is discussed in the hospital clinic with patients who are eligible and is
156 completed with patient consent by a consultant ophthalmologist. Currently, a paper version is
157 completed which is sent to the local authority social services who use this to update their
158 visual impairment register. Every three years, the Social Service departments complete an
159 annual return which is sent to the Information Centre (IC) for health and social services
160 reporting the number of new registrations and the total number of registrations in their
161 register. This return is mandatory. Another copy of the CVI form is sent to the Certifications
162 Office, Moorfields Eye Hospital NHS Foundation Trust for epidemiological analysis. This
163 return is voluntary but there is a good rate of compliance (correlation coefficient 0.9).¹⁰ Data
164 held by the Certifications Office has more detailed information on the causes of registration

1
2
3 165 and allows incidence data calculation. For this study the data from the 2008/9 CVI forms
4 166 collected by the Certifications Office was used.

5
6 167 Calculation
7

8 168 Two rates were used for the analysis, the crude rate and the directly standardised rate (DSR).
9 169 The crude rate is the number of CVI forms divided by the population of that PCT. The DSR
10 170 was determined using age specific CVI rates with ONS 2008 mid-year population figures by
11 171 PCT with 95 % confidence intervals computed using Byar's method. The standard deviation
12 172 and coefficient of variation were then calculated.

13
14 173 Standardisation was used as a means of ensuring that any differences seen between PCT
15 174 populations were not as a result of differing age structures. As the numbers of CVI forms in
16 175 each PCT were relatively small, standardisation was conducted using three age bands (0-15,
17 176 16-64 and 65 plus). We chose direct rather than indirect standardisation because we wished to
18 177 compare PCTs with each other and indirect standardisation would not have allowed this.¹¹

19
20
21 178 The coefficient of variation is calculated by dividing the standard deviation of the rates by the
22 179 mean rate.¹² As it is relatively insensitive to population size, it provides a more powerful
23 180 measure of variation than the standard deviation when there are variable population sizes in
24 181 the data set. One disadvantage is that it may overestimate the amount of variation if rates are
25 182 low or if it is applied to small populations.

26
27
28 183 To eliminate the possibility of artefact from outliers in the data sets, the degree of variation
29 184 was calculated as the range within the data after exclusion of the five PCTs with the highest
30 185 and the five with the lowest values. Fold variation was determined as the upper limit of the
31 186 trimmed range divided by the lower limit of the trimmed range.

32
33 187 A funnel plot was constructed to examine whether or not the rate of certification was related
34 188 to the size of the population and to examine whether there was a relationship between the
35 189 estimate size and the precision of that estimate.

36
37
38 190 Comparison with Index of Multiple Deprivation (IMD)
39

40 191 The Indices of Deprivation (ID) is a measure of social deprivation prepared by the
41 192 Department of Communities and local Government (DCLG). The English Indices of
42 193 Deprivation measures relative levels of deprivation in small areas of England.¹³The English
43 194 ID2010 use 38 separate indicators, organised across seven distinct domains of deprivation,
44 195 including income, employment and health. The latter can be combined, using appropriate
45 196 weights, to calculate the Index of Multiple Deprivation 2010 (IMD 2010). The IMD is used
46 197 to help decide the allocation of resources to PCTs. Scatter plots of the CVI rates with the
47 198 index of multiple of deprivation were drawn and correlation coefficients calculated.

48
49 199 Comparison with Spend on Vision
50

51 200
52 201 In the UK each PCT receives its healthcare budget allocated by programme area. There are
53 202 23 main programmes, broadly corresponding to the chapters in the WHO ICD-10 e.g.
54 203 Cancers and tumours, Mental Health Disorders. The eye care services budget comes under
55 204 the Vision programme budget. This includes NHS sight tests as well as all primary care
56 205 prescribing, community services, inpatients and outpatients expenditure. Scatter plots of CVI
57 206 rates against spend on vision were examined and correlation coefficients calculated to assess
58
59
60

207 whether there was any evidence of association between spend versus CVI blindness and sight
208 impairment rates.

209 Converting Data to Maps

210 The data is shown as a map of England with London shown as an inset on the PCT maps so
211 that the details of the small areas are not lost. The PCTs have been grouped into ranges to
212 allow comparison of areas on the map with ease. The method used to group the data into
213 ranges is quantiling. Quantile's build ranges (in this case five were chosen) to display the
214 distribution of the variable. This is calculated by ranking the data values from highest to
215 lowest and then splitting the values into five ranges, which do not necessarily contain equal
216 numbers. The ranges are from the lowest value (light blue) to the highest (dark blue). The
217 map was produced in Adobe Illustrator.

218 **Results**

219
220 There were 23,773 CVI certifications for 2008/9 in England. Table 1 summarises the degree
221 of variation, standard deviation and co-efficient of variation. It shows that after
222 standardisation there is approximately an 11-fold variation in the number of CVIs. A
223 coefficient of variation of 0.38 or 38% indicates marked variation in CVI registration.

224 **Table 1: Summary of CVI certifications with the mean, standard deviation, coefficient**
225 **of variation and degree of variation**

	Mean	Standard deviation	Coefficient of variation	Fold Variation
CVI Crude Rate (per 100,000 population)	42.97	18.10	0.42	12.47
CVI Directly Standardised Rate (per 100,000 population)	43.69	16.69	0.38	10.79
Programme Spend (in pounds sterling) on Vision	32.55	6.16	0.19	2.13
Index of Multiple Deprivation*	23.63	8.40	0.36	3.67

226 ***In 2010 IMD scores ranged from 1.4- 87.8¹⁴**

227 **Figure 1 and 1a:** Map and Bar Graph of Geographical Variation of in blindness and sight
228 impairment rates in England

229 Figure 1 and 1a shows the directly standardised rates of sight impaired and blindness directly
230 per 100,000 in England, in 2008-09 in the form of a map, as detailed in the methods. The map
231 illustrates a fairly uniform distribution of variation, although there is a cluster of relatively
232 low CVI registration in the West of England. This would require further study including a
233 time trend to explore whether this is a repeating trend over 5 to 10 years. There is otherwise
234 very little evidence of a geographical explanation for the variation such a "north-south
235 divide".¹⁵

237 **Figure 2:** CVI directly age-standardised rate per 100,000 vs Index of Multiple Deprivation
238 2010 by Primary Care Trust, 2008/9

239

240 Figure 2 displays the CVI standardised rates per 100,000 versus the IMD 2010 by PCT. The
241 figures illustrate a very weak association between the CVI rates and IMD 2010. (correlation
242 coefficients 0.11, $p=0.15$). It is therefore unlikely that deprivation is the only cause for the 11
243 fold variation seen in CVI registration rates.

244

245 **Figure 3:** CVI directly age-standardised rate per 100,000 vs Spend (in pounds sterling) per
246 Head by Primary Care Trust, 2008/9

247 Figure 3 displays the CVI standardised rates per 100,000 versus the spend per head by PCT.
248 Again, there is little evidence of any association seen (correlation coefficient 0.0329, $p=0.69$)
249 and therefore spend per head is unlikely to account for the variation observed in CVI rates.

250 **Figure 4**

251 There is high degree of heterogeneity seen in the funnel plot, of 151 PCTs, with twenty seven
252 being above the upper three SD line and thirty six below. Another 17 PCTs are between the
253 upper two and three SD lines and 12 between the lower two and three SD lines. This is likely
254 to be both due to real differences between PCTs but also unmeasured covariates that alone
255 impact by small amounts but together impact greatly.

256 **Discussion**

257 The certification rates of blindness and sight impairment differ widely amongst PCTs with an
258 11 fold difference between the highest and lowest rate. There is little association seen with
259 the Index of Deprivation or Spend on Vision. The limitations of the study included the
260 relatively smaller numbers of CVI data for each PCT so that the coefficient of variation may
261 have overestimated the level of variation.¹¹ Increasing the local areas to larger geographical
262 areas of England may improve the accuracy, though such a measure would be less relevant to
263 commissioners and healthcare professionals. Residual confounding by age may remain a
264 limitation as we had to use relatively large age bands again due to the relatively smaller
265 number of events in each age band.

266

267 Despite these limitations this is a high level of variation and understanding the data collection
268 is important. The completion of a CVI form requires a consultant ophthalmologist to offer
269 certification to a patient who is attending a hospital eye clinic and the patient to accept that
270 offer. Therefore there are a number of factors which can influence both the offering and
271 acceptance of the certification and it is difficult to distinguish these other than through direct
272 audits. The certification process is also limited by the fact that it takes place mostly in the
273 hospital setting by a consultant, as there may be many more patients in the community who
274 may be eligible but are not offered it. The magnitude of variation raises questions about the
275 consistency of this process around the country and the variation in how many eligible people
276 are offered certification.

277 It is recognised that the reported numbers of CVI registrations of blindness and sight
278 impairment have decreased significantly in the last 10 years, at a time when, for demographic
279 reasons, they should be increasing.¹⁶ The reasons for this are not entirely clear but they may

280 also contribute to the variation across the country. There are a number of possible factors.
281 The number of blind people in England has been counted since 1851. The decrease in
282 certification rates has coincided with the introduction of the new CVI form to replace the
283 previous BD8 form. It has been expressed that the new form is more complex to complete.
284 The new form was intended to be accompanied by a change in culture where it is now an
285 indication that the person may benefit from the support and rehabilitation in the community,
286 rather than be an indication that ‘nothing more can be done’. This was supposed to trigger
287 increased certification being offered, which may be done more in certain areas or by
288 certain individuals than by others. The change in form was also accompanied by a change in
289 the payment system, from ophthalmologists being automatically entitled to a fee to the
290 entitlement for fee being variable depending on whether a consultant is on a new contract or
291 old or if it is seen as an additional examination.

292 The sustainability of CVI data collection and analysis has also been in question since 2007.
293 First, it was not included in the National Indicator Set, which lists those data collections that
294 would remain mandatory for local authorities.¹⁷ Then an NHS information centre review
295 concluded that the collection of the data should cease. Support by eye care professionals for
296 the data collection led to a further government review, which concluded the data collection
297 was essential but that the system needed improvement. These conclusions were further
298 supported by a Law Commission’s report, published in May 2011.¹⁸ These issues have
299 slowed progress in improving and updating the process of data collection including the
300 development of an electronic collection system. Continuing uncertainty may have affected
301 the quality of data collection. Certainly, the data collection could be improved by
302 streamlining and adopting an electronic version which auto-populates demographic
303 information by linking to local EPRs. Raising understanding of CVI figures is also of merit –
304 a CVI for diabetic eye disease means that a patient has lost sight due to a preventable eye
305 condition. The distinction between ‘preventable’ and ‘not preventable’ blindness is
306 important. Blindness due to diabetes, glaucoma and cataract is considered preventable or
307 treatable if diagnosed in a timely manner. Similarly AMD now also has effective treatments
308 which can halt or improve sight loss, hence its inclusion with glaucoma and diabetes in the
309 Public Health Outcome framework ‘preventable sight loss’ indicator. Hospitals should be
310 encouraged to examine their own CVI figures to ensure that all that could have been done
311 was done and regular audits could be conducted to ensure that patients who are eligible for
312 certification are offered a CVI. An analysis of one London PCT found significantly higher
313 levels of certification due to glaucoma and diabetic retinopathy, both preventable causes of
314 blindness.¹⁹

315 However this. There have been, to our knowledge, no other studies on geographical variation
316 in sight loss conducted in the UK. Reliable collection of national data on sight loss is an issue
317 throughout developed as well as developing countries. In a Danish population based study of
318 prevalence and causes of blindness they noted there was no accurate and up-to-date data for
319 Denmark, therefore they conducted their own population cross-sectional survey for
320 Copenhagen.²⁰ The figures used in the WHO database for Europe are based in some cases on
321 data collection from over 15 years ago.²¹ Population based surveys, often focussed
322 exclusively on the elderly, have been done in many European countries but these types of
323 surveys have their own limitations.²¹ Rapid assessment of avoidable blindness (RAAB) has
324 been developed to allow a simple and rapid survey methodology that can provide data on
325 prevalence and causes of blindness.²² This has proved extremely successful in developing
326 country settings and many have been conducted globally. However the methodology differs
327 to our study and they do not specifically look for geographical variation within countries

1
2
3 328 although this may sometimes be implicated in some results. Geographical variation has been
4 329 studied in the UK with regard to mainly surgical rates, including cataract surgery, intravitreal
5 330 injections and more recently uveal melanoma.^{23,24,25} In some areas where available it may be
6 331 interesting to compare these hospital based data with the rate of blindness and sight
7 332 impairment certification. This lack of comparable data highlights the importance of the work
8 333 being done in the UK with this routine data collection on sight loss and its causes, and serves
9 334 as an example for other countries

11 335 The inclusion of the public health indicator of ‘preventable sight loss’ in the Public Health
12 336 Outcome Framework is a landmark decision in the inclusion of eye health into the wider
13 337 public health agenda. However this highlights the importance of improving the quality of
14 338 this important data collection, if it is to be used to monitor the number of people with
15 339 preventable sight loss. Our results show that there is a wide level of variation between PCTs
16 340 and it is likely that much of this is due to factors including variation in levels of offering of
17 341 certification, care pathways, perceived value of certification and payment for CVI forms. It is
18 342 vital that these are now addressed with a more streamlined process, and locally and nationally
19 343 awareness is raised in the importance of the data. The analysis of the number of people losing
20 344 sight due to conditions which may be preventable is vital. There is an additional need for
21 345 accurate data to see whether the introduction of new (and costly) interventions for diseases
22 346 (such as Lucentis for Age related Macular Degeneration and possibly Diabetic Macular
23 347 Oedema) are reducing sight loss nationally. Further research on the causes of sight
24 348 impairment amongst those certified and its variation will be important as well as the
25 349 comparison of rates with other eye health care indicators. Variation of sight loss certification
26 350 is a concern if patients are not gaining access to social service support. It is vital for those
27 351 who plan and manage services to determine if there is more that can be done to improve
28 352 services to prevent avoidable sight loss and improve eye health outcomes.

32 353 **Word Count 3051**

34 354 **What this paper adds**

36 355 **section 1:**

- 38 356
- 39 357 • The number of certifications for blindness and sight impairment have been falling,
40 358 despite estimates due to demographic changes of rising rates.
 - 41 359 • There has been no previous study looking at the geographical variation in blindness
42 359 and sight impairment rates.

44 360 **section 2:**

- 46 361
- 47 362 • There is a large geographical variation in the registration of blindness and sight
48 363 impairment in England
 - 49 364 • This implies both a need to improve consistency in access to certification across the
50 365 country and investigate further the causes of this variation, particularly as this will
51 365 now be used to as an outcome in the Public Health Outcomes Framework

53 366

55 367 The Corresponding Author has the right to grant on behalf of all authors and does grant on
56 368 behalf of all authors, an exclusive licence (or non exclusive for government employees) on a
57 369 worldwide basis to the BMJ Publishing Group Ltd to permit this article (if accepted) to be

1
2
3 370 published in BMJ editions and any other BMJ PGL products and sublicences such use and
4 371 exploit all subsidiary rights, as set out in our licence.

5
6 372 All authors have completed the Unified Competing Interest form at
7 373 www.icmje.org/coi_disclosure.pdf (available on request from the corresponding author) and
8 374 declare that (1) No authors have support for the submitted work; (2) No authors have
9 375 relationships that might have an interest in the submitted work in the previous 3 years; (3)
10 376 their spouses, partners, or children have no financial relationships that may be relevant to the
11 377 submitted work; and (4) No authors have non-financial interests that may be relevant to the
12 378 submitted work.”

13
14
15 379 **Acknowledgements:**

16
17 380 We would like to acknowledge the Royal College of Ophthalmologists, Royal National
18 381 Institute of the Blind and Guide Dogs for the Blind for their help in making this data
19 382 available.

20
21 383 The CVI data are copyright of the Department of Health. However any views expressed in
22 384 the publication are those of the author(s) alone and are not necessarily those of the
23 385 Department of Health.

24
25 386 **Details of contributors:**

26
27 387 Aeesha NJ Malik (guarantor): conception, design, analysis and interpretation of data, drafting
28 388 original article, revision and final approval

29
30 389 Catey Bunce: analysis and interpretation of data, revision of article and final approval

31
32 390 Richard Wormald (guarantor): revision of article and final approval

33
34 391 Mehrunisha Suleman: interpretation of data, revision of article and final approval

35
36 392 Irene Stratton: analysis and interpretation of data, revision of article and final approval

37
38 393 Muir Gray: revision of article and final approval

39
40 394 **Ethical Approval:** not required

41
42 395 **Sources of Funding:** none

43
44 396 **All researchers were independent from funders**

45
46 397 **All authors had full access to all of the data (including statistical reports and tables) in**
47 398 **the study and can take responsibility for the integrity of the data and the accuracy of**
48 399 **the data analysis**

49
50 400

51
52 401 **References**

53
54 402 1. Dept of Health. Healthy lives, healthy people: our strategy for public health in England.
55 403 <http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAn>

- 1
2
3 404 dGuidance/DH_121941, 30 November 2010.2. Dept of Health. Equity and excellence:
4 405 Liberating the NHS.
5 406 <http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAnd>
6 407 dGuidance/DH_117353. 12 July 2010
- 7 408 3. World Health Organization. WHA 56.26 Elimination of avoidable blindness.
8 409 http://www.who.int/pbd/publications/wha_eb/en/, 28 May 2003.
- 9 410 4. A VISION 2020 UK initiative. UK Vision Strategy: Setting the direction for eye health
10 411 and sight loss services.
11 412 [http://www.vision2020uk.org.uk/UKVisionstrategy/page.asp?section=32§ionTitl](http://www.vision2020uk.org.uk/UKVisionstrategy/page.asp?section=32§ionTitle=About+the+Strategy#Download%20the%20UK%20Vision%20Strategy)
12 413 <e=About+the+Strategy#Download%20the%20UK%20Vision%20Strategy>, April
13 414 2008.
- 14 415 5. Dept of Health. Healthy Lives, Healthy People: transparency in outcomes, proposals for a
15 416 public health outcomes framework.
16 417 http://www.dh.gov.uk/en/Consultations/Liveconsultations/DH_122962, 20 December
17 418 2010.6. QIPP Right Care programme. Gray M, Da Silva P (ed). The NHS Atlas of
18 419 Variation in Healthcare. Reducing unwarranted variation to increase value and
19 420 improve quality. <http://www.rightcare.nhs.uk/atlas/> 2010.
- 20 421 7. Evans JR, Fletcher AE, Wormald RPL et al. Prevalence of visual impairment in people
21 422 aged 75 years and older in Britain: results from the MRC trial of assessment and
22 423 management of older people in the community. *Brit J of Opth* 2001;86(7):795-800.
- 23 424 8. Economics A. Future Sight Loss UK 1: Economic Impact of Partial Sight and Blindness in
24 425 the UK adult population.
25 426 <http://www.rnib.org.uk/aboutus/Research/reports/prevention/Pages/fsluk1.aspx>:
26 427 RNIB. , 2009. .
- 27 428 9. Minassian D and Reidy A. Future Sight Loss UK 2: An epidemiological and economic
28 429 model for sight loss in the decade 2010-
29 430 2020.<http://www.rnib.org.uk/aboutus/Research/reports/prevention/Pages/fsluk2.aspx>
- 30 431 10. The NHS Information Centre, Adult Social Care Team. Registered Blind and Partially
31 432 Sighted People Year ending 31 March 2011, England. 1st September 2011.
32 433 [http://www.ic.nhs.uk/statistics-and-data-collections/social-care/adult-social-care-](http://www.ic.nhs.uk/statistics-and-data-collections/social-care/adult-social-care-information/registered-blind-and-partially-sighted-people--year-ending-31-march-2011-in-england)
33 434 [information/registered-blind-and-partially-sighted-people--year-ending-31-march-2011-in-](information/registered-blind-and-partially-sighted-people--year-ending-31-march-2011-in-england)
34 435 [england](http://www.avon.nhs.uk/phnet/PHinfo/understanding.htm#Indirect) | 1. <http://www.avon.nhs.uk/phnet/PHinfo/understanding.htm#Indirect>
- 35 436 12. Diehr P CK, Connell F, Volinn E. What is too much variation? The null hypothesis in
36 437 small-area analysis. *Heath Ser Res*1990;24(6):741–71.
- 37 438 13. Department of Communities and Local Government. The English Indices of Deprivation
38 439 2010. <http://www.communities.gov.uk/publications/corporate/statistics/indices2010>,
39 440 24 March 2011.
- 40 441 14. <http://www.communities.gov.uk/publications/corporate/statistics/indices2010>
- 41 442
- 42 443 15. [Hacking JM](#), [Muller S](#), [Buchan IE](#). Trends in mortality from 1965 to 2008 across the
43 444 English north-south divide: comparative observational study. *BMJ*. 2011; 15;342
- 44 445 16. Bunce C XW, Wormald R. Causes of blind and partial sight certifications in England and
45 446 Wales: April 2007-March 2008. *Eye* 2010;24(11):1692-9.
- 46 447 17. Department of Communities and Local Government. The New Performance Framework
47 448 for Local Authorities and Local Authority Partnerships – A Single Set of National
48 449 Indicators.
49 450 <http://www.communities.gov.uk/publications/localgovernment/nationalindicator>,
50 451 2007.

