

OXFORD
UNIVERSITY PRESS

Journal of Public Health

<http://mc.manuscriptcentral.com/jph>**Maternal health inequalities and GP provision: investigating variation in consultation rates for women in the Born in Bradford cohort.**

Journal:	<i>Journal of Public Health</i>
Manuscript ID	JPH-15-0587
Manuscript Type:	Original Article
Date Submitted by the Author:	22-Dec-2015
Complete List of Authors:	Kelly, Brian; Bradford Institute for Health Research, Mason, Dan; Bradford Institute for Health Research Petherick, Emily; University of Loughborough, School of Sport, Exercise and Health Sciences Wright, John; Bradford Institute for Health Research, Born in Bradford Mohammed, Mohammed; University of Bradford, Faculty of Health Studies Bates, Chris; TPP
Keywords:	Primary care, Public health, Ethnicity

SCHOLARONE™
Manuscripts<http://jpubhealth.oupjournals.org>

1
2
3 **Maternal health inequalities and GP provision: investigating variation in consultation rates**
4 **for women in the Born in Bradford cohort.**
5
6
7
8
9

10 Dr Brian Kelly. Statistician: Bradford Institute for Health Research. Bradford Teaching Hospitals
11 Foundation Trust, Bradford, UK, BD9 6RJ.
12

13
14
15 Dr Dan Mason. Program Manager Research Analytics: Bradford Institute for Health Research.
16 Bradford Teaching Hospitals Foundation Trust, Bradford, UK, BD9 6RJ.
17

18
19
20 Dr Emily S Petherick. Lecturer in Epidemiology & Biostatistics: School of Sport, Exercise and
21 Health Sciences. Loughborough University, Leicestershire, UK. LE11 3TU.
22
23

24
25
26 Professor John Wright. Director: Bradford Institute for Health Research. Bradford Teaching
27 Hospitals Foundation Trust, Bradford, UK, BD9 6RJ.
28

29
30
31 Professor Mohammed A Mohammed. Professor of Healthcare Quality and Effectiveness:
32 Faculty of Health Studies, University of Bradford, Bradford, UK. BD7 1DP.
33
34

35
36
37 Chris Bates. Head of Data and Analytics Informatics & Research: TPP. Mill House, Troy Road,
38 Leeds, UK, LS18 5TN.
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

Abstract

Background

The 'Five Year Forward View' (NHS England) calls for a radical upgrade in public health provision. Inequalities in maternal health may perpetuate general patterns of health inequalities across generations; therefore equitable access to GP provision during maternity is important. This paper explores variation in GP consultation rates for disadvantaged mothers.

Method

Data from the Born in Bradford cohort (around 12,000 women), combined with GP records and GP practice variables, were modelled to predict GP consultation rates, before and after adjusting for individual health and GP provision.

Results

Observed GP consultation rates are higher for women in materially deprived neighbourhoods and Pakistani women. However these groups were found to consult less often after controlling for individual health. This difference, around one appointment per year, is 'explained' by the nature of GP provision. Women in practices with a low GP to patient ratio had around 9 fewer consultations over the six year period compared to women in practices with the highest ratio.

Conclusions

Equitable access to GP services, particularly for women during the maternal period, is essential for tackling deep-rooted health inequalities. Future GP funding should take account of neighbourhood material deprivation to focus resources on areas of the greatest need.

Introduction

The 'Five Year Forward View' for the NHS in England calls for a radical upgrade in public health provision. Equitable access to GP services will be crucial if the key objectives of reducing preventative illness and tackling health inequalities are to be met.¹⁻³ There are a number of challenges. Demand for GP services has increased in the last decade,^{4,5} while the proportion of NHS funding allocated to general practice has fallen.⁶ One particular area of concern is in maternal health inequality,⁷⁻¹⁰ and the ways in which this may reinforce general patterns of inequality, which have proved to be remarkably persistent.¹¹⁻¹⁴ So tackling maternal health inequality may be important for making a sustainable long term difference to entrenched inequalities in the wider population.¹⁵ While maternity care is currently under review,¹ GP's are usually the first health care professional that women go to when they discover they are pregnant and remain important throughout subsequent years.^{16,17}

It is known that GP consultation rates are relatively high for economically disadvantaged and ethnic minority groups, reflecting poorer health,¹⁸⁻²¹ and higher levels of maternal morbidity.^{22,23} Women from ethnic minorities and lower socio-economic groups may also be less able to access health care as early as required,⁸ due to a deficit of GP provision in the most materially deprived neighbourhoods.²⁴⁻²⁶ As a result they may be accessing fewer preventative services and consulting GP's at later stages of illness.^{27,28}

The government has suggested that, as part of the promised 'new deal', GP funding would for the first time take account of neighbourhood material deprivation.²⁹ However there is still uncertainty, and on-going debate about whether the GP deficit actually exists.³⁰⁻³² With decisions currently being made about the future role and funding of primary care and maternity services there is a need for a clear understanding of current use of GP services by women in the years around giving birth in relation to inequalities in individual health and service provision.