- 1
2
3 452 18. Commission TL. Adult Social Care.
4 453 <http://www.justice.gov.uk/lawcommission/publications/1460.htm>, 11 May 2011.
5 454 19. Royal National Institute of the Blind. An Internal Report: CVI data update
6 455 20. Buch H, Vinding T, La Cour M et al. The prevalence and causes of bilateral and
7 456 unilateral blindness in an elderly urban Danish population. The Copenhagen City Eye
8 457 Study. *Acta Opth Scan* 2001; 79: 441-9
9
10 458 21. Thylefors B, Negrel AD, Pararajasegaram R et al. Available data on blindness (update
11 459 1994). *Opth Epidemiol* 1995; 2: 5-39.
12 460 22. Kuper H, Polack S and Limburg H. Rapid assessment of avoidable blindness. *Community*
13 461 *Eye Health* 2006; 19 (60): 68-69
14 462 23. Keenan TD, Yeates D and Goldacre MJ. Uveal melanoma in England: trends over time
15 463 and geographical variation. *Brit J Opth* 2012; Sep 13 (epub)
16 464 24. Keenan TD, Wotton CJ and Golacre MJ. Trends over time and geographical variation in
17 465 rates of intravitreal injections in England. *Brit J Opth* 2012; 96 (3):413-8
18 466 25. Keenan T, Rosen P, Yeates D et al. Time trends and geographical variation in cataract
19 467 surgery rates in England: study of surgical workload. *Brit J Opthal* 2007; 91 (7):
20 468 901-4
21 469
22 470
23 471
24
25
26 472
27
28 473
29
30 474
31
32 475
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3 **1 Geographical variation in blindness and sight impairment rates in England, 2008-09**

4 Aeesha NJ Malik, Catey Bunce, Richard Wormald, Mehrunisha Suleman, Irene Stratton, J.A.
5 Muir Gray.
6

7 An analysis and report of national register data
8
9

10 Corresponding Author:
11

12 Miss Aeesha NJ Malik

13 Ophthalmology Specialist Registrar

14 Work Address: Moorfields Eye Hospital, 162 City Road, London EC1V 2PD

15 Correspondance address and contact details: aeeshamalik@gmail.com

16 ~~24 Carmichael Court, Grove Road~~ [2 Elm Walk](#), London, ~~SW13 0HA~~ [SW20 9ED](#)
17
18

19 Catey Bunce

20 Senior Statistician

21 Moorfields Eye Hospital, 162 City Road, London EC1V 2PD
22

23 Mr Richard Wormald

24 Consultant Ophthalmologist and Director Cochrane Eyes and Vision Group

25 Moorfields Eye Hospital, 162 City Road, London EC1V 2PD
26
27

28 Dr Mehrunisha Suleman

29 ~~FY2 doctor Oxford Radcliffe Trust~~ [QIPP Right Care Programme, Department of Health](#)

30 [Summertown Pavilion, 18 - 24 Middle Way, Oxford, OX2 7LG, UK](#) ~~Cranbrook House, 287-~~

31 ~~291 Banbury Road, Oxford, Oxfordshire, OX2 7JQ~~
32
33

34 Irene Stratton

35 Senior Statistician (Honorary Associate Professor, University of Warwick Clinical Sciences
36 Research Institute)

37 English National Diabetic Retinopathy Screening Programme

38 Cheltenham General Hospital, Sandford Road Cheltenham GL53 7AL
39
40

41 Professor Sir Muir Gray

42 Co-lead QIPP Right Care Programme, Department of Health

43 [Summertown Pavilion, 18 - 24 Middle Way, Oxford, OX2 7LG, UK](#)

44 ~~Cranbrook House, 287-291 Banbury Road, Oxford, Oxfordshire, OX2 7JQ~~
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3 54
4 55 Article Summary
5 56

6 57 Article Focus

- 7 58 | 1. To examine and interpret ~~e-ate~~ the variation in the incidence of blindness and sight
8 59 impairment in England by PCT, as reported by the Certificate of Visual Impairment (CVI).
9 60 | 2. To assess whether there was any evidence of association between CVI rates with the index
10 61 of Multiple Deprivation (IMD) and the Programme spend for Vision
11 62

12 63 Key messages:

- 13 64 | 1. There is a wide geographical variation in certified rates of blindness and sight impairment
14 65 across England
15 66 | 2. The wide geographical variation we found raises questions both about the quality of the
16 67 data and whether there is genuine unmet need for prevention of sight loss.
17 68 | 2. ~~The Certificate of Visual Impairment (CVI) will form the basis of the 'preventable sight~~
18 69 ~~loss' indicator in the new 'Public Health Outcomes Framework'~~
19 70 | 3. The certification (CVI) data forms the basis of the 'preventable sight loss' indicator in the
20 71 'Public Health Outcomes Framework' and improving the quality and interpretation of the
21 72 data will be vital. Poor quality data and inadequate interpretation will only create confusion
22 73 if not addressed adequately from the outset. However unmet need will lead to avoidable sight
23 74 loss and not address the WHO VISION 2020 goals, to which the UK is a signatory.
24 75

25 76 Strengths and Limitations of this Study:

- 26 77 | 1. A prospective routinely collected national routinely collected dataset analysis was used for
27 78 analysis giving accurate data on certification rates across England.
28 79 | 2. There was relatively small numbers of certification for each PCT therefore there is a
29 80 possibility of over estimation of the variation. limitations of the Certificate of Visual
30 81 Impairment as proxy for visual impairment and blindness rates discussed
31 82 -no comparison as no previous similar studies
32 83

33 84
34 85
35 86 **Abstract**
36 87

37 88 **Objectives**

38 89 | To examine and interpret ~~e-ate~~ the variation in the incidence of blindness and sight
39 90 impairment in England by PCT, as reported by the Certificate of Visual Impairment (CVI).
40 91

41 92 **Design**

42 93 | Analysis of national ~~register-certification~~ data
43 94

44 95 **Setting**

45 96 All Primary Care Trusts, England
46 97

47 98 **Participants**

48 99 23,773 CVI certifications issued from 2008-9
49 100

50 101 **Main Outcome measures**

51 102 Crude and Age standardised rates of CVI data for blindness and sight loss by PCT
52 103

53 104 **Methods**
54
55
56
57
58
59
60

1
2
3 105 The crude and age standardised CVI rates were calculated with 95 % confidence intervals
4 106 using Byar's method. Spearman's rank correlation was used to assess whether there was any
5 107 evidence of association between CVI rates with IMD and the Programme spend for Vision.
6 108

7 109 **Results**

8 110 There was high level variation, almost 11 fold (Coefficient of Variation 38%) in standardised
9 111 CVI blindness and sight impairment annual certification rates across PCTs. The mean rate
10 112 was 43.7 and the standard deviation 16.7. We found little-weak evidence of any association
11 113 between the rate of blindness and sight impairment with either the IMD or Programme Spend
12 114 on Vision.
13 115

14 116 **Conclusions**

15 117
16 118 ~~The Department of Health recently published a 'Public Health Outcomes Framework', which~~
17 119 ~~included 'preventable sight loss' as one of the indicators. The Certificate of Visual~~
18 120 ~~Impairment (CVI) will form the basis of this new indicator.~~ The wide geographical variation
19 121 we found raises questions both about the quality of the data and whether there is genuine
20 122 unmet need for prevention of sight loss. It is a concern for public health practitioners who
21 123 will be interpreting this data locally and nationally as the CVI data will form the basis of the
22 124 public health indicator 'preventable sight loss'. Poor quality data and inadequate
23 125 interpretation will only create confusion if not addressed adequately from the outset.
24 126 ~~However unmet need will lead to avoidable sight loss and not address the WHO VISION~~
25 127 ~~2020 goals, to which the UK is a signatory.~~ There is an urgent need to address the
26 128 shortcomings of the current data collection system and to educate all public health
27 129 practitioners.
28
29
30

31
32 130 Word Count 299267
33

34 131

35 132
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

133 Introduction

134 Eye care services have traditionally not featured highly in national health policy or the public
135 health agenda. In the UK there has been no Department of Health led eye care services
136 strategy and there is no mention of eye health in the recent NHS or Public Health White
137 papers, ~~both published last year.~~^{1,2} The UK however does have a Vision Strategy ~~but this has~~
138 ~~been~~ produced by a collaboration of Eye care organisations, professionals and patients, ~~not~~
139 ~~the government,~~ in response to the World Health Assembly Resolution of 2003. This
140 resolution urged the development and implementation of national plans to tackle sight
141 impairment, to which the UK government pledges its support.³ VISION 2020 was launched
142 by the World Health Organization (WHO) and the International Agency for the Prevention of
143 Blindness (IAPB) in order to bring together governments, eye care professionals and patients
144 to work towards the global goal to eliminate avoidable blindness by the year 2020.⁴

145 However ~~only this year there has been a major step forward in the UK for the recognition of~~
146 ~~eye health in the national public health agenda. The this year the~~ new Public Health
147 Outcomes Framework has included an indicator for preventable sight loss, ~~following a united~~
148 ~~effort by the eye care community and the UK Vision Strategy to support its inclusion,~~
149 ~~constituting a major step forward for the recognition of eye health on the public health~~
150 ~~agenda.~~⁵ This indicator will be based upon the Certificate of Vision Impairment (CVI) – this
151 being ~~the only routinely collected national measure of blindness and sight impairment. This~~
152 ~~places a greater responsibility on those involved with ensuring the quality of the data, both in~~
153 ~~its collection and analysis.~~

154 The NHS Atlas of Variation has highlighted the variations in healthcare activity, expenditure,
155 quality and outcomes in the UK.⁶ This brought to attention the need to address unwarranted
156 variation, focussing on the appropriateness of the clinical services and their outcomes. The
157 most recent edition of the Atlas published last year included the rate of sight impairment and
158 blindness due to diabetes (as measured by CVI), which showed a high level of variation (8
159 fold), and raised concerns, particularly as there is a diabetic eye screening programme already
160 in place. ~~There is a growing incidence of diabetes in the UK and w~~With an aging population
161 ~~and rising incidence of diabetes~~ the prevalence of sight loss has also been predicted to
162 increase significantly over the next decade.^{7,8} The total costs of sight loss in the UK were
163 estimated at £6.5 billion in 2008 with £40 million per million population being spent on eye
164 care services last year in England.⁹ With rising costs from expensive medications for Age
165 Related Macular Degeneration (AMD) and other diseases there will be huge pressures on the
166 eye care budget in the coming years. The adoption of an indicator for preventable sight loss
167 will be a vital part of monitoring eye care outcomes. However public health practitioners will
168 need to know that the quality of the data is adequate and how to interpret the CVI rates. ~~An~~
169 ~~examination of the variation in blindness and sight loss in the CVI data is an important step in~~
170 ~~order to understand and address sight loss and blindness across England.~~ In this paper we
171 examine, for the first time, the geographical variation of blindness and sight impairment, as
172 measured by the CVI.

173 Methods

174 CVI data collection

175 The CVI form is discussed in the hospital clinic with patients who are eligible and is
176 completed with patient consent by a consultant ophthalmologist. Currently, a paper version is
177 completed which is sent to the local authority social services who use this to update their

1
2
3 178 visual impairment register. Every three years, the Social Service departments complete an
4 179 annual return which is sent to the Information Centre (IC) for health and social services
5 180 reporting the number of new registrations and the total number of registrations in their
6 181 register. This return is mandatory. Another copy of the CVI form is sent to the Certifications
7 182 Office, Moorfields Eye Hospital NHS Foundation Trust for epidemiological analysis. This
8 183 return is voluntary but there is a good rate of compliance (correlation coefficient 0.9).¹⁰ Data
9 184 held by the Certifications Office has more detailed information on the causes of registration
10 185 and allows incidence data calculation. For this study the data from the 2008/9 CVI forms
11 186 collected by the Certifications Office was used.

14 187 Calculation

15
16 188 Two rates were used for the analysis, the crude rate and the directly standardised rate (DSR).
17 189 The crude rate is the number of CVI forms divided by the population of that PCT. The DSR
18 190 was determined using age specific CVI rates with ONS 2008 mid-year population figures by
19 191 PCT with 95 % confidence intervals computed using Byar's method. The standard deviation
20 192 and coefficient of variation were then calculated.

21
22 193 Standardisation was used as a means of ensuring that any differences seen between PCT
23 194 populations were not as a result of differing age structures. As the numbers of CVI forms in
24 195 each PCT were relatively small, standardisation was conducted using three age bands (0-15,
25 196 16-64 and 65 plus). We chose direct rather than indirect standardisation because we wished to
26 197 compare PCTs with each other and indirect standardisation would not have allowed this.¹¹

27
28 198 The coefficient of variation is calculated by dividing the standard deviation of the rates by the
29 199 mean rate.¹² As it is relatively insensitive to population size, it provides a more powerful
30 200 measure of variation than the standard deviation when there are variable population sizes in
31 201 the data set. One disadvantage is that it may overestimate the amount of variation if rates are
32 202 low or if it is applied to small populations.

33
34 203 To eliminate the possibility of artefact from outliers in the data sets, the degree of variation
35 204 was calculated as the range within the data after exclusion of the five PCTs with the highest
36 205 and the five with the lowest values. Fold variation was determined as the upper limit of the
37 206 trimmed range divided by the lower limit of the trimmed range.

38
39 207 A funnel plot was constructed to examine whether or not the rate of certification was related
40 208 to the size of the population and to examine whether there was a relationship between the
41 209 estimate size and the precision of that estimate.

42 210 Comparison with Index of Multiple Deprivation (IMD)

43
44 211 The Indices of Deprivation (ID) is a measure of social deprivation prepared by the
45 212 Department of Communities and local Government (DCLG). The English Indices of
46 213 Deprivation measures relative levels of deprivation in small areas of England.¹³ The English
47 214 ID2010 use 38 separate indicators, organised across seven distinct domains of deprivation,
48 215 including income, employment and health. The latter can be combined, using appropriate
49 216 weights, to calculate the Index of Multiple Deprivation 2010 (IMD 2010). The IMD is used
50 217 to help decide the allocation of resources to PCTs. Scatter plots of the CVI rates with the
51 218 index of multiple of deprivation were drawn and correlation coefficients calculated.

52 219 Comparison with Spend on Vision

220
 221 In the UK each PCT receives its healthcare budget allocated by programme area. There are
 222 23 main programmes, broadly corresponding to the chapters in the WHO ICD-10 e.g.
 223 Cancers and tumours, Mental Health Disorders. The eye care services budget comes under
 224 the Vision programme budget. This includes NHS sight tests as well as all primary care
 225 prescribing, community services, inpatients and outpatients expenditure. Scatter plots of CVI
 226 rates against spend on vision were examined and correlation coefficients calculated to assess
 227 whether there was any evidence of association between spend versus CVI blindness and sight
 228 impairment rates.

229 Converting Data to Maps

230 The data is shown as a map of England with London shown as an inset on the PCT maps so
 231 that the details of the small areas are not lost. The PCTs have been grouped into ranges to
 232 allow comparison of areas on the map with ease. The method used to group the data into
 233 ranges is quantiling. Quantile's build ranges (in this case five were chosen) to display the
 234 distribution of the variable. This is calculated by ranking the data values from highest to
 235 lowest and then splitting the values into five ranges, (quintiles). The quintiles which do not
 236 necessarily contain equal numbers. Each quintile includes a range of values that is within
 237 each fifth of the cumulative total of all values. The quintile-ranges are from the lowest value
 238 (light blue) to the highest (dark blue). The map was produced in Adobe Illustrator.

239 **Results**

240
 241 There were 23,773 CVI certifications for 2008/9 in England. Table 1 summarises the degree
 242 of variation, standard deviation and co-efficient of variation. It shows that after
 243 standardisation there is approximately an 11-fold variation in the number of CVIs. A
 244 coefficient of variation of 0.38 or 38% indicates marked variation in CVI registration.

245 **Table 1: Summary of ~~the~~ CVI certifications rates with the mean, standard deviation,**
 246 **coefficient of variation and degree of variation**

	Mean	Standard deviation	Coefficient of variation	Fold Variation
CVI Crude Rate <u>(per 100,000 population)</u>	42.97	18.10	0.42	12.47
CVI Directly Standardised Rate <u>(per 100,000 population)</u>	43.69	16.69	0.38	10.79
Programme Spend <u>(in pounds sterling)</u> on Vision	32.55	6.16	0.19	2.13
Index of Multiple Deprivation*	23.63	8.40	0.36	3.67

247 ***In 2010 IMD scores ranged from 1.4- 87.8¹⁴**

248 **Figure 1 and 1a:** Map and Bar Graph of Geographical Variation of in blindness and sight
 249 impairment rates in England (Attached as PDF)

250 Figure 1 and 1a shows the directly standardised rates of sight impaired and blindness directly
 251 per 100,000 in England, in 2008-09 in the form of a map, as detailed in the methods. The map
 252 illustrates a fairly uniform distribution of variation, although there is a cluster of relatively
 253 low CVI registration in the West of England. This would require further study including a

254 [time trend to explore whether this is a repeating trend over 5 to 10 years. There is otherwise](#)
 255 [very little evidence of a geographical explanation for the variation such a “north-south](#)
 256 [divide”](#).¹⁵

258 **Figure 2:** CVI directly age-standardised rate per 100,000 vs Index of Multiple Deprivation
 259 2010 by Primary Care Trust, 2008/9

260

261 Figure 2 displays the CVI standardised rates per 100,000 versus the IMD 2010 by PCT. The
 262 figures illustrate [little evidence of any very weak](#) association between the CVI rates and
 263 IMD 2010. (correlation coefficients 0.11, p=0.15). [It is therefore unlikely that deprivation is](#)
 264 [the only cause for the 11 fold variation seen in CVI registration rates.](#)

266 **Figure 3:** CVI directly age-standardised rate per 100,000 vs Spend ([in pounds sterling](#)) per
 267 Head by Primary Care Trust, 2008/9

268

269

270 Figure 3 displays the CVI standardised rates per 100,000 versus the spend per head by PCT.
 271 Again, there is little evidence of any association seen (correlation coefficient 0.0329, p=0.69)
 272 [and therefore spend per head is unlikely to account for the variation observed in CVI rates.](#)

273 **Figure 4**

274

275 [There is high degree of heterogeneity seen in the funnel plot, of 151 PCTs, with twenty seven](#)
 276 [being above the upper three SD line and thirty six below. Another 17 PCTs are between the](#)
 277 [upper two and three SD lines and 12 between the lower two and three SD lines. This funnel](#)
 278 [plot shows that many rates lie outside the limits showing much variability.](#) This is likely to be
 279 both due to real differences between PCTs but also unmeasured covariates that alone impact
 280 by small amounts but together impact greatly. [The lines shown are two and three standard](#)
 281 [deviation limits.](#)

282 **Discussion**

283 The [certification](#) rates of blindness and sight impairment differ widely amongst PCTs with an
 284 11 fold difference between the highest and lowest rate. There is little association seen with
 285 the Index of Deprivation or Spend on Vision. [The limitations of the study included the](#)
 286 [relatively smaller numbers of CVI data for each PCT so that the coefficient of variation may](#)
 287 [have overestimated the level of variation.](#)¹¹ [Increasing the local areas to larger geographical](#)
 288 [areas of England may improve the accuracy, though such a measure would be less relevant to](#)
 289 [commissioners and healthcare professionals. Residual confounding by age may remain a](#)
 290 [limitation as we had to use relatively large age bands again due to the relatively smaller](#)
 291 [number of events in each age band.](#)

292

293 ~~Despite these~~This is limitations this is a high level of variation and understanding the data
 294 collection is important. The completion of a CVI form requires a consultant ophthalmologist
 295 to offer ~~registration certification~~ to a patient who is attending a hospital eye clinic and the
 296 patient to accept that offer. Therefore there are a number of factors which can influence both
 297 the offering and acceptance of the ~~registration certification~~ and it is difficult to distinguish
 298 these other than through direct audits. The ~~registration certification~~ process is also limited by
 299 the fact that it takes place mostly in the hospital setting by a consultant- ~~ophthalmologist~~, as
 300 there may be many more patients in the community who may be eligible but are not offered
 301 ~~registration~~. ~~The~~ There should still however not be such a magnitude of variation between
 302 those being offered and accepting registration between PCTs in England, and it raises
 303 questions about the consistency of ~~the this~~ process around the country and the variation in
 304 how many eligible people are offered certification, and the quality of the data.