The aim of this paper is to explore variation in GP consultation rates for women in the years around childbirth and to address three specific questions. First, are GP consultation rates higher for women in more materially deprived neighbourhoods and, if so, is this due to higher

1
2
3 rates amongst economically disadvantaged and ethnic minority women living in these
4 neighbourhoods? Secondly, do economically disadvantaged and ethnic minority women, or all
5 women in materially deprived neighbourhoods, have higher or lower consultation rates after
6 controlling for differences in individual health? Lastly, to what extent can variation in
7 consultation rates be explained by differences in GP practices, particularly the level of GP
8 provision?
9
10
11
12
13
14
15
16

17 Method

18
19
20 This study uses data from the Born in Bradford birth cohort, 12,450 women recruited at 28
21 weeks of pregnancy, who gave birth at the Bradford Royal Infirmary between 2007 to 2011.³³
22 Bradford may be considered a suitable focus for this research, being a large multi-ethnic city
23 with high levels of economic disadvantage and neighbourhood material deprivation.³⁴ In 2015
24 the UK Health Secretary identified Bradford as having one of the worst shortages of family
25 doctors in England.³⁵
26
27
28
29
30
31
32

33 Cohort members gave their consent to access GP records via SystemOne, which currently has
34 complete coverage of all GP practices in Bradford. In total 12,286 women, 98.7% of the
35 cohort, were matched by NHS number, surname and date of birth. The outcome variable for
36 this study was the number of general practice consultations recorded for each woman for the
37 period one year before giving birth to, on average, five years after birth. When more than one
38 consultation was recorded on a single day this was treated as a single consultation to avoid
39 double counting. Rates are expressed as consultations per person year, the denominator
40 being years registered with a GP practice during the study period. Cohort baseline records
41 were used to identify ethnicity, and derive a measure economic disadvantage, equivalent to
42 women in low income households or in receipt of means tested benefits.³⁶ Standardised
43 counts of unique, and repeat, prescriptions taken from GP records were used as an indicator
44 of individual health over the study period, based on previous research suggesting this is a
45 useful proxy for ill health.³⁷ The Charlson score for individuals was also calculated from GP
46 records using Read codes.³⁸
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3 Data for Bradford GP practices; IMD (2010 Index of Multiple Deprivation), under 65 standard
4 mortality ratio, number of GP's per thousand patients and the practice list size were obtained
5 from the Health and Social Care Information Centre.³⁹ Figure 1 shows the relationship
6 between IMD and the number of GP's per thousand patients and between IMD and the under
7 65 standard mortality ratio for all GP practices in England, with Bradford GP practices
8 identified by CCG. Bradford City practices, where most of the sample are registered, are
9 amongst the most materially deprived neighbourhoods of England. While there is no
10 relationship between IMD and the number of GP's per thousand patients for England as a
11 whole, in Bradford City most GP practices have relatively low levels of GP provision. The
12 median number of GP's per thousand patients is 0.52 in Bradford City CCG compared to 0.63
13 in the rest of England. Figure 1 also shows a strong correlation between IMD and the under 65
14 standardised mortality ratio.
15
16
17
18
19
20
21
22
23
24
25
26
27

28 *Figure 1 about here*
29
30

31 The time around childbirth is associated with relatively high levels of residential mobility^{40, 41}
32 and almost four in ten women changed GP practice at least once in the study period.
33 Therefore standardised GP scores, weighted by the proportion of time in each practice were
34 calculated for individuals. Standardised mortality ratios were not used in the analysis due to
35 multicollinearity with GP practice IMD. Average residential IMD score over the study period
36 for individuals was calculated in the same way. Finally a number of covariates, potentially
37 related to variation in GP consultations and ill health, were derived from GP and cohort
38 records. These were; age, previous parity, subsequent pregnancies in the period, smoking
39 status, BMI, country of birth and the number of GP practices registered with, and different
40 neighbourhoods lived in, during the period. A profile of the cohort is shown in table 1.
41 Economically disadvantaged and ethnic minority women were more likely to live in materially
42 deprived neighbourhoods, have a higher number of GP appointments and receive more
43 prescriptions. In particular Pakistani women were more likely to be registered with GP
44 practices in materially deprived neighbourhoods, with higher mortality rates and fewer GP's
45 per thousand patients.
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3 *Table 1 about here.*
4
5

6 Negative binomial regression models were employed⁴² using Stata 13⁴³ to estimate
7 consultation rates for different groups, based on neighbourhood material deprivation,
8 economic disadvantage and ethnicity; first separately and then after adjustment for
9 covariates. Next, measures of individual ill health and GP practice level measures were
10 introduced to predict adjusted estimates. Average marginal effects were calculated to aid the
11 substantive interpretation of effect sizes.⁴⁴
12
13
14
15
16
17

20 **Results**

21
22
23
24 Table 2 presents estimated coefficients from the models and predicted consultation rates for
25 certain groups are shown in figure 2.
26
27

28
29 *Table 2 about here*
30
31

32
33 *Figure 2 about here*
34
35

36 It is useful to consider the difference between GP consultation rates that are observed and GP
37 consultation rates that are estimated after adjusting for individual ill health and GP practice
38 variables. Model 1 estimates GP consultation rates for economically disadvantaged women,
39 women in materially deprived neighbourhoods and different ethnic groups separately; model
40 2 estimates rates when these variables, and covariates, are considered together. So model 1
41 and 2 can be thought of in terms of what is actually observed. In contrast, model 3, which
42 adds measures of individual health, predicts adjusted consultation rates that would be
43 observed if all women had the same levels of health. Model 4 adds GP practice measures and
44 predicts adjusted consultation rates that would be observed if all women had the same levels
45 of health and used GP practices with equivalent levels of provision. It is the difference
46 between these observed and adjusted rates that will inform the substantive interpretation of
47 results, first in relation to neighbourhood material deprivation and economic disadvantage,
48 and then in relation to ethnicity.
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3
4
5 Both neighbourhood material deprivation and economic disadvantage, when considered
6 separately in model 1, show a significant association with variation in GP consultation rates;
7 with higher rates for women in materially deprived neighbourhoods and for women who are
8 economically disadvantaged. Figure 2 illustrates that those in neighbourhoods with high
9 material deprivation (a score of 1 standard deviation above the mean IMD score) are
10 predicted to have an average of 6.40 consultations per year (95% CI: 6.27 - 6.52), compared to
11 6.03 (5.92 – 6.14) for those in neighbourhoods with low material deprivation (a score of 1
12 standard deviation below the mean IMD score). Economically disadvantaged women were
13 predicted to have an average of 6.76 (6.64 – 6.88) consultations per year, compared with 5.46
14 (5.35 – 5.57) for women not economically disadvantaged. Model 2 considers these measures
15 in a single multivariate model, along with covariates as discussed in the methods section and
16 detailed in Table 2. Neighbourhood material deprivation becomes non-significant while higher
17 consultation rates are still predicted for economically disadvantaged women.
18
19
20
21
22
23
24
25
26
27
28

29
30 Model 3 adds measures of individual health. There is no longer a significant association
31 between individual economic disadvantage and consultation rates, suggesting that the
32 observed higher consultation rates for economically disadvantaged women are as a result of
33 this group having poorer health. In model 3 neighbourhood material deprivation once again
34 becomes significant, but now predicted consultation rates are lower in more materially
35 deprived neighbourhoods; 6.10 per year (6.00 - 6.20), compared to 6.43 (6.32 - 6.54) for
36 women with the same levels of ill health in neighbourhoods with low levels of material
37 deprivation. Finally in model 4, after GP practice level variables are added, the difference in GP
38 consultation rates between individuals in neighbourhoods that have high material deprivation
39 are no longer significantly different from those in neighbourhoods with low levels of material
40 deprivation. This suggests there may be a potential under use of GP services in materially
41 deprived neighbourhoods which can be explained by the number of GP's per 1000 patients
42 and the level of material deprivation where the GP practice is situated.
43
44
45
46
47
48
49
50
51
52
53

54
55 When ethnicity is considered in isolation in model 1, and together with other variables in
56 model 2, Pakistani women are predicted to have 6.96 consultations per year (6.82 – 7.10),
57 compared to 5.78 (5.66 – 5.90) for White British women, this being independent of socio-
58
59
60

1
2
3 economic status and neighbourhood material deprivation. However in model 3 Pakistani
4 women are predicted to have lower consultation rates 6.09 (5.98 - 6.20) than White British
5 women 6.62 (6.47 – 6.77) with the same level of ill health. In model 4 when GP practice
6 measures were introduced, the differences in the predicted consultation rate between White
7 British and Pakistani women reduces and becomes non-significant. This suggests that much of
8 the difference identified in model 3, a potential relative under use of GP services for Pakistani
9 women compared to White British women with the same levels of ill health, can be explained
10 by variation in available GP provision. The observed consultation rates for women in the
11 'Other' ethnic group are high in model 1 and 2, and in model 4, after controlling for individual
12 health and GP practice variables they remain so. As noted this group contains a range of
13 different ethnicities, including more recently arrived groups and so there may be less
14 engagement with GP's for groups that are less established.