305 It is recognised that the reported numbers of CVI registrations of blindness and sight
 306 impairment have decreased significantly in the last 10 years, at a time when, for demographic
 307 reasons, they should be increasing.¹⁶ The reasons for this are not entirely clear but they may
 308 also contribute to the variation across the country. ~~There~~ there are a number of possible
 309 factors. The number of blind people in England has been counted since 1851. ~~From the mid~~
 310 ~~1930s registration was initiated by completion of a designated certificate, the BD8.~~ The
 311 decrease in certification rates has coincided with the introduction of the new CVI form to
 312 replace which has replaced the previous BD8 form. It has been expressed that the new form is
 313 more complex to complete, and any change in routine may lead to an initial loss of
 314 compliance. ~~Traditionally, registration was delayed until it was felt nothing more could be~~
 315 ~~done to help.~~ ~~However,~~ the new form was intended to be accompanied by a change in
 316 culture where it is now an indication that the person may benefit from the support and
 317 rehabilitation in the community, which registration can trigger rather than be an indication
 318 that 'nothing more can be done'. This was to supposed to trigger increased certification
 319 being offered, which may be done more in certain areas or by certain individuals than by
 320 others, The change in form was also accompanied by a change in the payment system, from -
 321 Ophthalmologists being automatically were entitled to a fee for completion of the BD8 -
 322 entitlement to a CVI fee is to the entitlement for fee being variable depending on whether a
 323 consultant is on a new contract or old and depending on whether or not, the certification
 324 process is seen as an or if it is seen as an additional examination. Being offered certification
 325 can be a highly emotive experience for patients and in order to expedite registration,
 326 additional social questions are asked of the patient. ~~For this reason and to ensure high~~
 327 ~~coverage of certification, modest payment seems acceptable but this should be standardised~~
 328 ~~to reduce variation across the UK.~~

329 -The sustainability of CVI data collection and analysis has also been in question since 2007.
 330 First, it was not included in the National Indicator Set, which lists those data collections that
 331 would remain mandatory for local authorities.¹⁷ Then an NHS information centre review
 332 concluded that the collection and publication of the data should cease. The support by eye
 333 care organisations and professionals for the data collection led to a further government
 334 review, which concluded the data collection was essential but that the system needed
 335 improvement. These conclusions were further supported by a Law Commission's report,
 336 published in May 2011.¹⁸ These issues have slowed progress in improving and updating the
 337 process of data collection including the development of an electronic collection system.
 338 Continuing uncertainty may have affected the quality of data collection. Certainly, the data

1
2
3 339 ~~collection~~ could be improved by streamlining —~~the CVI could be streamlined to reduce the~~
4 340 ~~burden of data collection, hospitals could and~~ adopting an electronic version which ~~could~~
5 341 ~~mandate some data entry and~~ auto-populates demographic information by linking to local
6 342 EPRs. Raising understanding of CVI figures is also of merit – a CVI for diabetic eye disease
7 343 means that a patient has lost sight due to a preventable eye condition. The distinction
8 344 between ‘preventable’ and ‘not preventable’ blindness is important. Blindness due to
9 345 diabetes, glaucoma and cataract is considered preventable or treatable if diagnosed in a timely
10 346 manner. Similarly AMD now also has effective treatments which can halt or improve sight
11 347 loss, hence its inclusion with glaucoma and diabetes in the Public Health Outcome
12 348 framework ‘preventable sight loss’ indicator. Hospitals should be encouraged to examine
13 349 their own CVI figures to ensure that all that could have been done was done and regular
14 350 audits could be conducted to ensure that patients who are eligible for certification are offered
15 351 a CVI. An analysis of one London PCT found significantly higher levels of certification due
16 352 to glaucoma and diabetic retinopathy, both preventable causes of blindness.¹⁹ This also may
17 353 raise the profile and perceived value of the certification process, as lack of awareness by
18 354 those collecting the data of its importance.

21
22 355 ~~It may also be that as the CVI data for PCTs contains relatively smaller numbers so that the~~
23 356 ~~coefficient of variation may have overestimated the level of variation.¹⁴ Increasing the local~~
24 357 ~~areas to larger geographical areas of England may improve the accuracy, though such a~~
25 358 ~~measure would be less relevant to commissioners and healthcare professionals. However~~
26 359 ~~this~~ This level of variation may mean that people with blindness and sight impairment are not
27 360 getting equitable access to registration across the country. This has implications for access to
28 361 the social service benefits that are associated with registration for patients. There is certainly
29 362 a need to explain the observed variation and, notably, to look at how much of this variation is
30 363 in preventable causes of blindness. An analysis of one London PCT found significantly
31 364 higher levels of certification due to glaucoma and diabetic retinopathy, both preventable
32 365 causes of blindness. This has potential implications for those responsible for planning
33 366 healthcare in those areas on how to improve early access to eye care services for those at
34 367 higher risk.

37 368 There have been, to our knowledge, no other studies on geographical variation in sight loss
38 369 conducted in the UK. ~~This may be partly due to the fact that reliable~~ Reliable collection of
39 370 national data on sight loss is an issue throughout developed as well as developing countries.
40 371 In a Danish population based study of prevalence and causes of blindness they noted there
41 372 was no accurate and up-to-date data for Denmark, therefore they conducted their own
42 373 population cross-sectional survey for Copenhagen.²⁰ The figures used in the WHO database
43 374 for Europe are based in some cases on data collection from over 15 years ago.²¹ Population
44 375 based surveys, often focussed exclusively on the elderly, have been done in many European
45 376 countries but these types of surveys have their own limitations.²¹ Rapid assessment of
46 377 avoidable blindness (RAAB) has been developed to allow a simple and rapid survey
47 378 methodology that can provide data on prevalence and causes of blindness.²² This has proved
48 379 extremely successful in developing country settings and many have been conducted globally.
49 380 However the methodology differs to our study and they do not specifically look for
50 381 geographical variation within countries although this may sometimes be implicated in some
51 382 results. Geographical variation has been studied in the UK with regard to mainly surgical
52 383 rates, including cataract surgery, intravitreal injections and more recently uveal melanoma.
53 384 ^{23,24,25} In some areas where available it may be interesting to compare these hospital based
54 385 data with the rate of blindness and sight impairment certification. This lack of comparable

386 | [data highlights the importance of the work being done in the UK with this routine data](#)
387 | [collection on sight loss and its causes, and serves as an example for other countries](#)

388 The inclusion of the public health indicator of ‘preventable sight loss’ in the Public Health
389 Outcome Framework is a landmark decision in the inclusion of eye health into the wider
390 public health agenda. However this highlights the importance of improving the quality of
391 this important data collection, if it is to be used to monitor the number of people with
392 preventable sight loss. Our results show that there is a wide level of variation between PCTs
393 and it is likely that much of this is due to factors including variation in levels of offering of
394 certification, care pathways, perceived value of certification and payment for CVI forms. It is
395 vital that these are now addressed with a more streamlined process, and locally and nationally
396 awareness is raised in the importance of the data. The analysis of the number of people losing
397 sight due to conditions which may be preventable is vital. There is an additional need for
398 accurate data to see whether the introduction of new (and costly) interventions for diseases
399 (such as Lucentis for Age related Macular Degeneration and possibly Diabetic Macular
400 Oedema) are reducing sight loss nationally. Further research on the causes of sight
401 impairment amongst those ~~registered~~ [certified](#) and its variation will be important [as well as](#)
402 [the comparison of rates with other eye health care indicators](#). Variation of sight loss
403 ~~registration-certification~~ is a concern if patients are not gaining access to social service
404 support. It is vital for those who plan and manage services to determine if there is more that
405 can be done to improve services to prevent avoidable sight loss and improve eye health
406 outcomes.

407 | **Word Count** ~~3004~~[3051](#)

408 | **What this paper adds**

409 | **section 1:**

- 410 • The number of certifications for blindness and sight impairment have been falling,
411 despite estimates due to demographic changes of rising rates.
- 412 • There has been no previous study looking at the geographical variation in blindness
413 and sight impairment rates.

414 | **section 2:**

- 415 • There is a large geographical variation in the registration of blindness and sight
416 impairment in England
- 417 • This implies both a need to improve consistency in access to certification across the
418 country and investigate further the causes of this variation, particularly as this will
419 now be used to as an outcome in the Public Health Outcomes Framework

420

421 The Corresponding Author has the right to grant on behalf of all authors and does grant on
422 behalf of all authors, an exclusive licence (or non exclusive for government employees) on a
423 worldwide basis to the BMJ Publishing Group Ltd to permit this article (if accepted) to be
424 published in BMJ editions and any other BMJPGJL products and sublicences such use and
425 exploit all subsidiary rights, as set out in our licence.

1
2
3 426 All authors have completed the Unified Competing Interest form at
4 427 www.icmje.org/coi_disclosure.pdf (available on request from the corresponding author) and
5 428 declare that (1) No authors have support for the submitted work; (2) No authors have
6 429 relationships that might have an interest in the submitted work in the previous 3 years; (3)
7 430 their spouses, partners, or children have no financial relationships that may be relevant to the
8 431 submitted work; and (4) No authors have non-financial interests that may be relevant to the
9 432 submitted work.”

11 433 **Acknowledgements:**

13 434 We would like to acknowledge the Royal College of Ophthalmologists, Royal National
14 435 Institute of the Blind and Guide Dogs for the Blind for their help in making this data
15 436 available.

17 437 The CVI data are copyright of the Department of Health. However any views expressed in
18 438 the publication are those of the author(s) alone and are not necessarily those of the
19 439 Department of Health.

21 440 **Details of contributors:**

22 441 Aeesha NJ Malik (guarantor): conception, design, analysis and interpretation of data, drafting
23 442 original article, revision and final approval

24 443 Catey Bunce: analysis and interpretation of data, revision of article and final approval

25 444 Richard Wormald (guarantor): revision of article and final approval

26 445 Mehrunisha Suleman: interpretation of data, revision of article and final approval

27 446 Irene Stratton: analysis and interpretation of data, revision of article and final approval

28 447 Muir Gray: revision of article and final approval

29 448 **Ethical Approval:** not required

30 449 **Sources of Funding:** none

31 450 **All researchers were independent from funders**

32 451 **All authors had full access to all of the data (including statistical reports and tables) in**
33 452 **the study and can take responsibility for the integrity of the data and the accuracy of**
34 453 **the data analysis**

35 454

36 455 **References**

37 456 1. Dept of Health. Healthy lives, healthy people: our strategy for public health in England.
38 457 [http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAnd](http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_121941)
39 458 [dGuidance/DH_121941](http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_121941), 30 November 2010.

- 1
2
3 459 2. Dept of Health. Equity and excellence: Liberating the NHS.
4 460 [http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAnd](http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_117353)
5 461 [dGuidance/DH_117353](http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_117353). 12 July 2010
- 6 462 3. World Health Organization. WHA 56.26 Elimination of avoidable blindness.
7 463 http://www.who.int/pbd/publications/wha_eb/en/, 28 May 2003.
- 8 464 4. A VISION 2020 UK initiative. UK Vision Strategy: Setting the direction for eye health
9 465 and sight loss services.
10 466 [http://www.vision2020uk.org.uk/UKVisionstrategy/page.asp?section=32§ionTitl](http://www.vision2020uk.org.uk/UKVisionstrategy/page.asp?section=32§ionTitle=About+the+Strategy#Download%20the%20UK%20Vision%20Strategy)
11 467 [e=About+the+Strategy#Download%20the%20UK%20Vision%20Strategy](http://www.vision2020uk.org.uk/UKVisionstrategy/page.asp?section=32§ionTitle=About+the+Strategy#Download%20the%20UK%20Vision%20Strategy), April
12 468 2008.
- 13 469 5. Dept of Health. Healthy Lives, Healthy People: transparency in outcomes, proposals for a
14 470 public health outcomes framework.
15 471 http://www.dh.gov.uk/en/Consultations/Liveconsultations/DH_122962, 20 December
16 472 2010.
- 17 473
18
19 474 6. QIPP Right Care programme. Gray M, Da Silva P (ed). The NHS Atlas of Variation in
20 475 Healthcare. Reducing unwarranted variation to increase value and improve quality.
21 476 <http://www.rightcare.nhs.uk/atlas/> 2010.
- 22 477 7. Evans JR, Fletcher AE, Wormald RPL et al. Prevalence of visual impairment in people
23 478 aged 75 years and older in Britain: results from the MRC trial of assessment and
24 479 management of older people in the community. *Brit J of Opth* 2001;86(7):795-800.
- 25 480 8. Economics A. Future Sight Loss UK 1: Economic Impact of Partial Sight and Blindness in
26 481 the UK adult population.
27 482 <http://www.rnib.org.uk/aboutus/Research/reports/prevention/Pages/fsluk1.aspx>:
28 483 RNIB. , 2009. .
- 29 484 9. Minassian D and Reidy A. Future Sight Loss UK 2: An epidemiological and economic
30 485 model for sight loss in the decade 2010-
31 486 2020.<http://www.rnib.org.uk/aboutus/Research/reports/prevention/Pages/fsluk2.aspx>
32 487
- 33 488 10. The NHS Information Centre, Adult Social Care Team. Registered Blind and Partially
34 489 Sighted People Year ending 31 March 2011, England. 1st September 2011.
35 490 [http://www.ic.nhs.uk/statistics-and-data-collections/social-care/adult-social-care-](http://www.ic.nhs.uk/statistics-and-data-collections/social-care/adult-social-care-information/registered-blind-and-partially-sighted-people--year-ending-31-march-2011-in-england)
36 491 [information/registered-blind-and-partially-sighted-people--year-ending-31-march-2011-in-](http://www.ic.nhs.uk/statistics-and-data-collections/social-care/adult-social-care-information/registered-blind-and-partially-sighted-people--year-ending-31-march-2011-in-england)
37 492 [england](http://www.ic.nhs.uk/statistics-and-data-collections/social-care/adult-social-care-information/registered-blind-and-partially-sighted-people--year-ending-31-march-2011-in-england)
- 38 493 11. <http://www.avon.nhs.uk/phnet/PHinfo/understanding.htm#Indirect>
- 39 494 12. Diehr P CK, Connell F, Volinn E. What is too much variation? The null hypothesis in
40 495 small-area analysis. *Heath Ser Res*1990;24(6):741–71.
- 41 496 13. Department of Communities and Local Government. The English Indices of Deprivation
42 497 2010. <http://www.communities.gov.uk/publications/corporate/statistics/indices2010>,
43 498 24 March 2011.
- 44 499 14. <http://www.communities.gov.uk/publications/corporate/statistics/indices2010>
45 500
- 46 501 15. [Hacking JM](#), [Muller S](#), [Buchan IE](#). Trends in mortality from 1965 to 2008 across the
47 502 English north-south divide: comparative observational study. *BMJ*. 2011; 15;342
- 48 503 16. Bunce C XW, Wormald R. Causes of blind and partial sight certifications in England and
49 504 Wales: April 2007-March 2008. *Eye* 2010;24(11):1692-9.

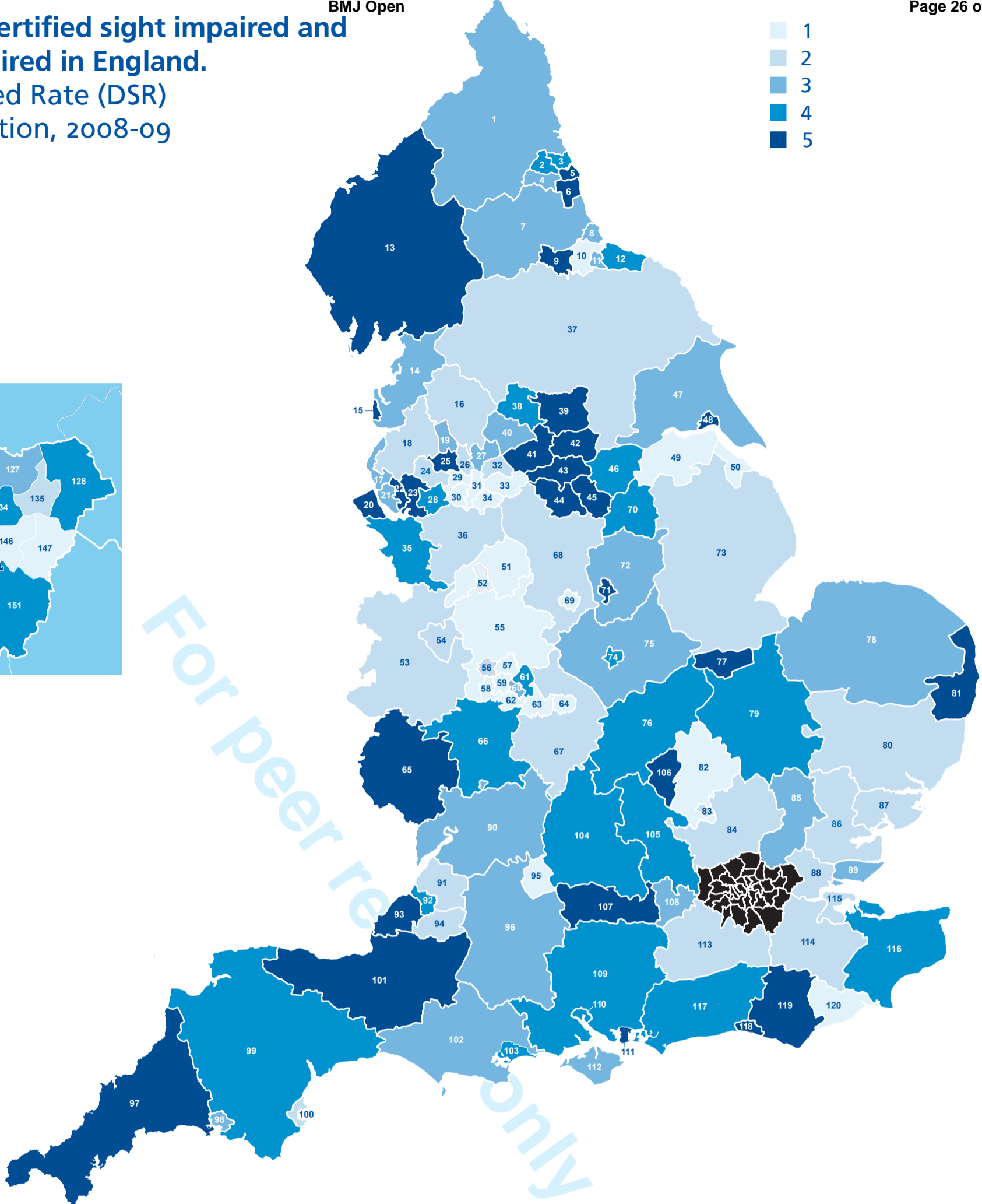
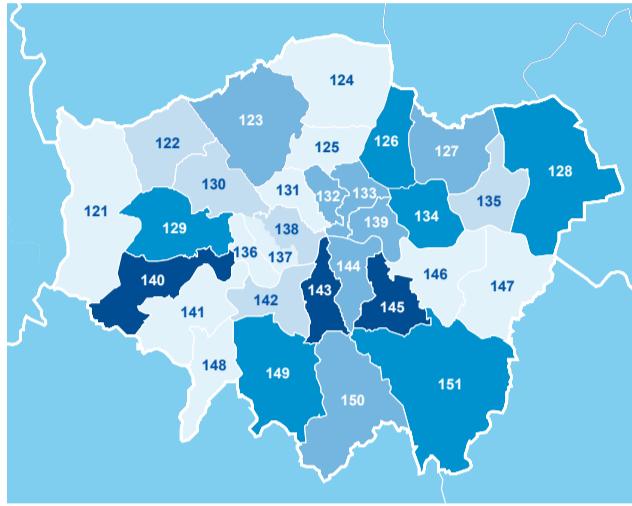
- 1
2
3 505 17. Department of Communities and Local Government. The New Performance Framework
4 506 for Local Authorities and Local Authority Partnerships – A Single Set of National
5 507 Indicators.
6 508 <http://www.communities.gov.uk/publications/localgovernment/nationalindicator>,
7 509 2007.
8
9 510 18. Commission TL. Adult Social Care.
10 511 <http://www.justice.gov.uk/lawcommission/publications/1460.htm>, 11 May 2011.
11 512 19. Royal National Institute of the Blind. An Internal Report: CVI data update
12 513 20. Buch H, Vinding T, La Cour M et al. The prevalence and causes of bilateral and
13 514 unilateral blindness in an elderly urban Danish population. The Copenhagen City Eye
14 515 Study. *Acta Opth Scan* 2001; 79: 441-9
15 516 21. Thylefors B, Negrel AD, Pararajasegaram R et al. Available data on blindness (update
16 517 1994). *Ophth Epidemiol* 1995; 2: 5–39.
17 518 22. Kuper H, Polack S and Limburg H. Rapid assessment of avoidable blindness. *Community*
18 519 *Eye Health* 2006; 19 (60): 68-69
19 520 23. Keenan TD, Yeates D and Goldacre MJ. Uveal melanoma in England: trends over time
20 521 and geographical variation. *Brit J Ophth* 2012; Sep 13 (epub)
21 522 24. Keenan TD, Wotton CJ and Golacre MJ. Trends over time and geographical variation in
22 523 rates of intravitreal injections in England. *Brit J Ophth* 2012; 96 (3):413-8
23 524 25. Keenan T, Rosen P, Yeates D et al. Time trends and geographical variation in cataract
24 525 surgery rates in England: study of surgical workload. *Brit J Ophthal* 2007; 91 (7):
25 526 901-4
26 527
27 528
28 529
29
30
31 530
32
33 531
34
35 532
36
37 533
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

Number of newly certified sight impaired and severely sight impaired in England.