15
16
17
18
19
20
21
22
23
24
25
26 In model 4 the largest substantive effects on the number of predicted consultations are
27 individual health, as measured by the proxy of prescription counts, and measures related to
28 the GP practice. Taking almost the full range of GP variable measures, from two standard
29 deviations below to two standard deviations above the mean, consultation rates range from
30 5.46 (5.32 – 5.60) a year for women in practices with the lowest GP to patient ratio, to 7.14
31 (6.96 – 7.33) for women in practices with the highest. There is a difference of about one
32 consultation a year across the range of IMD values. Taking the most extreme situations,
33 women registered with GP practices that are in the most deprived neighbourhoods, with the
34 lowest GP to patient ratio are predicted to have 5.61 (5.25- 5.98) consultations a year,
35 compared to 7.93 (7.47 – 8.39) for women with the same level of ill health registered with GP
36 practices that are in the least deprived neighbourhoods, with the highest GP to patient ratio.

Discussion

Main findings of this study

This paper set out to investigate variation in GP consultation rates for women in the years around childbirth and answer three specific questions. In relation to the first, it was found that, due to poorer levels of ill health, economically disadvantaged women consult GP's more frequently, leading to high observed consultation rates in materially deprived neighbourhoods. This is useful to know, but perhaps not so surprising. More novel insights were gained when considering the second and third questions. After controlling for individual ill health it was found that women in materially deprived neighbourhoods had lower consultation rates than women with the same level of economic disadvantage and ill health who are not in materially deprived neighbourhoods. Also, after controlling for individual health, Pakistani women who had high observed consultation rates, independent of economic disadvantage or neighbourhood material deprivation, were found to consult less than White British women with the same level of ill health. This suggests a potential relative under use of GP services for all women in materially deprived neighbourhoods, and independently, for Pakistani women.

The answer to the third question, whether variation in GP consultation rates could be explained by differences between GP practices, was largely yes, and this is an important finding. After introducing GP practice measures it was found that there was now no significant difference in consultation rates for women in materially deprived neighbourhoods. So the relative underuse of GP services in these neighbourhoods can be explained by the nature of GP provision. The relative under use of GP services by Pakistani women, when compared to White British women with the same levels of ill health, was seen to be independent of economic disadvantage of neighbourhood material deprivation. However, as shown in table 1, Pakistani women were, on average, registered with GP practices that were in more deprived neighbourhoods with fewer GP's per thousand patients. Controlling for these differences in GP provision also explained the relative under use of GP services for Pakistani women.

Limitations of this study.

One limitation may appear to be that differences in predicted consultation rates are relatively small. However, rates are presented per mother per year and the study period of interest covers one year before giving birth to five years after, so it is useful to consider the cumulative effect over this period. A difference of one or two appointment a year can amount to a substantive difference over the maternal period.

The use of prescription counts as a measure of underlying ill health was assumed to be valid based on previous research,²⁸ but it would have been better to have been able to employ direct objective measures. Also, the final model did not explain all the variation in consultation rates by ethnicity, therefore it may be that further measures, related to health seeking behaviours for different groups, would have been useful to have access to and consider.

What is already known on this topic?

Observed GP consultation rates are known to be high for economically disadvantaged and ethnic minority groups, reflecting higher levels of ill health.¹¹⁻¹⁴ In particular, women from economically disadvantaged and ethnic minority groups are known to have higher levels of maternal morbidity.^{27, 28} What is less clear is whether consultation rates for women with higher levels of ill health are high enough, or whether these groups go to GP's less often than other women with the same levels of ill health. It has been suggested that women in materially deprived neighbourhoods report being least able to see health care workers quickly when needed,²¹ and that there is a deficit of GP provision in the most materially deprived neighbourhoods.¹⁵⁻¹⁷ However, in general, there is a lack of knowledge about how aspects of inverse care may operate in practice,³³ and there are on-going debates about whether such a deficit in GP provision exists at all.³⁰⁻³²

What this study adds

By utilising measures of individual health and GP provision this study is able to identify that women in materially deprived neighbourhoods access GP services less often than women with the same level of ill health in neighbourhoods that are not materially deprived. And further, to suggest that these differences are in turn explained by the GP to patient ratio and level of material deprivation of GP practices that women are registered with. This study also adds to existing knowledge of differences in GP consultation rates by ethnicity. High observed rates for Pakistani women obscure the fact that they are actually consulting GP's less often than White British women with the same level of ill health. Pakistani mothers are registered with GP practices with, on average, poorer levels of provision, and the relative underuse of GP services by Pakistani women is also largely explained by these inequalities in GP provision.