Directly Standardised Rate (DSR) per 100 000 population, 2008-09



London



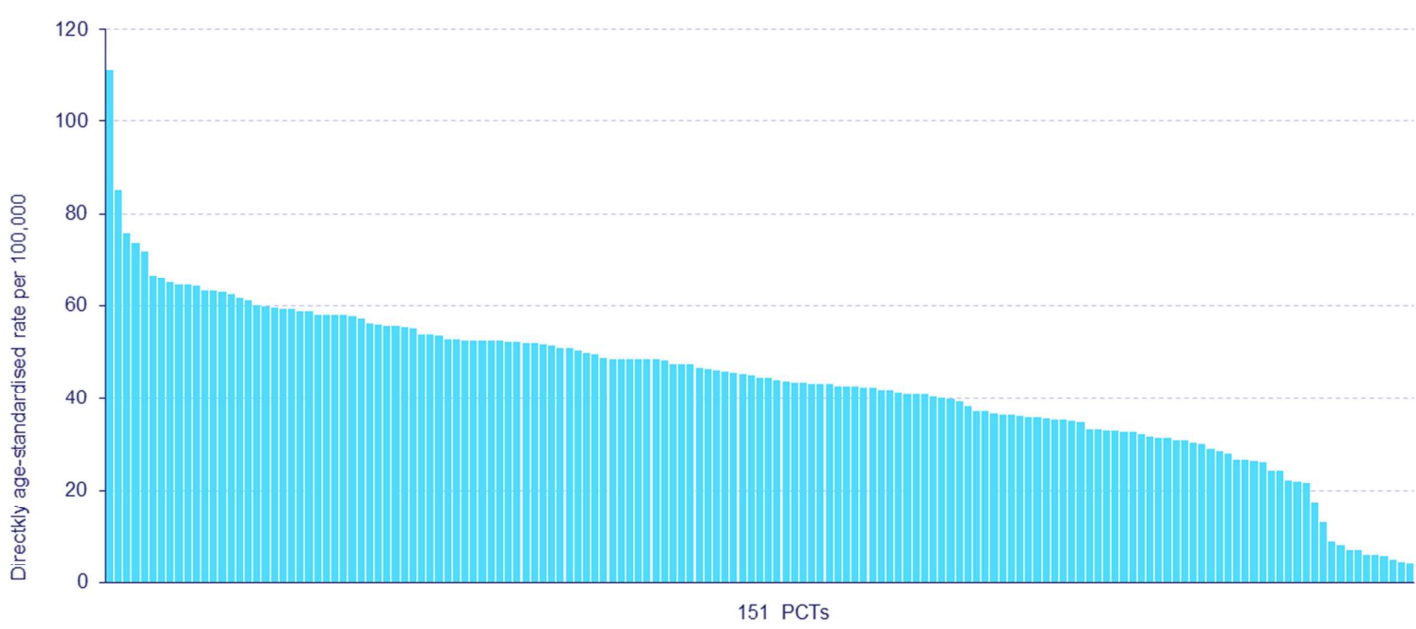
Key

1	Northumberland	42.7	24	Ashton, Leigh & Wigan	33.1	50	North East Lincolnshire	26.5	76	Northamptonshire	55.8	101	Somerset	60.1	126	Waltham Forest	52.1
2	Newcastle	52.4	25	Bolton	57.8	51	North Staffordshire	8.1	77	Peterborough	58.1	102	Dorset	42.7	127	Redbridge	43.1
3	North Tyneside	52.3	26	Bury	41.4	52	Stoke on Trent	4.4	78	Norfolk	48.5	103	Bournemouth & Poole	52.5	128	Havering	52.6
4	Gateshead	46.7	27	Heywood, Middleton & Rochdale	48.3	53	Shropshire County	36.4	79	Cambridgeshire	49.5	104	Oxfordshire	52.3	129	Ealing	49
5	South Tyneside	61.3	28	Warrington	51.9	54	Telford & Wrekin	33.2	80	Suffolk	40.9	105	Buckinghamshire	55.5	130	Brent	40.1
6	Sunderland	63.3	29	Salford	31.1	55	South Staffordshire	13.1	81	Great Yarmouth & Waveney	64.5	106	Milton Keynes	75.6	131	Camden	26.1
7	County Durham	48.6	30	Trafford	6.1	56	Wolverhampton City	35.1	82	Bedfordshire	24.2	107	Berkshire West	58	132	Islington	44.6
8	Hartlepool	43.6	31	Manchester	4.2	57	Walsall	26.7	83	Luton	40	108	Berkshire East	48.5	133	City & Hackney	46.5
9	Darlington	58.7	32	Oldham	39.4	58	Dudley	9.1	84	Hertfordshire	36.5	109	Hampshire	52.3	134	Newham	56.3
10	Stockton-on-Tees	31.7	33	Tameside & Glossop	5.8	59	Sandwell	26.7	85	West Essex	42.7	110	Southampton City	55.7	135	Barking & Dagenham	36.1
11	Middlesbrough	43.5	34	Stockport	5	60	Heart of Birmingham	47.4	86	Mid Essex	33	111	Portsmouth City	71.8	136	Hammersmith & Fulham	28.4
12	Redcar & Cleveland	50.7	35	Western Cheshire	52	61	Birmingham East & North	52	87	North East Essex	33.4	112	Isle of Wight NHS	48.5	137	Kensington & Chelsea	28.5
13	Cumbria	65.1	36	Central & Eastern Cheshire	35.7	62	South Birmingham	17.5	88	South West Essex	40.8	113	Surrey	40.9	138	Westminster	36.3
14	North Lancashire	48.6	37	North Yorkshire & York	35.9	63	Solihull	31.6	89	South East Essex	45.1	114	West Kent	35.3	139	Tower Hamlets	47.5
15	Blackpool	51.5	38	Bradford & Airedale	50.9	64	Coventry	21.9	90	Gloucestershire	42	115	Medway	37.4	140	Hounslow	61.7
16	East Lancashire	41.9	39	Leeds	59.7	65	Herefordshire	57.2	91	South Gloucestershire	34.8	116	Eastern & Coastal Kent	56.3	141	Richmond & Twickenham	22.8
17	Sefton	46.3	40	Calderdale	43.3	66	Worcestershire	51.2	92	Bristol	53.3	117	West Sussex	52.6	142	Wandsworth	38.4
18	Central Lancashire	37.4	41	Kirklees	59.9	67	Warwickshire	35.5	93	North Somerset	58.2	118	Brighton & Hove City	66.7	143	Lambeth	62.4
19	Blackburn with Dawen	48.1	42	Wakefield District	64.2	68	Derbyshire County	40.4	94	Bath & North East Somerset	32.3	119	East Sussex Downs & Weald	58.7	144	Southwark	42.4
20	Wirral	73.7	43	Barnsley	111.2	69	Derby City	31.9	95	Swindon	31	120	Hastings & Rother	7.2	145	Lewisham	59.4
21	Liverpool	43.8	44	Sheffield	59.3	70	Bassetlaw	53.8	96	Wiltshire	43.2				146	Greenwich	27.9
22	Knowsley	64.5	45	Rotherham	85.01	71	Nottingham City	62.9	97	Cornwall & Isles of Scilly	58				147	Bexley Care Trust	31
23	Halton & St. Helens	66	46	Doncaster	55.1	72	Nottinghamshire County	42.3	98	Plymouth	44				148	Kingston	6.2
			47	East Riding & Yorkshire	45.3	73	Lincolnshire	36.8	99	Devon	50.2				149	Sutton & Merton	49.6
			48	Hull	63.4	74	Leicester City	54	100	Torbay	32.8				150	Croydon	44.5
			49	North Lincolnshire	7.2	75	Leicestershire County	45.9							151	Bromley	48.8

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49

Figure 1a (to be included with figure 1)

CVI directly age-standardised rate per 100,000 population by Primary Care Trust, 2008/09



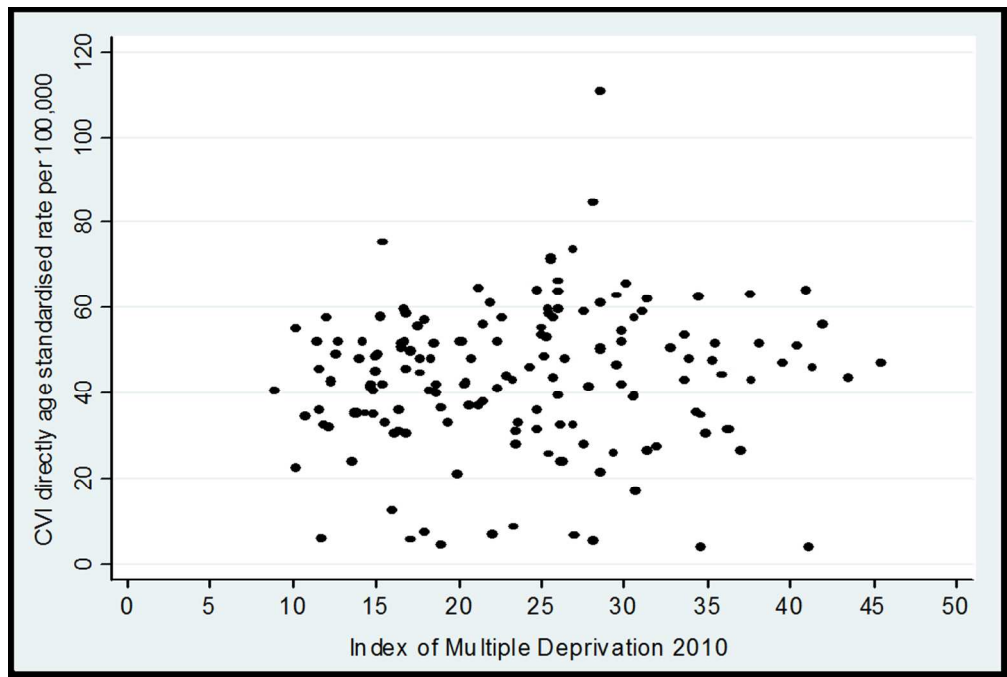


Figure 2: CVI directly age-standardised rate per 100,000 vs Index of Multiple Deprivation 2010 by Primary Care Trust, 2008/9

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

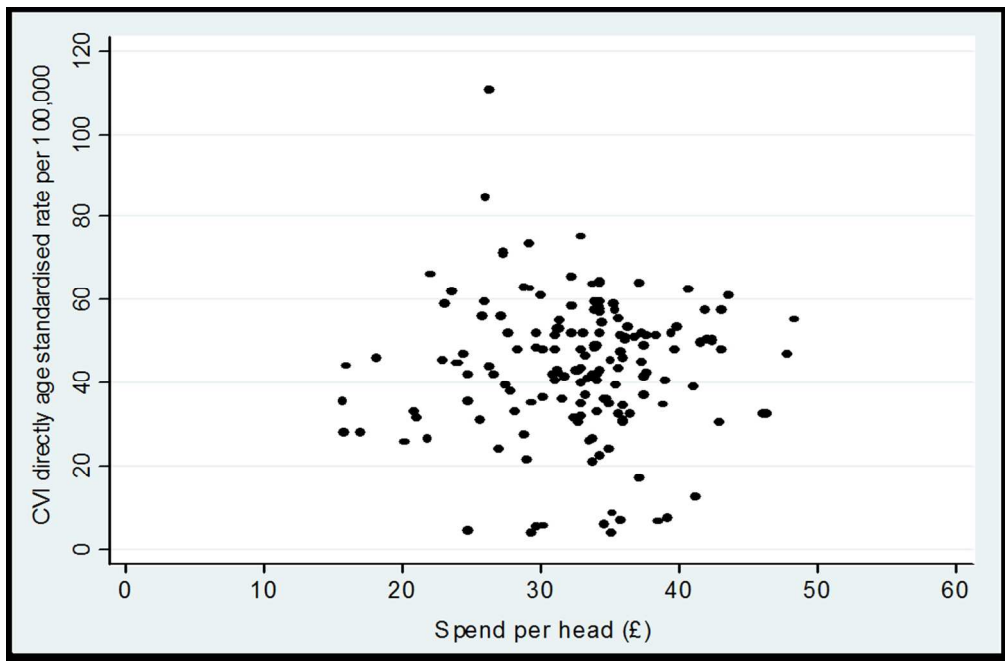
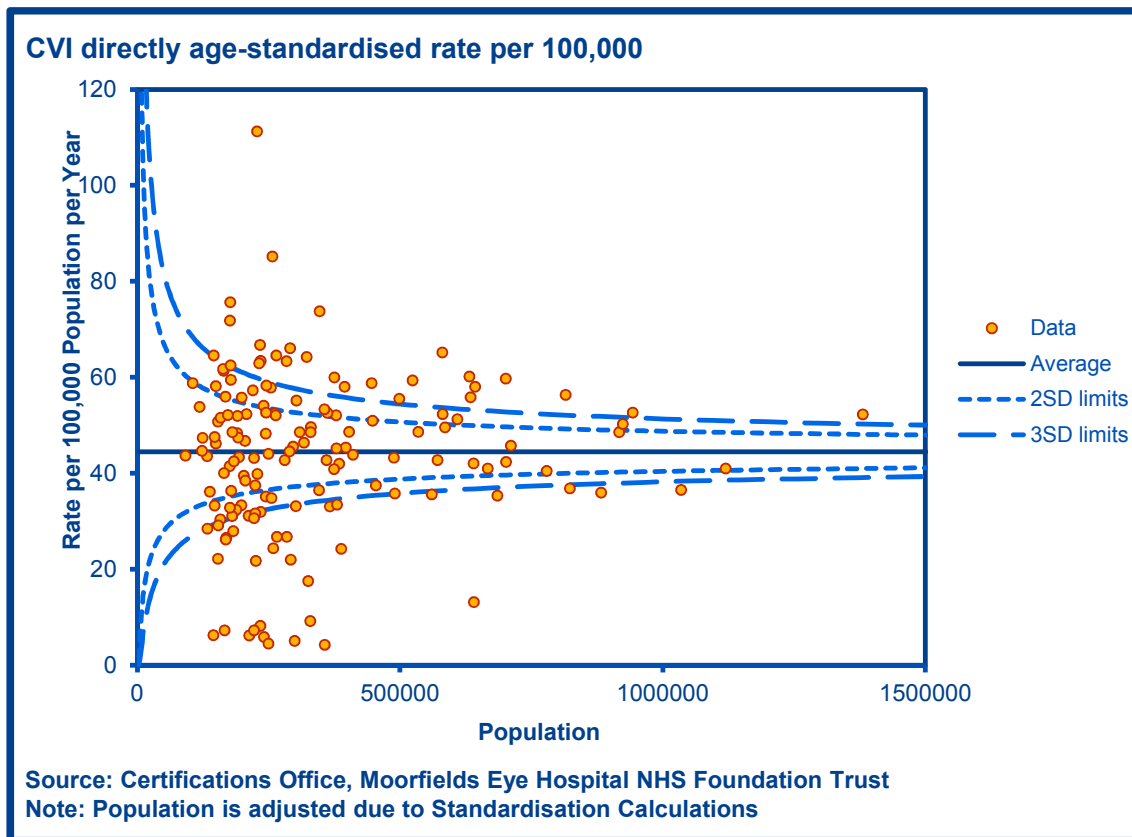


Figure 3: CVI directly age-standardised rate per 100,000 vs Spend per Head by Primary Care Trust, 2008/9

review only



There is high degree of heterogeneity seen in the funnel plot, of 151 PCTs, 27 are above the upper 3 s.d. line and 36 below the lower 3 s.d. line. Another 17 PCTs are between the upper 2 and 3 s.d. lines and 12 between the lower 2 and 3 s.d. lines.

BMJ reviewer comments

Reviewer: Jennifer Evans
Lecturer
London School of Hygiene and Tropical Medicine

I have worked with some of the authors of this paper, in particular Richard Wormald and Catey Bunce, over many years.

Under limitations, I felt that the question of standardisation and control of confounding by age might be one limitation of the analysis. The authors have controlled for age differences between PCTs using direct standardisation. They acknowledge one of the limitations of direct standardisation is that, if the number of events in each age band is low, then it can be subject to sampling error. As a result they have used rather wide age-bands. There may be residual confounding by age, particularly in the older age-groups. This might explain some of the variation. One option would be to repeat the analyses using indirect standardisation and smaller age-bands. If indirect standardisation is not a valid analysis with these data (for example, if the proportionality assumption does not hold) then the possible limitation of residual confounding needs to be more clearly stated and an explanation given as to why indirect standardisation not used.

We chose direct rather than indirect standardisation because we wished to compare PCTs with each other. Indirect standardisation would not allow this.
(<http://www.avon.nhs.uk/phnet/PHinfo/understanding.htm#Indirect>) reference added
Llimitation expanded and clearly stated in discussion

In general the results were well presented but Table 1 and Figure 1 could be made a bit clearer.

Table 1 could benefit from reporting the units i.e. rates per 100,000, spend per head of population (in pounds sterling?). Presumably IMD does not have units but it would be good to put the score in context - perhaps by noting the range of possible scores in a footnote to the table.

Changes to table made in the paper, as suggested.
Footnote and reference added with regard the IMD

In Figure 1 the term "severely sight impaired" is introduced. Is this the same as "blindness" as used elsewhere in the paper?

Yes the 'official' term is severely sight impaired which replaces the word blindness (but has the same definition). Blindness was previously used but since this is a relatively new change to terminology and 'severely sight impaired' is less intuitive to understand as a comparison to sight impairment we have kept the word blindness throughout the text for the sake of clarity for readers, who will mainly not be ophthalmology professionals.

Figure 3 "Cases as a percentage of population" is that the same as what is called elsewhere the "crude rate"? Would it be better to plot the directly standardised rate here? Presumably population is population of the PCT. It would be good to show the units here if possible. Perhaps be a bit clearer in the text as to what "outside the limits" means exactly.

This comments refers to figure 4, not figure3. New funnel plot using directly standardised rate and units added. Comment clarified in paper after figure 4

The discussion is quite wide-ranging and could be improved by being a bit more focussed on the results of the study. Before discussing the limitations of CVI data it may be helpful to discuss the limitations of the analysis, including control of confounding by age. The implications of the variation are discussed in terms of equitable access to services for visually impaired people and use of these data in the Public Health Outcome Framework, but it would be helpful to have more specific suggestions for future research.

Discussion expanded on limitations of study and moved to the first paragraph in the discussion section of the paper. Specific suggestions on future research expanded on lines

1
2
3 **348 in last paragraph, although the main point of the paper is the data needs to be**
4 **improved so that it can be used for further research and analysis. Therefore we have**
5 **deliberately not put in many further suggestions for research.**

6
7 The terminology is quite confusing in this area and it would help to use consistent
8 terminology throughout.

9
10 The "certificate of vision impairment" uses the terms sight impairment and severe sight
11 impairment (replacing the terms previously used which were "partially sighted" and
12 "blind"). The paper mostly uses the terms sight impairment and blindness, which does not
13 correspond to the current CVI terminology. However, the analyses are not done separately
14 for these two categories and it may be simpler just to refer to the incidence of certification
15 (as vision impaired).