Results suggest the inverse care law still exists in multi-ethnic urban England. That despite high observed consultation rates in materially deprived neighbourhoods there is still a need for more provision in these areas if public health objectives are to be met. The results reinforce calls for change in the funding of GP services to take account of neighbourhood material deprivation.

Acknowledgements:

Born in Bradford is only possible because of the enthusiasm and commitment of the Children and Parents in BiB. We are grateful to all the participants, health professionals and researchers who have made Born in Bradford happen.

We gratefully acknowledge the contribution of TPP and the TPP ResearchOne team in completing study participant matching to GP primary care records and in providing on-going informatics support.

For Peer Review

References:

1. NHS. *Five year forward view*. London: HM Government; 2014.
2. Ali A, Wright N, Rae M. *Addressing Health Inequalities – A guide for general practitioners*. Royal College of General Practitioners Health Inequalities Standing Group. London: RCGP; 2008.
3. Hutt P, Gilmour S. *Tackling inequalities in general practice*. The Kings Fund Research Paper; 2010.
4. Hippisley-Cox J, Vinogradova Y. *Trends in consultation rates in general practice 1995 to 2008: analysis of the QResearch database*. NHS: The Information Centre for Health and Social Care; 2009.
5. Adams B. NHS Alliance: the evolution of primary care. *Prescriber*. 2015; 26(3): 32-34.
6. Baker, M., Ware, J., & Morgan, K. (2014). Time to put patients first by investing in general practice. *British Journal of General Practice*, 64(623), 268-269.
7. Watt, G. (2011). Working with vulnerable families in deprived areas. *British Journal of General Practice*, 61(585), 298-298.
8. Lindquist, A., Kurinczuk, J. J., Redshaw, M., & Knight, M. (2014). Experiences, utilisation and outcomes of maternity care in England among women from different socio-economic groups: findings from the 2010 National Maternity Survey. *BJOG: An International Journal of Obstetrics & Gynaecology*.
9. Knight, M., Kenyon, S., Brocklehurst, P., Neilson, J., Shakespeare, J., & Kurinczuk, J. J. E. (2014). Saving Lives, Improving Mothers' Care Lessons learned to inform future maternity care from the UK and Ireland Confidential Enquiries into Maternal Deaths and Morbidity 2009-2012.
10. Mitchell, C. A., Jones, G., & Anumba, D. O. (2015). Why do 'high risk' women book late or not at all for antenatal care?. *Br J Gen Pract*, 65(640), 574-574.
11. Black D. *Inequalities in Health: Black Report*. London: Pelican Books; 1982.
12. Acheson D. *Independent inquiry into inequalities in health: report*. London: Stationery Office; 1998.
13. Marmot M, Allen J, Goldblatt P, Boyce T, McNeish D, Grady M, Geddes I. *Fair society, healthy lives: strategic review of health inequalities in England post 2010*. Global Health Equity Group, University College London Research Department of Epidemiology and Public Health; 2010.
14. Hart, J. T. (1971). The inverse care law. *The Lancet*, 297(7696), 405-412.

- 1
2
3 15. Korkodilos, M., Earwicker, R., Perry, M., & Thorpe, A. (2013). Tackling inequalities in infant
4 and maternal health outcomes. *Perspectives in public health*, 133(1), 23.
5
6
7 16. Redshaw, M., & Heikkila, K. (2010). Delivered with care: a national survey of women's
8 experience of maternity care 2010. National Perinatal Epidemiology Unit. Oxford: University of
9 Oxford
10
11 17. Smith, A., Shakespeare, J., & Dixon, A. (2010). The role of GPs in maternity care-what does
12 the future hold. *London: The King's Fund*.
13
14
15 18. Carr-Hill RA, Rice N, Roland M. Socioeconomic determinants of rates of consultation in
16 general practice based on fourth national morbidity survey of general practices. *BMJ*. 1996;
17 312(7037): 1008-1012.
18
19
20 19. Scaife B, Gill PS, Heywood PL, Neal RD. Socio-economic characteristics of adult frequent
21 attenders in general practice: secondary analysis of data. *Family Practice*. 2000; 17(4): 298-
22 304.
23
24
25 20. Gillam SJ, Jarman B, White P, Law R. Ethnic differences in consultation rates in urban
26 general practice. *BMJ*. 1989; 299(6705): 953-957.
27
28
29 21. Smaje C, Le Grand J. Ethnicity, equity and the use of health services in the British NHS.
30 *Social Science & Medicine*. 1997; 45(3): 485-496.
31
32 22. Knight, M., Kurinczuk, J. J., Spark, P., & Brocklehurst, P. (2009). Inequalities in maternal
33 health: national cohort study of ethnic variation in severe maternal morbidities. *BMJ*, 338.
34
35 23. Lindquist, A., Knight, M., & Kurinczuk, J. J. (2013). Variation in severe maternal morbidity
36 according to socioeconomic position: a UK national case-control study. *BMJ open*, 3(6),
37 e002742.
38
39
40 24. Balarajan R, Yuen P, Machin D. Deprivation and general practitioner workload. *BMJ*. 1992;
41 304(6826): 529-534.
42
43 25. NHS. *Improving General Practice—a call to action. Evidence pack*. NHS England; 2013.
44
45
46 26. Gravelle H, Sutton M. Inequality in the geographical distribution of general practitioners in
47 England and Wales 1974–1995. *Journal of Health Services and Research Policy*. 2001; 6(1): 6–
48 13.
49
50 27. House of Commons Health Committee. *Health inequalities: (Written evidence Session*
51 *2007-2008 Volume II)*. HC422-II. London: The Stationery Office Limited; 2008.
52
53
54 28. Van de Kar A, Knottnerus A, Meertens R, Dubois V, Kok G. Why do patients consult the
55 general practitioner? Determinants of their decision. *British Journal of General Practice*. 1992;
56 42(361): 313-316.
57
58
59
60