16 **We agree the terminology in this area is very confusing, compounded by the fact that it has**
17 **recently changed, and we have tried to keep as clear as possible for non specialist readers.**
18 **We feel it is very important to keep the word 'blindness' in the title as this gives a very clear**
19 **picture of what is being discussed. Replacing the two terms with either 'certification' or**
20 **'vision impaired' (which would also be a new term) and removing 'blindness' altogether**
21 **may mislead readers into thinking it is not significant visual loss, as most people will not**
22 **understand what constitutes vision impaired and its implications for the individual. We**
23 **have not currently changed the terminology as requested but we could change it in the**
24 **paper if requested by the editor but feel strongly the title should not be changed.**

25 The terms registration and certification appear to be used interchangeably in the paper. For
26 example, what this paper adds " There is a large geographical variation in the registration
27 of blindness and sight impairment..." They are not strictly the same thing as registration
28 occurs after certification.

29 **Again we take this point and our reasons are above. However in this case we have changed**
30 **the terminology in the paper to 'certification' for consistency and removed 'registration', as**
31 **requested.**

32 Sometimes the "incidence of blindness and sight impairment" is discussed. In the context
33 of this paper, this needs to be qualified that this is vision impairment eligible for
34 registration, which is not the same thing as incidence of vision impairment per se. Under
35 the terms of the National Assistance Act registration should be offered to people who are
36 permanently visually impaired, and so conditions that are amenable to treatment are not
37 usually counted by this routine data collection system. This is one of the reasons this
38 dataset is so valuable, in my opinion, is that it counts people who have lost their vision and
39 will not benefit from any more treatment. Particularly important to count this for conditions
40 where sight impairment is potentially preventable (such as diabetic retinopathy).

41 **We have added the word 'certified' in front of any references made to incidence of**
42 **blindness and sight impairment. We have already put in detailed explanations as to what**
43 **the definitions are of certified sight impairment as discussed in the paper in both the**
44 **methods (first paragraph) and the discussion (2nd and 3rd paragraphs). This should make it**
45 **very clear to the reader what we are referring to throughout the paper.**

46
47 Reviewer: Tiarnan Keenan, MRCOphth
48 Clinical Research Fellow
49 University of Manchester and Manchester Royal Eye Hospital
50 UK
51 Competing interests - none

52 This manuscript presents important and novel research findings, but requires some
53 redrafting to improve the clarity and presentation. The methodology used was appropriate
54 and well described in the Methods section. However the Results section needs to be
55 expanded to 'tell the story' of the research findings, and the Introduction and Discussion
56 sections need to be more concise and precise.

57 Some particular points:
58
59
60

1
2
3 Key messages – presumably the first message should be the finding of wide geographical
4 variation; these three messages could be more concise
5 Strengths and limitations – these should stand alone, rather than refer to the manuscript
6 Abstract – generally clear but the conclusion needs to be more concise (some of what is
7 written includes introductory statements rather than genuine conclusions drawn from the
8 results); results section – needs more actual data – no rates of blindness are given, e.g.
9 consider giving lowest and highest rates (trimmed rates) and 95% confidence intervals;
10 also ‘rate’ can be ambiguous and needs descriptors for the time period (e.g. annual rate)
11 and the population

12 **Changes made to the text of the paper as suggested above.**

13 Introduction – in general, this is too long and needs to be more concise and focused.
14 Not all references written at the bottom of the article are actually cited in the manuscript.

15 **This has been shortened and references double checked.**

16 Methods section – very clear; the methodology used is appropriate and well explained.
17 CVI data collection – could the authors include a quick indication of what is meant by ‘good
18 rate of compliance’ as this is very important for data validity? (i.e. what percentage, so that
19 readers do not have to look up the reference cited)
20 Converting data to maps – the discussion of quantiles and quintiles and ranges could be
21 shorter and clearer. Is it necessary to discuss quantiles?
22

23 **Have amended as suggested but kept in some information about quantiles as may be
24 unfamiliar to readers**

25 Results section – as mentioned above, this is extremely short and should be lengthened to
26 ‘tell the story’ of the research in a logical and interesting manner.

27 **Have added further explanation in results section**

28 Table 1 legend – ‘CVI rates’ is unclear (e.g. per 100,000 population per year?). Also the
29 Methods section says that 95% confidence intervals were calculated, but these are not
30 given in Table 1 (or elsewhere). Would the authors consider adding an extra figure? – a plot
31 of each PCT’s mean annual DSR of CVI blind certifications (y axis) arranged highest to
32 lowest (x axis), i.e. each PCT as a point with its 95% confidence intervals. This would help
33 give a visual representation of what 11-fold variation looks like, before moving on to the
34 two following figures.
35

36 **Table amended and extra figure which should be included within figure 1 added (attached
37 as separate file called figure 1a)**

38 Figure 1 – ‘directly’? **yes, states this on the map**

39 Figure 2 – ‘The figures illustrate little evidence of any association between the rates and
40 IMD 2010 (correlation coefficients 0.11, p=0.15).’ I would say that there is weakly positive
41 correlation. **Amended**

42 Figure 4 – no legend is given, and the explanation is not very clear. Also the key to the
43 figure does not correspond to the lines used. **Adjusted as per other reviewers comments
44 and clarified**

45 Discussion – in general this needs to be more concise and specific. The paragraphs are
46 extremely long and need to be shortened and refined. There is not a great deal of critical
47 analysis, e.g. what factors may affect patients being referred to and attending the hospital
48 eye service; is there a literature on this? In general, very few references are given; the
49 findings need to be put in the context of existing reports in the literature on UK
50 geographical variation in eye disease. I know from my own group’s research that there are
51 wide variations in (standardised) rates of patients receiving various ophthalmology
52 services by geographical area across the UK (including cataract surgery, corneal grafts,
53 trabeculectomy and intravitreal therapy, and particularly wide for intravitreal therapy).
54 Are there international comparisons?
55
56
57
58
59
60

1
2
3 **The discussion has been shortened and amended to take in the comments above. We have**
4 **included some of the reviewers own papers now, as he has mentioned. They were left out**
5 **before as they were quite different, mainly relying on hospital data and on specific surgical**
6 **procedures. We wanted to concentrate in the discussion on issues of blindness and sight**
7 **impairment and the wider public health issue that this has and its implications. There are**
8 **no international comparisions, as mentioned in the discussion.**

9 Also it may be worth discussing the distinction bewteen incident blindness which is
10 considered preventable versus not preventable. This is alluded to in the article but is an
11 important distinction.

12 **Added**

13 In addition, a formal discussion of the limitations of the research methodology is required
14 (e.g. use of wide age bands for standardisation). **Done**

15
16 'There have been, to our knowledge, no other studies on geographical variation in sight
17 loss conducted' – do the authors mean in the UK? If so, this must be stated. If not, RAAB
18 studies have now been conducted in many countries, and some of these have reported very
19 significant differences in the prevalence of blindness within countries (e.g. Gaza versus
20 West Bank of the Palestinian Territories).

21
22 **We do mean in the UK-clarified in the discussion. We are aware of RAAB studies but these**
23 **have a very different methodology and are not directly comparable to ours but we have**
24 **however added them into the discussion now.**

25 What this paper adds – section 1: 'The number of certifications for blindness and sight
26 impairment have been falling' – no data have been presented on this.

27 **this is what is now reference 16**

28 Large variation - 'This implies both a need to improve consistency in access to certification
29 across the country and investigate further the causes of this variation' – little discussion is
30 presented in the manuscript as to how we might distinguish between genuine regional
31 differences in incident blindness versus artefactual differences in CVI take-up.

32
33 **We would not describe differences in CVI take up as artefactual differences. Higher CVI**
34 **figures may not necessary reflect higher rates of blindness but they do nevertheless reflect**
35 **higher numbers of people being put in touch with social services in those areas because of**
36 **their visual problems. The discussion already includes and analyses the reasons for**
37 **inconsistencies in offering CVI and possibly uptake and this is one of the issues the paper**
38 **and discussion highlights.**

39 In summary, this is an important and novel piece of research, and the methodology used is
40 appropriate to answer the research question. However the clarity of discussion and
41 analysis should be improved for the message to be communicated effectively.
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60



Geographical variation in blindness and sight impairment rates in England, 2008-09: Analysis of national certification data

Journal:	<i>BMJ Open</i>
Manuscript ID:	bmjopen-2012-001496.R2
Article Type:	Research
Date Submitted by the Author:	08-Oct-2012
Complete List of Authors:	Malik, Aeesha; Moorfields Eye Hospital, Bunce, Catey; Moorfields Eye Hospital, Wormald, Richard; Moorfields Eye Hospital, Suleman, Mehrunisha; Department of Health, Stratton, Irene; University of Warwick Clinical Sciences Research Institute, Gray, Muir; Department of Health,
Primary Subject Heading:	Public health
Secondary Subject Heading:	Ophthalmology, Health policy
Keywords:	PUBLIC HEALTH, OPHTHALMOLOGY, Health policy < HEALTH SERVICES ADMINISTRATION & MANAGEMENT

SCHOLARONE™
Manuscripts

1
2
3 **1 Geographical variation in certification rates of blindness and sight impairment in**
4 **2 England, 2008-09**

5 3 Aeesha NJ Malik, Catey Bunce, Richard Wormald, Mehrunisha Suleman, Irene Stratton, J.A.
6 4 Muir Gray.

7 5
8 6 An analysis and report of national certification data

9 7
10 8 Corresponding Author:

11 9
12 10 Miss Aeesha NJ Malik

13 11 Ophthalmology Specialist Registrar

14 12 Work Address: Moorfields Eye Hospital, 162 City Road, London EC1V 2PD

15 13 Correspondance address and contact details: aeshamalik@gmail.com

16 14 2 Elm Walk, London, SW20 9ED

17 15
18 16 Catey Bunce

19 17 Senior Statistician

20 18 Moorfields Eye Hospital, 162 City Road, London EC1V 2PD

21 19
22 20 Mr Richard Wormald

23 21 Consultant Ophthalmologist and Director Cochrane Eyes and Vision Group

24 22 Moorfields Eye Hospital, 162 City Road, London EC1V 2PD

25 23
26 24 Dr Mehrunisha Suleman

27 25 QIPP Right Care Programme, Department of Health

28 26 Summertown Pavilion, 18 - 24 Middle Way, Oxford, OX2 7LG, UK

29 27
30 28 Irene Stratton

31 29 Senior Statistician (Honorary Associate Professor, University of Warwick Clinical Sciences
32 30 Research Institute)

33 31 English National Diabetic Retinopathy Screening Programme

34 32 Cheltenham General Hospital, Sandford Road Cheltenham GL53 7AL

35 33
36 34 Professor Sir Muir Gray

37 35 Co-lead QIPP Right Care Programme, Department of Health

38 36 Summertown Pavilion, 18 - 24 Middle Way, Oxford, OX2 7LG, UK

1
2
3 54 **Article Summary**
4 55

5 56 **Article Focus**

- 6 57 1. To examine and interpret the variation in the incidence of blindness and sight impairment
7 58 in England by PCT, as reported by the Certificate of Vision Impairment (CVI).
8 59 2. To assess whether there was any evidence of association between CVI rates with the index
9 60 of Multiple Deprivation (IMD) and the Programme spend for Vision
10 61

11 62 **Key messages:**

- 12 63 1. There is a wide geographical variation in rates of certification of blindness and sight
13 64 impairment across England
14 65 2. The wide geographical variation we found raises questions both about the quality of the
15 66 data and whether there is genuine unmet need for prevention of sight loss. 3. The certification
16 67 (CVI) data forms the basis of the 'preventable sight loss' indicator in the 'Public Health
17 68 Outcomes Framework' and improving the quality and interpretation of the data will be vital.
18 69

19 70 **Strengths and Limitations of this Study:**

- 20 71 1. A prospectively routinely collected national dataset was used for analysis giving accurate
21 72 data on certification rates across England.
22 73 2. There were relatively small numbers of certifications for each PCT therefore there is a
23 74 possibility of over estimation of the variation.
24 75
25 76
26 77

27 78 **Abstract**
28 79

29 80 **Objectives**

30 81 To examine and interpret the variation in the incidence of blindness and sight impairment in
31 82 England by PCT, as reported by the Certificate of Vision Impairment (CVI).
32 83

33 84 **Design**

34 85 Analysis of national certification data
35 86

36 87 **Setting**

37 88 All Primary Care Trusts, England
38 89

39 90 **Participants**

40 91 23,773 CVI certifications issued from 2008-9
41 92

42 93 **Main Outcome measures**

43 94 Crude and Age standardised rates of CVI data for blindness and sight loss by PCT
44 95

45 96 **Methods**

46 97 The crude and age standardised CVI rates per 100,000 were calculated with Spearman's rank
47 98 correlation used to assess whether there was any evidence of association between CVI rates
48 99 with IMD and the Programme spend for Vision.
49 100

50 101 **Results**

51 102 There was high level variation, almost 11 fold (Coefficient of Variation 38%) in standardised
52 103 CVI blindness and sight impairment annual certification rates across PCTs. The mean rate
53 54
55 56
57 58
59 60

1
2
3 104 was 43.7 and the standard deviation 16.7. We found little evidence of an association between
4 105 the rate of blindness and sight impairment with either the IMD or Programme Spend on
5 106 Vision.
6 107

7 108 **Conclusions**

8 109
9 110 The wide geographical variation we found raises questions both about the quality of the data
10 111 and whether there is genuine unmet need for prevention of sight loss. It is a concern for
11 112 public health practitioners who will be interpreting this data locally and nationally as the CVI
12 113 data will form the basis of the public health indicator 'preventable sight loss'. Poor quality
13 114 data and inadequate interpretation will only create confusion if not addressed adequately from
14 115 the outset. There is an urgent need to address the shortcomings of the current data collection
15 116 system and to educate all public health practitioners.
16
17

18 117 Word Count 259
19

20 118

21 119
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

120 Introduction

121 Eye care services have traditionally not featured highly in national health policy or the public
122 health agenda. In the UK there has been no Department of Health led eye care services
123 strategy and there is no mention of eye health in the recent NHS or Public Health White
124 papers.^{1,2} The UK however does have a Vision Strategy produced by a collaboration of Eye
125 care organisations, professionals and patients in response to the World Health Assembly
126 Resolution of 2003. This resolution urged the development and implementation of national
127 plans to tackle sight impairment, to which the UK government pledges its support.³ VISION
128 2020 was launched by the World Health Organization (WHO) and the International Agency
129 for the Prevention of Blindness (IAPB) in order to bring together governments, eye care
130 professionals and patients to work towards the global goal to eliminate avoidable blindness
131 by the year 2020.⁴

132 However this year the new Public Health Outcomes Framework has included an indicator for
133 preventable sight loss, constituting a major step forward for the recognition of eye health on
134 the public health agenda.⁵ This indicator will be based upon the Certificate of Vision
135 Impairment (CVI) – this being the only routinely collected national measure of blindness and
136 sight impairment.

137 The NHS Atlas of Variation has highlighted the variations in healthcare activity, expenditure,
138 quality and outcomes in the UK.⁶ This brought to attention the need to address unwarranted
139 variation, focussing on the appropriateness of the clinical services and their outcomes. The
140 most recent edition of the Atlas published last year included the rate of sight impairment and
141 blindness due to diabetes (as measured by CVI), which showed a high level of variation (8
142 fold), and raised concerns, particularly as there is a diabetic eye screening programme already
143 in place. With an aging population and rising incidence of diabetes the prevalence of sight
144 loss has also been predicted to increase significantly over the next decade.^{7,8} The total costs
145 of sight loss in the UK were estimated at £6.5 billion in 2008 with £40 million per million
146 population being spent on eye care services last year in England.⁹ With rising costs from
147 expensive medications for Age Related Macular Degeneration (AMD) and other diseases
148 there will be huge pressures on the eye care budget in the coming years. The adoption of an
149 indicator for preventable sight loss will be a vital part of monitoring eye care outcomes.
150 However public health practitioners will need to know that the quality of the data is adequate
151 and how to interpret the CVI rates. In this paper we examine, for the first time, the
152 geographical variation of blindness and sight impairment, as measured by the CVI.

153 Methods

154 CVI data collection

155 The CVI form is discussed in the hospital clinic with patients who are eligible and is
156 completed with patient consent by a consultant ophthalmologist. Currently, a paper version is
157 completed which is sent to the local authority social services who use this to update their
158 visual impairment register. Every three years, the Social Service departments complete an
159 annual return which is sent to the Information Centre (IC) for health and social services
160 reporting the number of new registrations and the total number of registrations in their
161 register. This return is mandatory. Another copy of the CVI form is sent to the Certifications
162 Office, Moorfields Eye Hospital NHS Foundation Trust for epidemiological analysis. This
163 return is voluntary but there is a good rate of compliance (correlation coefficient 0.9 between
164 the number of certifications and the number of registrations by unitary authority).¹⁰ Data held

1
2
3 165 by the Certifications Office has more detailed information on the causes of registration and
4 166 allows incidence data calculation. For this study the data from the 2008/9 CVI forms
5 167 collected by the Certifications Office was used.

7 168 Calculation

9 169 Two rates were used for the analysis, the crude rate and the directly standardised rate (DSR).
10 170 The crude rate is the number of CVI forms divided by the population of that PCT. The DSR
11 171 was determined using age specific CVI rates with Office of National Statistics (ONS) 2008
12 172 figures by PCT. The standard population was that for England 2008 mid year population.
13 173 The standard deviation and coefficient of variation were then calculated.

14
15
16 174 Standardisation was used as a means of ensuring that any differences seen between PCT
17 175 populations were not as a result of differing age structures. As the numbers of CVI forms in
18 176 each PCT were relatively small, standardisation was conducted using three age bands (0-15,
19 177 16-64 and 65 plus). We chose direct rather than indirect standardisation because we wished to
20 178 compare PCTs with each other and indirect standardisation would not have allowed this.¹¹

21
22 179 The coefficient of variation is calculated by dividing the standard deviation of the rates by the
23 180 mean rate.¹² As it is relatively insensitive to population size, it provides a more powerful
24 181 measure of variation than the standard deviation when there are variable population sizes in
25 182 the data set. One disadvantage is that it may overestimate the amount of variation if rates are
26 183 low or if it is applied to small populations.

27
28
29 184 To eliminate the possibility of artefact from outliers in the data sets, the degree of variation
30 185 was calculated as the range within the data after exclusion of the five PCTs with the highest
31 186 and the five with the lowest values. Fold variation was determined as the upper limit of the
32 187 trimmed range divided by the lower limit of the trimmed range.

33
34 188 A funnel plot was constructed to examine whether or not the rate of certification was related
35 189 to the size of the population and to examine whether there was a relationship between the
36 190 estimate size and the precision of that estimate.

37 38 39 191 Comparison with Index of Multiple Deprivation (IMD)

40
41 192 The Indices of Deprivation (ID) is a measure of social deprivation prepared by the
42 193 Department of Communities and local Government (DCLG). The English Indices of
43 194 Deprivation measures relative levels of deprivation in small areas of England.¹³The English
44 195 ID2010 use 38 separate indicators, organised across seven distinct domains of deprivation,
45 196 including income, employment and health. The latter can be combined, using appropriate
46 197 weights, to calculate the Index of Multiple Deprivation 2010 (IMD 2010). The IMD is used
47 198 to help decide the allocation of resources to PCTs. Scatter plots of the CVI rates with the
48 199 index of multiple of deprivation were drawn and correlation coefficients calculated.

50 200 Comparison with Spend on Vision

51 201
52
53 202 In the UK each PCT receives its healthcare budget allocated by programme area. There are
54 203 23 main programmes, broadly corresponding to the chapters in the WHO ICD-10 e.g.
55 204 Cancers and tumours, Mental Health Disorders. The eye care services budget comes under
56 205 the Vision programme budget. This includes NHS sight tests as well as all primary care
57 206 prescribing, community services, inpatients and outpatients expenditure. Scatter plots of CVI

207 rates against spend on vision were examined and correlation coefficients calculated to assess
 208 whether there was any evidence of association between spend versus CVI blindness and sight
 209 impairment rates.

210 Converting Data to Maps

211 The data is shown as a map of England with London shown as an inset on the PCT maps so
 212 that the details of the small areas are not lost. The PCTs have been grouped into ranges to
 213 allow comparison of areas on the map with ease. The method used to group the data into
 214 ranges is quantiling. Quantile's build ranges (in this case five were chosen) to display the
 215 distribution of the variable. This is calculated by ranking the data values from highest to
 216 lowest and then splitting the values into five ranges, which do not necessarily contain equal
 217 numbers. The ranges are from the lowest value (light blue) to the highest (dark blue). The
 218 map was produced in Adobe Illustrator.