- 1
2
3 29. Roberts N. Exclusive: Carr-Hill formula to weight GP pay for deprivation from 2016/17 . *GP Magazine online*. 2015; <http://www.gponline.com/exclusive-carr-hill-formula-weight-gp-pay-deprivation-2016-17/article/1328689>.
4
5
6
7
- 8 30. Boomla K, Hull S, Robson J. GP funding formula masks major inequalities for practices in
9 deprived areas. *BMJ*. 2014; 349:g7648.
10
- 11 31. Kaffash J. The 'new deal' that wasn't. *Pulse*. 2nd July 2015: 8-10.
12
- 13 32. Lind S. GPC questions need for review of GP funding formula to take deprivation into
14 account *Pulse*. 10th March 2015: 8-10.
15
16
- 17 33. Wright J, Small N, Raynor P, Tuffnell D, Bhopal R, Cameron N, West J. Cohort profile: The
18 Born in Bradford multi-ethnic family cohort study. *International Journal of Epidemiology*. 2013;
19 42(4): 978-991.
20
- 21 34. Lad, M. (2011). The English indices of deprivation 2010. *London: Department for*
22 *Communities and Local Government*.
23
24
- 25 35. Merrick R Health Secretary admits Bradford has a GP crisis. The Telegraph and Argus.
26 Friday 19 June 2015
27 http://www.thetelegraphandargus.co.uk/news/13343768.Health_Secretary_admits_Bradford_has_a_GP_crisis/
28
29
- 30 36. Fairley L, Cabieses B, Small N, Petherick ES, Lawlor DA, Pickett KE, Wright J. Using latent
31 class analysis to develop a model of the relationship between socioeconomic position and
32 ethnicity that can be used in population health research: cross-sectional analyses from a multi-
33 ethnic birth cohort study. *BMC Public Health*. 2014; 14 (1): 835
34
35
- 36 37. Brilleman SL, Salisbury C. Comparing measures of multimorbidity to predict outcomes in
37 primary care: a cross sectional study. *Family Practice*. 2013, 30(2), 172-178.
38
- 39 38. Khan NF, Perera R, Harper S, Rose PW. Adaptation and validation of the Charlson Index for
40 Read/OXMIS coded databases. *BMC Family Practice*. 2010; 11(1): 1.
41
42
- 43 39. Health and Social Care Information Centre (HSCIC) indicator portal.
44 <http://www.hscic.gov.uk/indicatorportal>
45
- 46 40. Tunstall, H., Pickett, K., & Johnsen, S. (2010). Residential mobility in the UK during
47 pregnancy and infancy: Are pregnant women, new mothers and infants 'unhealthy
48 migrants'? . *Social science & medicine*, 71(4), 786-798.
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3 41. Ketende S, McDonald J, Joshi H. Neighbourhoods and residential mobility
4 Chpt 7: Pages 115- 130 in: Hansen, K., Joshi, H., & Dex, S. (2014). Children of the 21st Century
5 (Volume 2): The first five years. Bristol: Policy Press.
6

7
8 42. Hilbe JM. *Negative binomial regression*. Cambridge: Cambridge University Press; 2011.
9

10 43. StataCorp. *Stata Statistical Software: Release 13*. College Station, Texas: StataCorp LP:
11 2013.
12

13
14 44. Williams R. Using the margins command to estimate and interpret adjusted predictions
15 and marginal effects. *Stata Journal*. 2012; 12: 308–331.
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