219 **Results**

220
 221 There were 23,773 CVI certifications for 2008/9 in England. Table 1 summarises the degree
 222 of variation, standard deviation and co-efficient of variation. It shows that after
 223 standardisation there is approximately an 11-fold variation in the number of CVIs. A
 224 coefficient of variation of 0.38 or 38% indicates marked variation in CVI registration.

225 **Table 1: Summary of CVI certifications with the mean, standard deviation, coefficient**
 226 **of variation and degree of variation**

	Mean	Standard deviation	Coefficient of variation	Fold Variation
CVI Crude Rate (per 100,000 population)	42.97	18.10	0.42	12.47
CVI Directly Standardised Rate (per 100,000 population)	43.69	16.69	0.38	10.79
Programme Spend (in pounds sterling) on Vision (per head of population)	32.55	6.16	0.19	2.13
Index of Multiple Deprivation*	23.63	8.40	0.36	3.67

227 ***In 2010 IMD scores ranged from 1.4- 87.8¹⁴**

228 **Figure 1 and 1a:** Map and Bar Graph of Geographical Variation of in blindness and sight
 229 impairment rates in England

230 Figure 1 and 1a shows the directly standardised rates of sight impaired and blindness per
 231 100,000 in England, in 2008-09 in the form of a map, as detailed in the methods. The map
 232 illustrates a fairly uniform distribution of variation, although there is a cluster of relatively
 233 low CVI registration in the West of England. This would require further study including a
 234 time trend to explore whether this is a repeating trend over 5 to 10 years. There is otherwise
 235 very little evidence of a geographical explanation for the variation such as a "north-south
 236 divide".¹⁵

237

238 **Figure 2:** CVI directly age-standardised rate per 100,000 vs Index of Multiple Deprivation
 239 2010 by Primary Care Trust, 2008/9

240

241 Figure 2 displays the CVI standardised rates per 100,000 versus the IMD 2010 by PCT. The
242 figures illustrate a very weak association between the CVI rates and IMD 2010. (correlation
243 coefficients 0.11, $p=0.15$). It is therefore unlikely that deprivation is the only cause for the 11
244 fold variation seen in CVI registration rates.

245

246 **Figure 3:** CVI directly age-standardised rate per 100,000 vs Spend (in pounds sterling) per
247 Head by Primary Care Trust, 2008/9

248 Figure 3 displays the CVI standardised rates per 100,000 versus the spend per head by PCT.
249 Again, there is little evidence of any association seen (correlation coefficient 0.0329, $p=0.69$)
250 and therefore spend per head is unlikely to account for the variation observed in CVI rates.

251 **Figure 4**

252 There is high degree of heterogeneity seen in the funnel plot of 151 PCTs, with twenty seven
253 being above the upper three SD line and thirty six below. Another 17 PCTs are between the
254 upper two and three SD lines and 12 between the lower two and three SD lines. This is likely
255 to be both due to real differences between PCTs but also unmeasured covariates that alone
256 impact by small amounts but together impact greatly.

257 **Discussion**

258 The certification rates of blindness and sight impairment differ widely amongst PCTs with an
259 11 fold difference between the highest and lowest rate. There is little association seen with
260 the Index of Deprivation or Spend on Vision. The limitations of the study included the
261 relatively smaller numbers of CVI data for each PCT so that the coefficient of variation may
262 have overestimated the level of variation.¹¹ Increasing the local areas to larger geographical
263 areas of England may improve the accuracy, though such a measure would be less relevant to
264 commissioners and healthcare professionals. Residual confounding by age may remain a
265 limitation as we had to use relatively large age bands again due to the relatively smaller
266 number of events in each age band.

267

268 Despite these limitations this is a high level of variation and understanding the data collection
269 is important. The completion of a CVI form requires a consultant ophthalmologist to offer
270 certification to a patient who is attending a hospital eye clinic and the patient to accept that
271 offer. Therefore there are a number of factors which can influence both the offering and
272 acceptance of the certification and it is difficult to distinguish these other than through direct
273 audits. The certification process is also limited by the fact that it takes place mostly in the
274 hospital setting by a consultant, as there may be many more patients in the community who
275 may be eligible but are not offered it. The magnitude of variation raises questions about the
276 consistency of this process around the country and the variation in how many eligible people
277 are offered certification.

278 It is recognised that the reported numbers of CVI registrations of blindness and sight
279 impairment have decreased significantly in the last 10 years, at a time when, for demographic
280 reasons, they should be increasing.¹⁶ The reasons for this are not entirely clear but they may

281 also contribute to the variation across the country. There are a number of possible factors.
282 The number of blind people in England has been counted since 1851. The decrease in
283 certification rates has coincided with the introduction of the new CVI form to replace the
284 previous BD8 form. It has been expressed that the new form is more complex to complete.
285 The new form was intended to be accompanied by a change in culture where it is now an
286 indication that the person may benefit from the support and rehabilitation in the community,
287 rather than be an indication that ‘nothing more can be done’. This was supposed to trigger
288 increased certification being offered, which may be done more in certain areas or by
289 certain individuals than by others. The change in form was also accompanied by a change in
290 the payment system, from ophthalmologists being automatically entitled to a fee to the
291 entitlement for fee being variable depending on whether a consultant is on a new contract or
292 old or if it is seen as an additional examination.

293 The sustainability of CVI data collection and analysis has also been in question since 2007.
294 First, it was not included in the National Indicator Set, which lists those data collections that
295 would remain mandatory for local authorities.¹⁷ Then an NHS information centre review
296 concluded that the collection of the data should cease. Support by eye care professionals for
297 the data collection led to a further government review, which concluded the data collection
298 was essential but that the system needed improvement. These conclusions were further
299 supported by a Law Commission’s report, published in May 2011.¹⁸ These issues have
300 slowed progress in improving and updating the process of data collection including the
301 development of an electronic collection system. Continuing uncertainty may have affected
302 the quality of data collection. Certainly, the data collection could be improved by
303 streamlining and adopting an electronic version which auto-populates demographic
304 information by linking to local Electronic Patient Record system (EPRs). Raising
305 understanding of CVI figures is also of merit – a CVI for diabetic eye disease means that a
306 patient has lost sight due to a preventable eye condition. The distinction between
307 ‘preventable’ and ‘not preventable’ blindness is important. Blindness due to diabetes,
308 glaucoma and cataract is considered preventable or treatable if diagnosed in a timely manner.
309 Similarly AMD now also has effective treatments which can halt or improve sight loss, hence
310 its inclusion with glaucoma and diabetes in the Public Health Outcome framework
311 ‘preventable sight loss’ indicator. Hospitals should be encouraged to examine their own CVI
312 figures to ensure that all that could have been done was done and regular audits could be
313 conducted to ensure that patients who are eligible for certification are offered a CVI. An
314 analysis of one London PCT found significantly higher levels of certification due to
315 glaucoma and diabetic retinopathy, both preventable causes of blindness.¹⁹

316 There have been, to our knowledge, no other studies on geographical variation in sight loss
317 conducted in the UK. Reliable collection of national data on sight loss is an issue throughout
318 developed as well as developing countries. In a Danish population based study of prevalence
319 and causes of blindness they noted there was no accurate and up-to-date data for Denmark,
320 therefore they conducted their own population cross-sectional survey for Copenhagen.²⁰ The
321 figures used in the WHO database for Europe are based in some cases on data collection from
322 over 15 years ago.²¹ Population based surveys, often focussed exclusively on the elderly,
323 have been done in many European countries but these types of surveys have their own
324 limitations.²¹ Rapid assessment of avoidable blindness (RAAB) has been developed to allow
325 a simple and rapid survey methodology that can provide data on prevalence and causes of
326 blindness.²² This has proved extremely successful in developing country settings and many
327 have been conducted globally. However the methodology differs to our study and they do not
328 specifically look for geographical variation within countries although this may sometimes be

329 implicated in some results. Geographical variation has been studied in the UK with regard to
330 mainly surgical rates, including cataract surgery, intravitreal injections and more recently
331 uveal melanoma.^{23,24,25} In some areas where available it may be interesting to compare these
332 hospital based data with the rate of blindness and sight impairment certification. This lack of
333 comparable data highlights the importance of the work being done in the UK with this routine
334 data collection on sight loss and its causes, and serves as an example for other countries

335 The inclusion of the public health indicator of ‘preventable sight loss’ in the Public Health
336 Outcome Framework is a landmark decision in the inclusion of eye health into the wider
337 public health agenda. However this highlights the importance of improving the quality of
338 this important data collection, if it is to be used to monitor the number of people with
339 preventable sight loss. Our results show that there is a wide level of variation between PCTs
340 and it is likely that much of this is due to factors including variation in levels of offering of
341 certification, care pathways, perceived value of certification and payment for CVI forms. It is
342 vital that these are now addressed with a more streamlined process, and locally and nationally
343 awareness is raised in the importance of the data. The analysis of the number of people losing
344 sight due to conditions which may be preventable is vital. There is an additional need for
345 accurate data to see whether the introduction of new (and costly) interventions for diseases
346 (such as Lucentis for Age related Macular Degeneration and possibly Diabetic Macular
347 Oedema) are reducing sight loss nationally. Further research on the causes of sight
348 impairment amongst those certified and its variation will be important as well as the
349 comparison of rates with other eye health care indicators. Variation of sight loss certification
350 is a concern if patients are not gaining access to social service support. It is vital for those
351 who plan and manage services to determine if there is more that can be done to improve
352 services to prevent avoidable sight loss and improve eye health outcomes.

353 **Word Count 3051**

354 **What this paper adds**

355 **section 1:**

- 356 • The number of certifications for blindness and sight impairment have been falling,
357 despite estimates due to demographic changes of rising rates.
- 358 • There has been no previous study looking at the geographical variation in blindness
359 and sight impairment rates.

360 **section 2:**

- 361 • There is a large geographical variation in the registration of blindness and sight
362 impairment in England
- 363 • This implies both a need to improve consistency in access to certification across the
364 country and investigate further the causes of this variation, particularly as this will
365 now be used to as an outcome in the Public Health Outcomes Framework

366

367 The Corresponding Author has the right to grant on behalf of all authors and does grant on
368 behalf of all authors, an exclusive licence (or non exclusive for government employees) on a
369 worldwide basis to the BMJ Publishing Group Ltd to permit this article (if accepted) to be

1
2
3 370 published in BMJ editions and any other BMJ PGL products and sublicences such use and
4 371 exploit all subsidiary rights, as set out in our licence.

5
6 372 All authors have completed the Unified Competing Interest form at
7 373 www.icmje.org/coi_disclosure.pdf (available on request from the corresponding author) and
8 374 declare that (1) No authors have support for the submitted work; (2) No authors have
9 375 relationships that might have an interest in the submitted work in the previous 3 years; (3)
10 376 their spouses, partners, or children have no financial relationships that may be relevant to the
11 377 submitted work; and (4) No authors have non-financial interests that may be relevant to the
12 378 submitted work.”

13
14
15 379 **Acknowledgements:**

16
17 380 We would like to acknowledge the Royal College of Ophthalmologists, Royal National
18 381 Institute of the Blind and Guide Dogs for the Blind for their help in making this data
19 382 available.

20
21 383 The CVI data are copyright of the Department of Health. However any views expressed in
22 384 the publication are those of the author(s) alone and are not necessarily those of the
23 385 Department of Health.

24
25 386 **Details of contributors:**

26
27 387 Aeesha NJ Malik (guarantor): conception, design, analysis and interpretation of data, drafting
28 388 original article, revision and final approval

29
30 389 Catey Bunce: analysis and interpretation of data, revision of article and final approval

31
32 390 Richard Wormald (guarantor): revision of article and final approval

33
34 391 Mehrunisha Suleman: interpretation of data, revision of article and final approval

35
36 392 Irene Stratton: analysis and interpretation of data, revision of article and final approval

37
38 393 Muir Gray: revision of article and final approval

39
40 394 **Ethical Approval:** not required

41
42 395 **Sources of Funding:** none

43
44 396 **All researchers were independent from funders**

45
46 397 **All authors had full access to all of the data (including statistical reports and tables) in**
47 398 **the study and can take responsibility for the integrity of the data and the accuracy of**
48 399 **the data analysis**

49
50 400

51
52 401 **References**

53
54 402 1. Dept of Health. Healthy lives, healthy people: our strategy for public health in England.
55 403 <http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAn>

- 1
2
3 404 dGuidance/DH_121941, 30 November 2010.2. Dept of Health. Equity and excellence:
4 405 Liberating the NHS.
5 406 <http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAnd>
6 407 dGuidance/DH_117353. 12 July 2010
- 7 408 3. World Health Organization. WHA 56.26 Elimination of avoidable blindness.
8 409 http://www.who.int/pbd/publications/wha_eb/en/, 28 May 2003.
- 9 410 4. A VISION 2020 UK initiative. UK Vision Strategy: Setting the direction for eye health
10 411 and sight loss services.
11 412 [http://www.vision2020uk.org.uk/UKVisionstrategy/page.asp?section=32§ionTitl](http://www.vision2020uk.org.uk/UKVisionstrategy/page.asp?section=32§ionTitle=About+the+Strategy#Download%20the%20UK%20Vision%20Strategy)
12 413 <e=About+the+Strategy#Download%20the%20UK%20Vision%20Strategy>, April
13 414 2008.
- 14 415 5. Dept of Health. Healthy Lives, Healthy People: transparency in outcomes, proposals for a
15 416 public health outcomes framework.
16 417 http://www.dh.gov.uk/en/Consultations/Liveconsultations/DH_122962, 20 December
17 418 2010.6. QIPP Right Care programme. Gray M, Da Silva P (ed). The NHS Atlas of
18 419 Variation in Healthcare. Reducing unwarranted variation to increase value and
19 420 improve quality. <http://www.rightcare.nhs.uk/atlas/> 2010.
- 20 421 7. Evans JR, Fletcher AE, Wormald RPL et al. Prevalence of visual impairment in people
21 422 aged 75 years and older in Britain: results from the MRC trial of assessment and
22 423 management of older people in the community. *Brit J of Opth* 2001;86(7):795-800.
- 23 424 8. Economics A. Future Sight Loss UK 1: Economic Impact of Partial Sight and Blindness in
24 425 the UK adult population.
25 426 <http://www.rnib.org.uk/aboutus/Research/reports/prevention/Pages/fsluk1.aspx>:
26 427 RNIB. , 2009. .
- 27 428 9. Minassian D and Reidy A. Future Sight Loss UK 2: An epidemiological and economic
28 429 model for sight loss in the decade 2010-2020.
29 430 <http://www.rnib.org.uk/aboutus/Research/reports/prevention/Pages/fsluk2.aspx>
30 431
- 31 432 10. The NHS Information Centre, Adult Social Care Team. Registered Blind and Partially
32 433 Sighted People Year ending 31 March 2011, England. 1st September 2011.
33 434 [http://www.ic.nhs.uk/statistics-and-data-collections/social-care/adult-social-care-](http://www.ic.nhs.uk/statistics-and-data-collections/social-care/adult-social-care-information/registered-blind-and-partially-sighted-people--year-ending-31-march-2011-in-england)
34 435 [information/registered-blind-and-partially-sighted-people--year-ending-31-march-2011-in-](information/registered-blind-and-partially-sighted-people--year-ending-31-march-2011-in-england)
35 436 <england>
- 36 437 11. Eayres D, Association of Public Health Observatories, 2008. Technical Briefing 3:
37 438 Commonly used public health statistics and their confidence intervals.
- 38 439 12. Diehr P CK, Connell F, Volinn E. What is too much variation? The null hypothesis in
39 440 small-area analysis. *Heath Ser Res*1990;24(6):741-71.
- 40 441 13. Department of Communities and Local Government. The English Indices of Deprivation
41 442 2010. <http://www.communities.gov.uk/publications/corporate/statistics/indices2010>,
42 443 24 March 2011.
- 43 444 14. <http://www.communities.gov.uk/publications/corporate/statistics/indices2010>
44 445
- 45 446 15. [Hacking JM](#), [Muller S](#), [Buchan IE](#). Trends in mortality from 1965 to 2008 across the
46 447 English north-south divide: comparative observational study. *BMJ*. 2011; 15;342
- 47 448 16. Bunce C XW, Wormald R. Causes of blind and partial sight certifications in England and
48 449 Wales: April 2007-March 2008. *Eye* 2010;24(11):1692-9.

- 1
2
3 450 17. Department of Communities and Local Government. The New Performance Framework
4 451 for Local Authorities and Local Authority Partnerships – A Single Set of National
5 452 Indicators.
6 453 <http://www.communities.gov.uk/publications/localgovernment/nationalindicator>,
7 454 2007.
8
9 455 18. Commission TL. Adult Social Care.
10 456 <http://www.justice.gov.uk/lawcommission/publications/1460.htm>, 11 May 2011.
11 457 19. Royal National Institute of the Blind. An Internal Report: CVI data update
12 458 20. Buch H, Vinding T, La Cour M et al. The prevalence and causes of bilateral and
13 459 unilateral blindness in an elderly urban Danish population. The Copenhagen City Eye
14 460 Study. *Acta Opth Scan* 2001; 79: 441-9
15 461 21. Thylefors B, Negrel AD, Pararajasegaram R et al. Available data on blindness (update
16 462 1994). *Ophth Epidemiol* 1995; 2: 5–39.
17 463 22. Kuper H, Polack S and Limburg H. Rapid assessment of avoidable blindness. *Community*
18 464 *Eye Health* 2006; 19 (60): 68-69
19 465 23. Keenan TD, Yeates D and Goldacre MJ. Uveal melanoma in England: trends over time
20 466 and geographical variation. *Brit J Ophth* 2012; Sep 13 (epub)
21 467 24. Keenan TD, Wotton CJ and Golacre MJ. Trends over time and geographical variation in
22 468 rates of intravitreal injections in England. *Brit J Ophth* 2012; 96 (3):413-8
23 469 25. Keenan T, Rosen P, Yeates D et al. Time trends and geographical variation in cataract
24 470 surgery rates in England: study of surgical workload. *Brit J Ophthal* 2007; 91 (7):
25 471 901-4
26
27
28
29
30
31
32 475
33
34 476
35
36 477
37
38 478
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3 | **Geographical variation in certification rates of blindness and sight impairment ~~rates~~ in**
4 | **England, 2008-09**

5 | Aeesha NJ Malik, Catey Bunce, Richard Wormald, Mehrunisha Suleman, Irene Stratton, J.A.
6 | Muir Gray.

7 |
8 |
9 | 6 | An analysis and report of national certification register data

10 |
11 | 8 | Corresponding Author:

12 | 9 |
13 | 10 | Miss Aeesha NJ Malik

14 | 11 | Ophthalmology Specialist Registrar

15 | 12 | Work Address: Moorfields Eye Hospital, 162 City Road, London EC1V 2PD

16 | 13 | Correspondance address and contact details: aeshamalik@gmail.com

17 | 14 | 2 Elm Walk, London, SW20 9ED

18 | 15 |
19 | 16 | Catey Bunce

20 | 17 | Senior Statistician

21 | 18 | Moorfields Eye Hospital, 162 City Road, London EC1V 2PD

22 | 19 |
23 | 20 | Mr Richard Wormald

24 | 21 | Consultant Ophthalmologist and Director Cochrane Eyes and Vision Group

25 | 22 | Moorfields Eye Hospital, 162 City Road, London EC1V 2PD

26 | 23 |
27 | 24 | Dr Mehrunisha Suleman

28 | 25 | QIPP Right Care Programme, Department of Health

29 | 26 | Summertown Pavilion, 18 - 24 Middle Way, Oxford, OX2 7LG, UK

30 | 27 |
31 | 28 | Irene Stratton

32 | 29 | Senior Statistician (Honorary Associate Professor, University of Warwick Clinical Sciences
33 | 30 | Research Institute)

34 | 31 | English National Diabetic Retinopathy Screening Programme

35 | 32 | Cheltenham General Hospital, Sandford Road Cheltenham GL53 7AL

36 | 33 |
37 | 34 | Professor Sir Muir Gray

38 | 35 | Co-lead QIPP Right Care Programme, Department of Health

39 | 36 | Summertown Pavilion, 18 - 24 Middle Way, Oxford, OX2 7LG, UK

54 Article Summary

56 Article Focus

- 57 1. To examine and ~~interpret~~interpret the variation in the incidence of blindness and sight
- 58 impairment in England by PCT, as reported by the Certificate of ~~Visual~~Visual Impairment
- 59 (CVI).
- 60 2. To assess whether there was any evidence of association between CVI rates with the index
- 61 of Multiple Deprivation (IMD) and the Programme spend for Vision

63 Key messages:

- 64 1. There is a wide geographical variation in ~~certified rates~~rates of certification of blindness
- 65 and sight impairment across England
- 66 2. The wide geographical variation we found raises questions both about the quality of the
- 67 data and whether there is genuine unmet need for prevention of sight loss.
- 68
- 69 3. The certification (CVI) data forms the basis of the ‘preventable sight loss’ indicator in the
- 70 ‘Public Health Outcomes Framework’ and improving the quality and interpretation of the
- 71 data will be vital.