Table 1: Profile of cohort sample	Economic Disadvantaged		White British n=4,121	Ethnicity	
	No n=4,154	Yes n=6,175		Pakistani n=4,615	Other n=1,627
Sub-Group					
Not Economically disadvantaged (4,154)			49.1%	28.7%	50.6%
Economically disadvantaged (6,175)			50.9%	71.3%	49.4%
White British	48.6%	33.9%			
Pakistani	31.8%	53.2%			
Other*	19.6%	12.9%			
Average GP appointments per year	5.6	6.9	5.9	7.1	5.4
Average number of prescriptions per year	2.6	3.3	2.6	3.5	2.8
Average IMD of GP Practice	36.0	42.1	33.2	44.9	40.9
Average under 65 SMR of GP Practice	135.1	148.6	128.5	155.3	145.8
Average GP's per 1,000 patients in GP Practice	0.75	0.71	0.79	0.67	0.73
Average list size of GP Practice	8,298	7,450	9,231	6,733	7,151
IMD 2010: Most deprived national quintile 1 (6,847)	50.3%	77.1%	51.1%	79.4%	67.7%
IMD 2010: quintile 2	23.6%	14.4%	21.7%	14.3%	20.0%
IMD 2010: quintile 3	17.3%	6.9%	17.7%	5.6%	9.8%
IMD 2010: quintile 4	5.4%	1.2%	6.0%	0.5%	1.5%
IMD 2010: Leastdeprived national quintile 5 (3,479)	3.5%	0.4%	3.4%	0.2%	1.0%
DOB: 1990's onward (496)	1.6%	7.0%	9.0%	1.3%	4.0%
DOB: 1980's (5,747)	52.1%	58.0%	54.6%	57.4%	52.9%
DOB: 1970's (3,773)	43.0%	32.2%	33.2%	38.3%	40.0%
DOB before 1970's (313)	3.3%	2.8%	3.2%	2.9%	3.1%

* The 'Other' ethnic group contains all ethnicities apart from White British and Pakistani. The largest groups are Indian, Bangladeshi and White Other. It is therefore a heterogeneous group.

Table 2: Estimates from regression models

	Model 1: Univariate Observed			Model 2: Multivariate Observed *a			Model 3: Multivariate Adjusted for Individual Heath *a			Model 4: Multivariate Adjusted for Individual Heath and GP Practice *a		
	b	SE	p	b	SE	p	b	SE	p	b	SE	p
Constant	*b			1.193	0.043	0.000	1.444	0.032	0.000	1.413	0.031	0.000
Neighbourhood IMD score (standardised) *c	0.030	0.007	0.000	-0.011	0.008	0.160	-0.027	0.006	0.000	-0.009	0.006	0.151
Economic disadvantage (reference: not disadvantaged)	0.213	0.014	0.000	0.137	0.016	0.000	0.002	0.012	0.852	0.011	0.012	0.337
Ethnicity (reference: White British)	0.000	.	.	0.000	.	.	0.000	.	.	0.000	.	.
Ethnicity: Pakistani	0.186	0.015	0.000	0.199	0.021	0.000	-0.083	0.015	0.000	-0.028	0.016	0.080
Ethnicity: Other	-0.081	0.020	0.000	-0.042	0.024	0.084	-0.096	0.018	0.000	-0.061	0.018	0.001
Adjusted prescription count (standardised)							0.489	0.006	0.000	0.489	0.006	0.000
Repeat prescription count (standardised)							0.047	0.005	0.000	0.046	0.005	0.000
Score at least 1 on Charlson Index (reference: no score)							0.033	0.014	0.017	0.030	0.014	0.027
IMD of GP practice (standardised) *c										-0.033	0.007	0.000
GP's per 1000 patients in GP practice (standardised) *c										0.067	0.006	0.000
List size of GP practice (standardised) *c										0.013	0.006	0.025
Interaction: IMD of GP practice & GP's per 1000 patients										-0.010	0.005	0.081

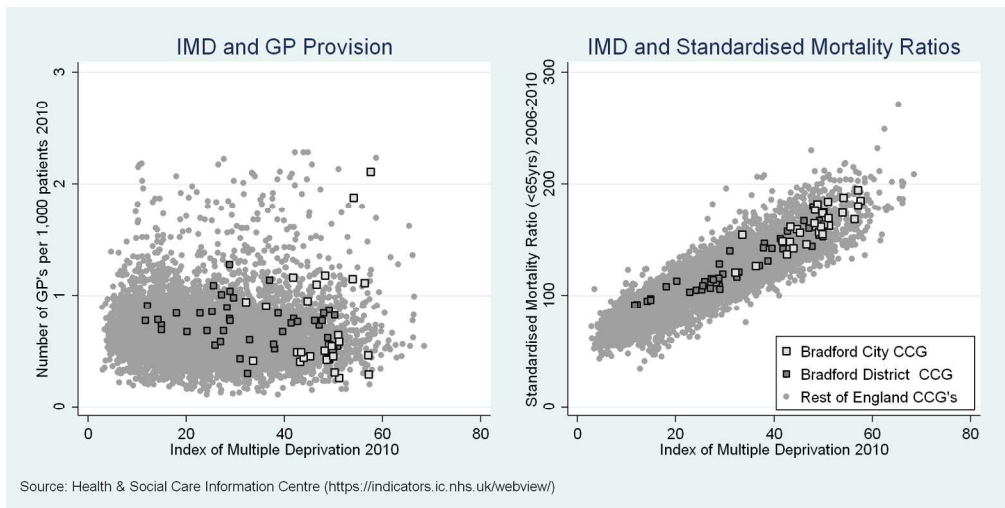
*a Models 2, 3 and 4 contain covariates: date of birth, Country of birth, previous parity, subsequent pregnancies in the study period, number of GP practices registered at in the study period, smoking and BMI.

*b Constant terms for univariate models: weighted IMD score (1.809), economic disadvantage (1.677), ethnicity (1.733).

*c Neighbourhood IMD and GP Practice scores are averaged for individuals who lived in more than one LSOA and more than one GP practice in the study period

Estimates obtained by negative binomial regression, exposure is years registered with a GP practice. Log alpha of all models is significantly greater than 1, for model 4 this is 1.639 ($p < 0.001$), indicating that the negative binomial distribution fits the data better than a Poisson distribution.

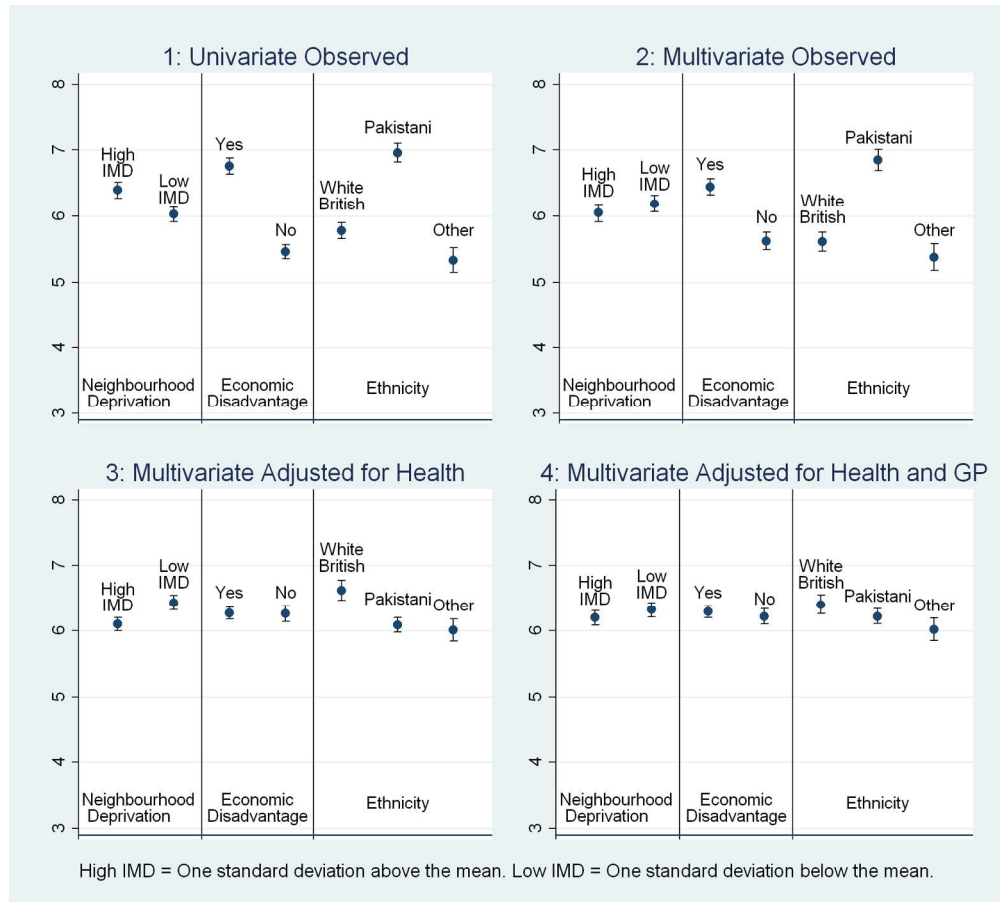
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60



Source: Health & Social Care Information Centre (<https://indicators.ic.nhs.uk/webview/>)

GP practice measures by CCG
Figure 1 about here
705x352mm (72 x 72 DPI)

Peer Review



Predicted GP consultation rates: Model 1 to 4
 Figure 2 about here
 705x635mm (72 x 72 DPI)