73 Strengths and Limitations of this Study:

- 74 1. A prospective routinely collected national dataset was used for analysis giving accurate
- 75 data on certification rates across England.
- 76 2. There was relatively small numbers of certification for each PCT therefore there is a
- 77 possibility of over estimation of the variation.

81 Abstract

83 Objectives

84 To examine and ~~interpret~~interpret the variation in the incidence of blindness and sight
85 impairment in England by PCT, as reported by the Certificate of ~~Visual~~Visual Impairment
86 (CVI).

88 Design

89 Analysis of national certification data

91 Setting

92 All Primary Care Trusts, England

94 Participants

95 23,773 CVI certifications issued from 2008-9

97 Main Outcome measures

98 Crude and Age standardised rates of CVI data for blindness and sight loss by PCT

100 Methods

101 The crude and age standardised CVI rates per 100,000 were calculated with 95% confidence
102 intervals using Byar’s method. Spearman’s rank correlation ~~was~~ used to assess whether there

1
2
3 103 was any evidence of association between CVI rates with IMD and the Programme spend for
4 104 Vision.

5 105

6 106 **Results**

7 107 There was high level variation, almost 11 fold (Coefficient of Variation 38%) in standardised
8 108 CVI blindness and sight impairment annual certification rates across PCTs. The mean rate
9 109 was 43.7 and the standard deviation 16.7. We found ~~weak~~ little evidence of ~~an~~ any
10 110 association between the rate of blindness and sight impairment with either the IMD or
11 111 Programme Spend on Vision.

12 112

13 113 **Conclusions**

14 114

15 115 The wide geographical variation we found raises questions both about the quality of the data
16 116 and whether there is genuine unmet need for prevention of sight loss. It is a concern for
17 117 public health practitioners who will be interpreting this data locally and nationally as the CVI
18 118 data will form the basis of the public health indicator 'preventable sight loss'. Poor quality
19 119 data and inadequate interpretation will only create confusion if not addressed adequately from
20 120 the outset. There is an urgent need to address the shortcomings of the current data collection
21 121 system and to educate all public health practitioners.

22 122 Word Count ~~2596~~7

23 123

24 124

25

26

27

28

29

30

31

32

33

34

35

36

37

38

39

40

41

42

43

44

45

46

47

48

49

50

51

52

53

54

55

56

57

58

59

60

1
2
3
4 1255
6 126 **Introduction**

7
8 127 Eye care services have traditionally not featured highly in national health policy or the public
9 128 health agenda. In the UK there has been no Department of Health led eye care services
10 129 strategy and there is no mention of eye health in the recent NHS or Public Health White
11 130 papers.^{1,2} The UK however does have a Vision Strategy produced by a collaboration of Eye
12 131 care organisations, professionals and patients in response to the World Health Assembly
13 132 Resolution of 2003. This resolution urged the development and implementation of national
14 133 plans to tackle sight impairment, to which the UK government pledges its support.³ VISION
15 134 2020 was launched by the World Health Organization (WHO) and the International Agency
16 135 for the Prevention of Blindness (IAPB) in order to bring together governments, eye care
17 136 professionals and patients to work towards the global goal to eliminate avoidable blindness
18 137 by the year 2020.⁴

19
20
21 138 However this year the new Public Health Outcomes Framework has included an indicator for
22 139 preventable sight loss, constituting a major step forward for the recognition of eye health on
23 140 the public health agenda.⁵ This indicator will be based upon the Certificate of Vision
24 141 Impairment (CVI) – this being the only routinely collected national measure of blindness and
25 142 sight impairment.

26
27
28 143 The NHS Atlas of Variation has highlighted the variations in healthcare activity, expenditure,
29 144 quality and outcomes in the UK.⁶ This brought to attention the need to address unwarranted
30 145 variation, focussing on the appropriateness of the clinical services and their outcomes. The
31 146 most recent edition of the Atlas published last year included the rate of sight impairment and
32 147 blindness due to diabetes (as measured by CVI) , which showed a high level of variation (8
33 148 fold), and raised concerns, particularly as there is a diabetic eye screening programme already
34 149 in place. With an aging population and rising incidence of diabetes the prevalence of sight
35 150 loss has also been predicted to increase significantly over the next decade.^{7,8} The total costs
36 151 of sight loss in the UK were estimated at £6.5 billion in 2008 with £40 million per million
37 152 population being spent on eye care services last year in England.⁹ With rising costs from
38 153 expensive medications for Age Related Macular Degeneration (AMD) and other diseases
39 154 there will be huge pressures on the eye care budget in the coming years. The adoption of an
40 155 indicator for preventable sight loss will be a vital part of monitoring eye care outcomes.
41 156 However public health practitioners will need to know that the quality of the data is adequate
42 157 and how to interpret the CVI rates. In this paper we examine, for the first time, the
43 158 geographical variation of blindness and sight impairment, as measured by the CVI.

44
45
46
47 159 **Methods**48
49 160 CVI data collection

50
51 161 The CVI form is discussed in the hospital clinic with patients who are eligible and is
52 162 completed with patient consent by a consultant ophthalmologist. Currently, a paper version is
53 163 completed which is sent to the local authority social services who use this to update their
54 164 visual impairment register. Every three years, the Social Service departments complete an
55 165 annual return which is sent to the Information Centre (IC) for health and social services
56 166 reporting the number of new registrations and the total number of registrations in their
57 167 register. This return is mandatory. Another copy of the CVI form is sent to the Certifications

1
2
3 168 Office, Moorfields Eye Hospital NHS Foundation Trust for epidemiological analysis. This
4 169 return is voluntary but there is a good rate of compliance (correlation coefficient 0.9 between
5 170 the number of certifications and the number of registrations by unitary authority).¹⁰ Data held
6 171 by the Certifications Office has more detailed information on the causes of registration and
7 172 allows incidence data calculation. For this study the data from the 2008/9 CVI forms
8 173 collected by the Certifications Office was used.

10 174 Calculation

12 175 Two rates were used for the analysis, the crude rate and the directly standardised rate (DSR).
13 176 The crude rate is the number of CVI forms divided by the population of that PCT. The DSR
14 177 was determined using age specific CVI rates with Office of National Statistics (ONS) 2008
15 178 mid-year population figures by PCT ~~with 95 % confidence intervals computed using Byar's~~
16 179 ~~method.~~ The standard population was that for England 2008 mid year population. The
17 180 standard deviation and coefficient of variation were then calculated.

18 181 Standardisation was used as a means of ensuring that any differences seen between PCT
19 182 populations were not as a result of differing age structures. As the numbers of CVI forms in
20 183 each PCT were relatively small, standardisation was conducted using three age bands (0-15,
21 184 16-64 and 65 plus). We chose direct rather than indirect standardisation because we wished to
22 185 compare PCTs with each other and indirect standardisation would not have allowed this.¹¹

23 186 The coefficient of variation is calculated by dividing the standard deviation of the rates by the
24 187 mean rate.¹² As it is relatively insensitive to population size, it provides a more powerful
25 188 measure of variation than the standard deviation when there are variable population sizes in
26 189 the data set. One disadvantage is that it may overestimate the amount of variation if rates are
27 190 low or if it is applied to small populations.

28 191 To eliminate the possibility of artefact from outliers in the data sets, the degree of variation
29 192 was calculated as the range within the data after exclusion of the five PCTs with the highest
30 193 and the five with the lowest values. Fold variation was determined as the upper limit of the
31 194 trimmed range divided by the lower limit of the trimmed range.

32 195 A funnel plot was constructed to examine whether or not the rate of certification was related
33 196 to the size of the population and to examine whether there was a relationship between the
34 197 estimate size and the precision of that estimate.

35 198 Comparison with Index of Multiple Deprivation (IMD)

36 199 The Indices of Deprivation (ID) is a measure of social deprivation prepared by the
37 200 Department of Communities and local Government (DCLG). The English Indices of
38 201 Deprivation measures relative levels of deprivation in small areas of England.¹³ The English
39 202 ID2010 use 38 separate indicators, organised across seven distinct domains of deprivation,
40 203 including income, employment and health. The latter can be combined, using appropriate
41 204 weights, to calculate the Index of Multiple Deprivation 2010 (IMD 2010). The IMD is used
42 205 to help decide the allocation of resources to PCTs. Scatter plots of the CVI rates with the
43 206 index of multiple of deprivation were drawn and correlation coefficients calculated.

44 207 Comparison with Spend on Vision

45 208
46 209 In the UK each PCT receives its healthcare budget allocated by programme area. There are

23 main programmes, broadly corresponding to the chapters in the WHO ICD-10 e.g. Cancers and tumours, Mental Health Disorders. The eye care services budget comes under the Vision programme budget. This includes NHS sight tests as well as all primary care prescribing, community services, inpatients and outpatients expenditure. Scatter plots of CVI rates against spend on vision were examined and correlation coefficients calculated to assess whether there was any evidence of association between spend versus CVI blindness and sight impairment rates.

217 Converting Data to Maps

218 The data is shown as a map of England with London shown as an inset on the PCT maps so
219 that the details of the small areas are not lost. The PCTs have been grouped into ranges to
220 allow comparison of areas on the map with ease. The method used to group the data into
221 ranges is quantiling. Quantile's build ranges (in this case five were chosen) to display the
222 distribution of the variable. This is calculated by ranking the data values from highest to
223 lowest and then splitting the values into five ranges, which do not necessarily contain equal
224 numbers. The ranges are from the lowest value (light blue) to the highest (dark blue). The
225 map was produced in Adobe Illustrator.

226 **Results**

227
228 There were 23,773 CVI certifications for 2008/9 in England. Table 1 summarises the degree
229 of variation, standard deviation and co-efficient of variation. It shows that after
230 standardisation there is approximately an 11-fold variation in the number of CVIs. A
231 coefficient of variation of 0.38 or 38% indicates marked variation in CVI registration.

232 **Table 1: Summary of CVI certifications with the mean, standard deviation, coefficient**
233 **of variation and degree of variation**

	Mean	Standard deviation	Coefficient of variation	Fold Variation
CVI Crude Rate (per 100,000 population)	42.97	18.10	0.42	12.47
CVI Directly Standardised Rate (per 100,000 population)	43.69	16.69	0.38	10.79
Programme Spend (in pounds sterling) on Vision (per head of population)	32.55	6.16	0.19	2.13
Index of Multiple Deprivation*	23.63	8.40	0.36	3.67

234 ***In 2010 IMD scores ranged from 1.4- 87.8¹⁴**

235 **Figure 1 and 1a:** Map and Bar Graph of Geographical Variation of in blindness and sight
236 impairment rates in England

237 Figure 1 and 1a shows the directly standardised rates of sight impaired and blindness **directly**
238 per 100,000 in England, in 2008-09 in the form of a map, as detailed in the methods. The map
239 illustrates a fairly uniform distribution of variation, although there is a cluster of relatively
240 low CVI registration in the West of England. This would require further study including a
241 time trend to explore whether this is a repeating trend over 5 to 10 years. There is otherwise
242 very little evidence of a geographical explanation for the variation such **as** a "north-south
243 divide".¹⁵

244

245 **Figure 2:** CVI directly age-standardised rate per 100,000 vs Index of Multiple Deprivation
246 2010 by Primary Care Trust, 2008/9

247

248 Figure 2 displays the CVI standardised rates per 100,000 versus the IMD 2010 by PCT. The
249 figures illustrate a very weak association between the CVI rates and IMD 2010. (correlation
250 coefficients 0.11, $p=0.15$). It is therefore unlikely that deprivation is the only cause for the 11
251 fold variation seen in CVI registration rates.

252

253 **Figure 3:** CVI directly age-standardised rate per 100,000 vs Spend (in pounds sterling) per
254 Head by Primary Care Trust, 2008/9

255 Figure 3 displays the CVI standardised rates per 100,000 versus the spend per head by PCT.
256 Again, there is little evidence of any association seen (correlation coefficient 0.0329, $p=0.69$)
257 and therefore spend per head is unlikely to account for the variation observed in CVI rates.

258 **Figure 4**

259 There is high degree of heterogeneity seen in the funnel plot of 151 PCTs, with twenty seven
260 being above the upper three SD line and thirty six below. Another 17 PCTs are between the
261 upper two and three SD lines and 12 between the lower two and three SD lines. This is likely
262 to be both due to real differences between PCTs but also unmeasured covariates that alone
263 impact by small amounts but together impact greatly.

264 **Discussion**

265 The certification rates of blindness and sight impairment differ widely amongst PCTs with an
266 11 fold difference between the highest and lowest rate. There is little association seen with
267 the Index of Deprivation or Spend on Vision. The limitations of the study included the
268 relatively smaller numbers of CVI data for each PCT so that the coefficient of variation may
269 have overestimated the level of variation.¹¹ Increasing the local areas to larger geographical
270 areas of England may improve the accuracy, though such a measure would be less relevant to
271 commissioners and healthcare professionals. Residual confounding by age may remain a
272 limitation as we had to use relatively large age bands again due to the relatively smaller
273 number of events in each age band.

274

275 Despite these limitations this is a high level of variation and understanding the data collection
276 is important. The completion of a CVI form requires a consultant ophthalmologist to offer
277 certification to a patient who is attending a hospital eye clinic and the patient to accept that
278 offer. Therefore there are a number of factors which can influence both the offering and
279 acceptance of the certification and it is difficult to distinguish these other than through direct
280 audits. The certification process is also limited by the fact that it takes place mostly in the
281 hospital setting by a consultant, as there may be many more patients in the community who
282 may be eligible but are not offered it. The magnitude of variation raises questions about the

283 consistency of this process around the country and the variation in how many eligible people
284 are offered certification.

285 It is recognised that the reported numbers of CVI registrations of blindness and sight
286 impairment have decreased significantly in the last 10 years, at a time when, for demographic
287 reasons, they should be increasing.¹⁶ The reasons for this are not entirely clear but they may
288 also contribute to the variation across the country. There are a number of possible factors.
289 The number of blind people in England has been counted since 1851. The decrease in
290 certification rates has coincided with the introduction of the new CVI form to replace the
291 previous BD8 form. It has been expressed that the new form is more complex to complete.
292 The new form was intended to be accompanied by a change in culture where it is now an
293 indication that the person may benefit from the support and rehabilitation in the community,
294 rather than be an indication that ‘nothing more can be done’. This was to supposed to trigger
295 increased certification being offered, which may be done more in certain areas or by
296 certain individuals than by others. The change in form was also accompanied by a change in
297 the payment system, from ophthalmologists being automatically entitled to a fee to the
298 entitlement for fee being variable depending on whether a consultant is on a new contract or
299 old or if it is seen as an additional examination.

300 The sustainability of CVI data collection and analysis has also been in question since 2007.
301 First, it was not included in the National Indicator Set, which lists those data collections that
302 would remain mandatory for local authorities.¹⁷ Then an NHS information centre review
303 concluded that the collection of the data should cease. Support by eye care professionals for
304 the data collection led to a further government review, which concluded the data collection
305 was essential but that the system needed improvement. These conclusions were further
306 supported by a Law Commission’s report, published in May 2011.¹⁸ These issues have
307 slowed progress in improving and updating the process of data collection including the
308 development of an electronic collection system. Continuing uncertainty may have affected
309 the quality of data collection. Certainly, the data collection could be improved by
310 streamlining and adopting an electronic version which auto-populates demographic
311 information by linking to local [Electronic Patient Record system \(EPRs\)](#). Raising
312 understanding of CVI figures is also of merit – a CVI for diabetic eye disease means that a
313 patient has lost sight due to a preventable eye condition. The distinction between
314 ‘preventable’ and ‘not preventable’ blindness is important. Blindness due to diabetes,
315 glaucoma and cataract is considered preventable or treatable if diagnosed in a timely manner.
316 Similarly AMD now also has effective treatments which can halt or improve sight loss, hence
317 its inclusion with glaucoma and diabetes in the Public Health Outcome framework
318 ‘preventable sight loss’ indicator. Hospitals should be encouraged to examine their own CVI
319 figures to ensure that all that could have been done was done and regular audits could be
320 conducted to ensure that patients who are eligible for certification are offered a CVI. An
321 analysis of one London PCT found significantly higher levels of certification due to
322 glaucoma and diabetic retinopathy, both preventable causes of blindness.¹⁹

323 ~~However this~~—There have been, to our knowledge, no other studies on geographical variation
324 in sight loss conducted in the UK. Reliable collection of national data on sight loss is an issue
325 throughout developed as well as developing countries. In a Danish population based study of
326 prevalence and causes of blindness they noted there was no accurate and up-to-date data for
327 Denmark, therefore they conducted their own population cross-sectional survey for
328 Copenhagen.²⁰ The figures used in the WHO database for Europe are based in some cases on
329 data collection from over 15 years ago.²¹ Population based surveys, often focussed

1
2
3 330 exclusively on the elderly, have been done in many European countries but these types of
4 331 surveys have their own limitations.²¹ Rapid assessment of avoidable blindness (RAAB) has
5 332 been developed to allow a simple and rapid survey methodology that can provide data on
6 333 prevalence and causes of blindness.²² This has proved extremely successful in developing
7 334 country settings and many have been conducted globally. However the methodology differs
8 335 to our study and they do not specifically look for geographical variation within countries
9 336 although this may sometimes be implicated in some results. Geographical variation has been
10 337 studied in the UK with regard to mainly surgical rates, including cataract surgery, intravitreal
11 338 injections and more recently uveal melanoma.^{23,24,25} In some areas where available it may be
12 339 interesting to compare these hospital based data with the rate of blindness and sight
13 340 impairment certification. This lack of comparable data highlights the importance of the work
14 341 being done in the UK with this routine data collection on sight loss and its causes, and serves
15 342 as an example for other countries

16
17
18 343 The inclusion of the public health indicator of 'preventable sight loss' in the Public Health
19 344 Outcome Framework is a landmark decision in the inclusion of eye health into the wider
20 345 public health agenda. However this highlights the importance of improving the quality of
21 346 this important data collection, if it is to be used to monitor the number of people with
22 347 preventable sight loss. Our results show that there is a wide level of variation between PCTs
23 348 and it is likely that much of this is due to factors including variation in levels of offering of
24 349 certification, care pathways, perceived value of certification and payment for CVI forms. It is
25 350 vital that these are now addressed with a more streamlined process, and locally and nationally
26 351 awareness is raised in the importance of the data. The analysis of the number of people losing
27 352 sight due to conditions which may be preventable is vital. There is an additional need for
28 353 accurate data to see whether the introduction of new (and costly) interventions for diseases
29 354 (such as Lucentis for Age related Macular Degeneration and possibly Diabetic Macular
30 355 Oedema) are reducing sight loss nationally. Further research on the causes of sight
31 356 impairment amongst those certified and its variation will be important as well as the
32 357 comparison of rates with other eye health care indicators. Variation of sight loss certification
33 358 is a concern if patients are not gaining access to social service support. It is vital for those
34 359 who plan and manage services to determine if there is more that can be done to improve
35 360 services to prevent avoidable sight loss and improve eye health outcomes.

36
37
38
39 361 **Word Count 3051**

40
41 362 **What this paper adds**

42
43 363 **section 1:**

- 44
45
46 364 • The number of certifications for blindness and sight impairment have been falling,
47 365 despite estimates due to demographic changes of rising rates.
48 366 • There has been no previous study looking at the geographical variation in blindness
49 367 and sight impairment rates.

50
51 368 **section 2:**

- 52
53 369 • There is a large geographical variation in the registration of blindness and sight
54 370 impairment in England
55 371 • This implies both a need to improve consistency in access to certification across the
56 372 country and investigate further the causes of this variation, particularly as this will
57 373 now be used to as an outcome in the Public Health Outcomes Framework

1
2
3 374
4

5 375 The Corresponding Author has the right to grant on behalf of all authors and does grant on
6 376 behalf of all authors, an exclusive licence (or non exclusive for government employees) on a
7 377 worldwide basis to the BMJ Publishing Group Ltd to permit this article (if accepted) to be
8 378 published in BMJ editions and any other BMJ PGL products and sublicences such use and
9 379 exploit all subsidiary rights, as set out in our licence.

10
11 380 All authors have completed the Unified Competing Interest form at
12 381 www.icmje.org/coi_disclosure.pdf (available on request from the corresponding author) and
13 382 declare that (1) No authors have support for the submitted work; (2) No authors have
14 383 relationships that might have an interest in the submitted work in the previous 3 years; (3)
15 384 their spouses, partners, or children have no financial relationships that may be relevant to the
16 385 submitted work; and (4) No authors have non-financial interests that may be relevant to the
17 386 submitted work.”

18
19
20 387 **Acknowledgements:**

21
22 388 We would like to acknowledge the Royal College of Ophthalmologists, Royal National
23 389 Institute of the Blind and Guide Dogs for the Blind for their help in making this data
24 390 available.

25
26
27 391 The CVI data are copyright of the Department of Health. However any views expressed in
28 392 the publication are those of the author(s) alone and are not necessarily those of the
29 393 Department of Health.

30
31 394 **Details of contributors:**

32
33 395 Aeesha NJ Malik (guarantor): conception, design, analysis and interpretation of data, drafting
34 396 original article, revision and final approval

35
36 397 Catey Bunce: analysis and interpretation of data, revision of article and final approval

37
38 398 Richard Wormald (guarantor): revision of article and final approval

39
40 399 Mehrunisha Suleman: interpretation of data, revision of article and final approval

41
42 400 Irene Stratton: analysis and interpretation of data, revision of article and final approval

43
44 401 Muir Gray: revision of article and final approval

45
46 402 **Ethical Approval:** not required

47
48 403 **Sources of Funding:** none

49
50 404 **All researchers were independent from funders**

51
52
53 405 **All authors had full access to all of the data (including statistical reports and tables) in**
54 406 **the study and can take responsibility for the integrity of the data and the accuracy of**
55 407 **the data analysis**

56
57 408
58
59
60

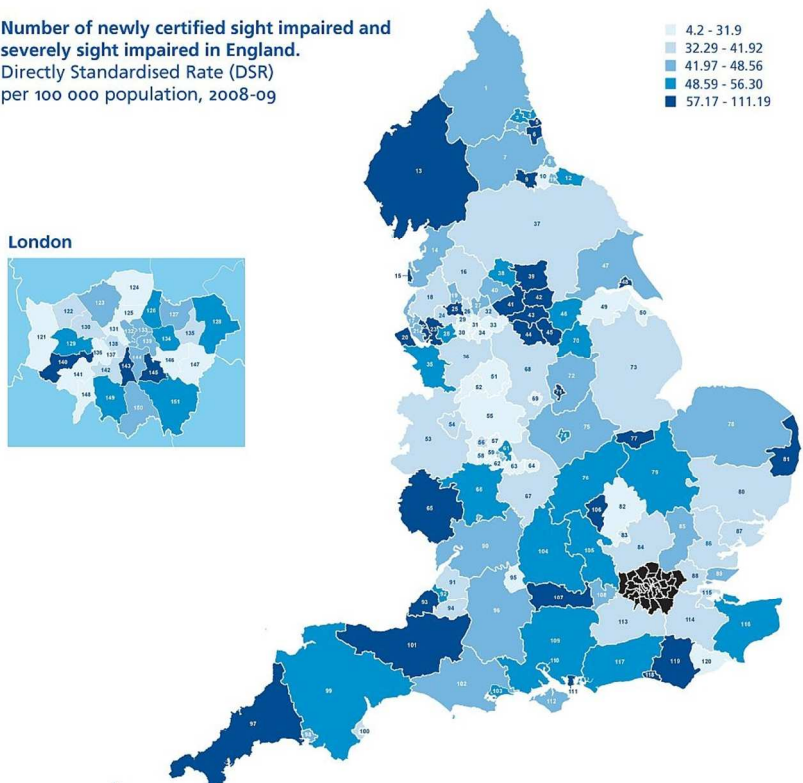
409 **References**

- 410 1. Dept of Health. Healthy lives, healthy people: our strategy for public health in England.
411 http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_121941, 30 November 2010.
- 412 2. Dept of Health. Equity and excellence:
413 Liberating the NHS.
414 http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_117353. 12 July 2010
- 415 3. World Health Organization. WHA 56.26 Elimination of avoidable blindness.
416 http://www.who.int/pbd/publications/wha_eb/en/, 28 May 2003.
- 417 4. A VISION 2020 UK initiative. UK Vision Strategy: Setting the direction for eye health
418 and sight loss services.
419 <http://www.vision2020uk.org.uk/UKVisionstrategy/page.asp?section=32§ionTitle=About+the+Strategy#Download%20the%20UK%20Vision%20Strategy>, April
420 2008.
421 2008.
- 422 5. Dept of Health. Healthy Lives, Healthy People: transparency in outcomes, proposals for a
423 public health outcomes framework.
424 http://www.dh.gov.uk/en/Consultations/Liveconsultations/DH_122962, 20 December
425 2010.
- 426 6. QIPP Right Care programme. Gray M, Da Silva P (ed). The NHS Atlas of
427 Variation in Healthcare. Reducing unwarranted variation to increase value and
428 improve quality. <http://www.rightcare.nhs.uk/atlas/> 2010.
- 429 7. Evans JR, Fletcher AE, Wormald RPL et al. Prevalence of visual impairment in people
430 aged 75 years and older in Britain: results from the MRC trial of assessment and
431 management of older people in the community. *Brit J of Ophth* 2001;86(7):795-800.
- 432 8. Economics A. Future Sight Loss UK 1: Economic Impact of Partial Sight and Blindness in
433 the UK adult population.
434 <http://www.rnib.org.uk/aboutus/Research/reports/prevention/Pages/fsluk1.aspx>:
435 RNIB. , 2009. .
- 436 9. Minassian D and Reidy A. Future Sight Loss UK 2: An epidemiological and economic
437 model for sight loss in the decade 2010-2020.
438 <http://www.rnib.org.uk/aboutus/Research/reports/prevention/Pages/fsluk2.aspx>
439
- 440 10. The NHS Information Centre, Adult Social Care Team. Registered Blind and Partially
441 Sighted People Year ending 31 March 2011, England. 1st September 2011.
442 [http://www.ic.nhs.uk/statistics-and-data-collections/social-care/adult-social-care-](http://www.ic.nhs.uk/statistics-and-data-collections/social-care/adult-social-care-information/registered-blind-and-partially-sighted-people--year-ending-31-march-2011-in-england)
443 [information/registered-blind-and-partially-sighted-people--year-ending-31-march-2011-in-](http://www.ic.nhs.uk/statistics-and-data-collections/social-care/adult-social-care-information/registered-blind-and-partially-sighted-people--year-ending-31-march-2011-in-england)
444 [england](http://www.ic.nhs.uk/statistics-and-data-collections/social-care/adult-social-care-information/registered-blind-and-partially-sighted-people--year-ending-31-march-2011-in-england)
- 445 11. [Eayres D, Association of Public Health Observatories, 2008. Technical Briefing 3:
446 Commonly used public health statistics and their confidence intervals.
447 <http://www.avon.nhs.uk/phnet/PHinfo/understanding.htm#Indirect>](http://www.avon.nhs.uk/phnet/PHinfo/understanding.htm#Indirect)
- 448 12. Diehr P CK, Connell F, Volinn E. What is too much variation? The null hypothesis in
449 small-area analysis. *Heath Ser Res*1990;24(6):741-71.
- 450 13. Department of Communities and Local Government. The English Indices of Deprivation
451 2010. <http://www.communities.gov.uk/publications/corporate/statistics/indices2010>,
452 24 March 2011.
- 453 14. <http://www.communities.gov.uk/publications/corporate/statistics/indices2010>
454

- 1
2
3 455 15. [Hacking JM, Muller S, Buchan IE](#). Trends in mortality from 1965 to 2008 across the
4 456 English north-south divide: comparative observational study. *BMJ*. 2011; 15;342
5 457 16. Bunce C XW, Wormald R. Causes of blind and partial sight certifications in England and
6 458 Wales: April 2007-March 2008. *Eye* 2010;24(11):1692-9.
7 459 17. Department of Communities and Local Government. The New Performance Framework
8 460 for Local Authorities and Local Authority Partnerships – A Single Set of National
9 461 Indicators.
10 462 <http://www.communities.gov.uk/publications/localgovernment/nationalindicator>,
11 463 2007.
12 464 18. Commission TL. Adult Social Care.
13 465 <http://www.justice.gov.uk/lawcommission/publications/1460.htm>, 11 May 2011.
14 466 19. Royal National Institute of the Blind. An Internal Report: CVI data update
15 467 20. Buch H, Vinding T, La Cour M et al. The prevalence and causes of bilateral and
16 468 unilateral blindness in an elderly urban Danish population. The Copenhagen City Eye
17 469 Study. *Acta Opth Scan* 2001; 79: 441-9
18 470 21. Thylefors B, Negrel AD, Pararajasegaram R et al. Available data on blindness (update
19 471 1994). *Ophth Epidemiol* 1995; 2: 5–39.
20 472 22. Kuper H, Polack S and Limburg H. Rapid assessment of avoidable blindness. *Community*
21 473 *Eye Health* 2006; 19 (60): 68-69
22 474 23. Keenan TD, Yeates D and Goldacre MJ. Uveal melanoma in England: trends over time
23 475 and geographical variation. *Brit J Ophth* 2012; Sep 13 (epub)
24 476 24. Keenan TD, Wotton CJ and Golacre MJ. Trends over time and geographical variation in
25 477 rates of intravitreal injections in England. *Brit J Ophth* 2012; 96 (3):413-8
26 478 25. Keenan T, Rosen P, Yeates D et al. Time trends and geographical variation in cataract
27 479 surgery rates in England: study of surgical workload. *Brit J Ophthal* 2007; 91 (7):
28 480 901-4
29 481
30 482
31 483
32 484
33 485
34 486
35 487
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

Number of newly certified sight impaired and severely sight impaired in England. Directly Standardised Rate (DSR) per 100 000 population, 2008-09



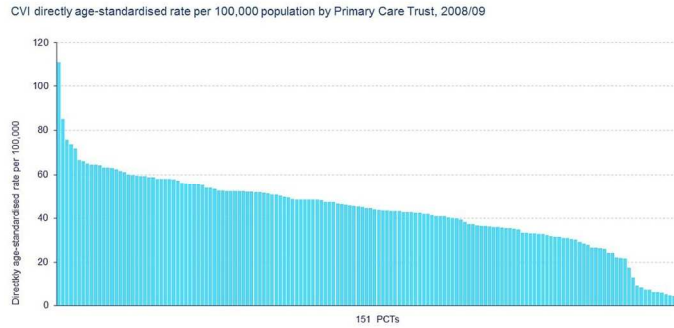
Key

1 Northumberland	42.7	28	Warrington	51.9	55	South Staffordshire	13.1	81	Great Yarmouth & Waveney	64.5	106	Milton Keynes	75.6	131	Cardon	26.1
2 Newcastle	52.4	29	Salford	31.1	56	Wolverhampton City	35.1	82	Bedfordshire	24.2	107	Berkshire West	58	132	Islington	44.6
3 North Tyneside	52.3	30	Trafford	6.1	57	Walsall	26.7	83	Luton	40	108	Berkshire East	48.5	133	City & Hackney	48.9
4 Gateshead	46.7	31	Manchester	4.2	58	Dudley	9.1	84	Hertfordshire	30.5	109	Hampshire	52.3	134	Newham	56.3
5 South Tyneside	61.3	32	Oldham	39.4	59	Sandwell	26.7	85	West Essex	42.7	110	Southampton City	55.7	135	Barking & Dagenham	36.1
6 Sunderland	63.3	33	Tameside & Glossop	5.8	60	Heart of Birmingham	47.4	86	West Essex	42.7	111	Portsmouth City	71.8	136	Hammersmith & Fulham	26.4
7 County Durham	48.6	34	Stockport	5	61	Birmingham East & North	52	87	Mid Essex	33	112	Isle of Wight NHB	48.5	137	Kensington & Chelsea	26.5
8 Hartlepool	43.6	35	Western Cheshire	52	62	South Birmingham	17.5	88	North East Essex	33.4	113	Surry	40.9	138	Westminster	36.3
9 Darlington	58.7	36	Central & Eastern Cheshire	35.7	63	Solihull	31.6	89	South East Essex	45.1	114	West Kent	35.3	139	Tower Hamlets	47.5
10 Stockton-on-Tees	31.7	37	North Yorkshire & York	35.9	64	Coventry	21.9	90	Gloucestershire	42	115	Medway	37.4	140	Hounslow	61.7
11 Middlesbrough	43.6	38	North Yorkshire & York	35.9	65	Herefordshire	57.2	91	South Gloucestershire	34.8	116	Epworth & Costal Keel	56.3	141	Bromley & Tonbridge	22.8
12 Rother & Cleveland	50.7	39	Bradford & Airedale	10.8	66	Worcestershire	51.2	92	Bristol	53.3	117	Brighton & Hove City	66.7	142	Wandsworth	38.4
13 Cumbria	65.1	40	Calderdale	43.3	67	Worcestershire	51.2	93	North Somerset	58.2	118	East Sussex Downs & Weald	58.7	143	Lambeth	62.4
14 North Lancashire	48.6	41	Kirkcaldy	59.9	68	Derbyshire County	40.4	94	Bath & North East Somerset	32.3	119	Hastings & Rother	7.2	144	Southwark	42.4
15 Blackpool	51.5	42	Wakefield District	64.2	69	Derby City	31.9	95	Swindon	31	120	London	148	145	Levensham	59.4
16 East Lancashire	41.9	43	Barnsley	111.2	70	Bassetlaw	53.8	96	Wiltshire	43.2	121	Hillingdon	21.7	146	Greenwich	27.9
17 Salford	46.3	44	Sheffield	59.3	71	Nottingham City	62.9	97	Corwall & Isles of Scilly	50	122	Harrow	33.3	147	Bealeys Care Trust	31
18 Central Lancashire	37.4	45	Rotherham	85.01	72	Nottinghamshire County	42.3	98	Plymouth	44	123	Barnet	45.8	148	Kingsdon	0.2
19 Blackburn with Darwen	48.1	46	Doncaster	55.1	73	Lincolnshire	36.8	99	Devon	50.2	124	Enfield	24.3	149	Sutton & Merton	49.8
20 Warral	73.7	47	East Riding & Yorkshire	45.3	74	Leicester City	54	100	Torbay	32.8	125	Wesley	31.9	150	Croydon	44.5
21 Liverpool	64.5	48	Hull	63.4	75	Leicestershire County & Rutland	45.9							151	Bloisley	48.8
22 Knowsley	64.5	49	North Lincolnshire	7.2												
23 Hutton & St. Helens	66															

90x127mm (300 x 300 DPI)

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

Figure 1a (to be included with figure 1)



127x90mm (300 x 300 DPI)

view only

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

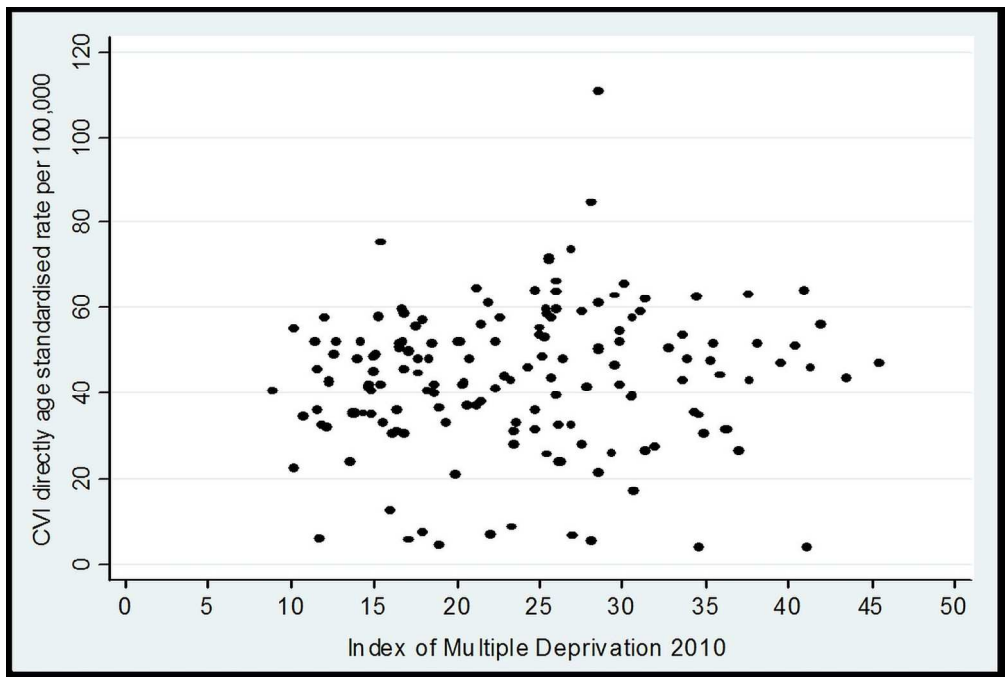


Figure 2: CVI directly age-standardised rate per 100,000 vs Index of Multiple Deprivation 2010 by Primary Care Trust, 2008/9
134x90mm (300 x 300 DPI)

view only

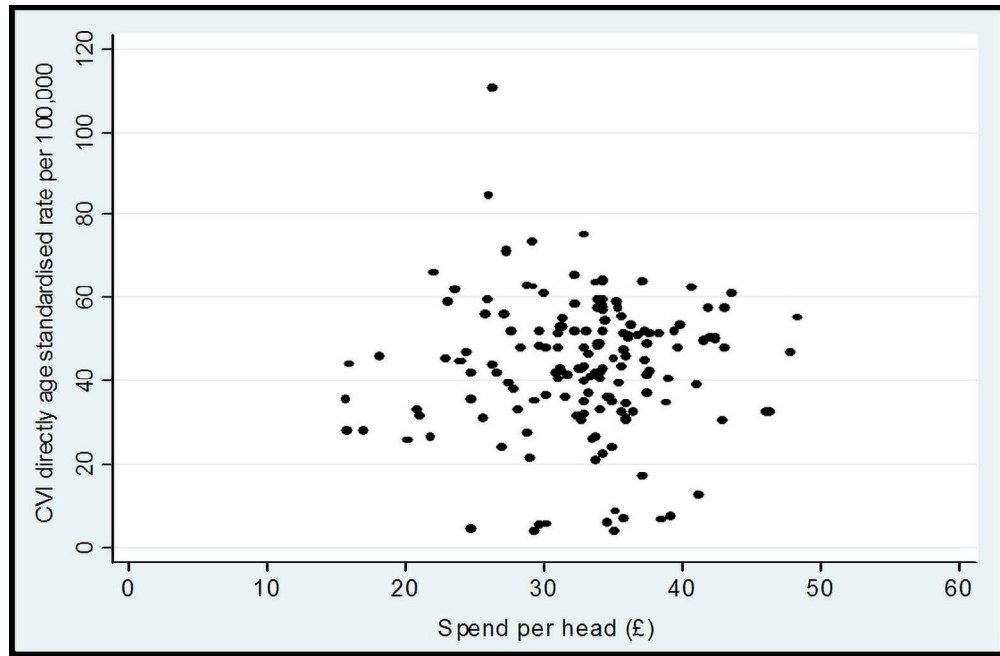
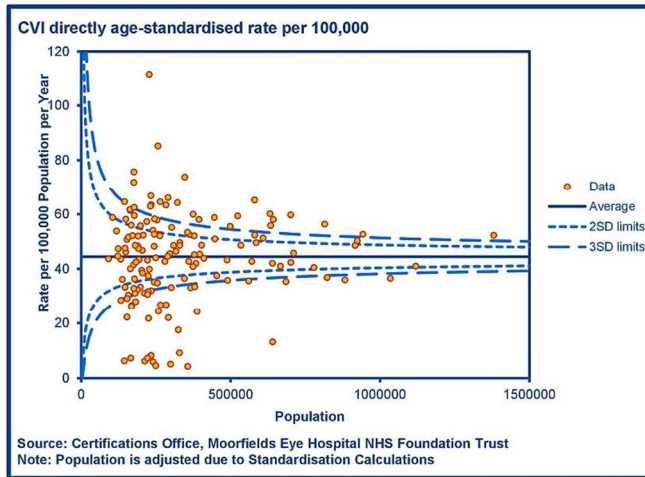


Figure 3: CVI directly age-standardised rate per 100,000 vs Spend per Head by Primary Care Trust, 2008/9
138x90mm (300 x 300 DPI)

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60



There is high degree of heterogeneity seen in the funnel plot, of 151 PCTs, 27 are above the upper 3 s.d. line and 36 below the lower 3 s.d. line. Another 17 PCTs are between the upper 2 and 3 s.d. lines and 12 between the lower 2 and 3 s.d. lines.

90x127mm (300 x 300 DPI)