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Breast cancer screening uptake among women from different ethnic groups in London

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ABSTRACT

Objective: To use newly available self-assigned ethnicity information to investigate variation in breast cancer screening uptake for women from the 16 specific ethnic groups within the broad Asian, Black and White groups that previous studies report.

Setting: National cancer screening programme services within London.

Participants: 655516 female residents aged 50-69, invited for screening between March 2006 and December 2009. Ethnicity information was available for 475478 (72.5%). White British women were the largest group (306,689, 46.8%), followed by Indian (34,687, 5.3%), White Other (30,053, 4.6%), Black Caribbean (25,607, 3.9%), White Irish (17,271, 2.6%), Black African (17,071, 2.6%) and Asian Other (10,579, 1.6%).

Outcome measures: Uptake for women in different ethnic groups aged 50-52 for a first call invitation to the programme, and for women aged 50-69 for a routine recall invitation after a previous mammography. Uptake is reported 1) for London overall, adjusted using logistic regression, for age at invitation, socioeconomic deprivation and geographical screening area, and 2) for individual areas, adjusted for age and deprivation.

Results: White British women attended their first call (67%) and routine recall (78%) invitations most often. Indian women were more likely to attend their first (61%) or routine recall (74%) than Bangladeshi women (43% and 61%, respectively), and Black Caribbean women were more likely than Black African women to attend both first call (63% versus 49%) and routine recall (74% versus 64%). There was less variation between ethnic groups in some screening areas.

Conclusion: Breast cancer screening uptake in London varies by specific ethnic group for first and subsequent invitations, with White British women being more likely to attend. The variation in the uptake for women from ethnic groups in different geographical areas suggests that collaboration about the successful engagement of services with different communities could improve uptake for all women.

296 words

Article summary**Strengths and limitations of this study**

- Women from different ethnic groups in the UK have differing awareness of NHS cancer screening programmes but studies assessing uptake of breast cancer screening have investigated only the broad Asian, Black and White ethnic groups.
- This study used new self-assigned data on the more specifically defined ethnic groups and investigated different geographical screening areas of a diverse London population which has a low screening uptake.
- The study found significant differences in the uptake of breast cancer screening within each of the broad White, Black and Asian ethnic groups in London.
- The variation in screening uptake found for women from specific ethnic groups between different geographical screening areas of London suggests there are significant opportunities to improve uptake for all women.

Introduction

The English Breast Screening Programme aims to identify breast cancers at an early stage, therefore improving treatment options and survival.[1, 2] Uptake of breast cancer screening is defined as the proportion of women invited who attend for screening within six months of their invitation. Within England, this has been consistently lower in London than other areas.[3] London is the most ethnically diverse area in England, and previous research has shown that different ethnic groups have varying knowledge of cancer screening programmes[4] and beliefs about their personal risk of breast cancer.[5]

A recent British survey found there was no statistically significant difference in the proportion of White British women and women from any other ethnic group who reported ever having had a mammogram, although White British women were more likely to report having had a cervical smear.[6] Breast screening attendance has been found to vary between the broad White (British, Irish and White Other), Black (Caribbean, African and Black Other) and Asian (Indian, Pakistani, Bangladeshi and Asian Other) groups within London,[7] and uptake is lower in some Asian religio-linguistic groups, particularly Muslim women, compared with non-Asian groups in the West Midlands.[8] Scottish data have shown that after taking age, education, deprivation, long-term illness and urban/rural status into account, White Scottish women were more likely to attend breast cancer screening than women from Other White British, Irish, Other White, Mixed, Indian, Pakistani, Other South Asian, African and Other ethnic groups.[9]

This study aimed to examine the difference in breast cancer screening uptake in London in the 16 more specifically defined ethnic groups from the England and Wales 2001 Census using individual-level self-assigned ethnicity information.

METHODS

Information on women resident in London who had been sent a breast cancer screening invitation between 31/03/2006 and 31/12/2009 was obtained from the London Quality

Assurance Reference Centre. Invitations were from six geographical screening areas – North London; West of London; Barking, Havering, Redbridge & Brentwood; Central & East London; South East London; and South West London. Each woman's earliest invitation in this period was examined and the data were split into two groups. Women aged 50-52 who had a first call invitation (a first invite to the national screening programme), and women aged 50-69 who had a routine recall invitation (after previously attending for a screening programme mammography) were analysed separately.

Self-assigned ethnicity was recorded by the screening programme on attendance, but if a woman never attended a screening appointment, or chose not to describe her ethnic group, this information was missing. In these cases, multiple imputation was used to estimate this variable, based on age when invited, screening area, type of invitation (first call or routine recall), ward of residence, socioeconomic deprivation and screening attendance. The 16 ethnic groups from the England and Wales 2001 Census were analysed (Table 1). Socioeconomic deprivation was measured using the income domain from the Indices of Deprivation 2007[10] divided into quintiles over the whole of England.

Table 1: Number and percentage of women invited for first call and routine recall breast cancer screening appointments in different ethnic groups, London screening areas

Ethnic group	First call		Routine recall		Total	
	N	(%)	n	(%)	N	(%)
White British	54,941	(34.5)	251,748	(50.7)	306,689	(46.8)
White Irish	2,498	(1.6)	14,773	(3.0)	17,271	(2.6)
White Other	6,838	(4.3)	23,215	(4.7)	30,053	(4.6)
Mixed White & Black Caribbean	437	(0.3)	1,096	(0.2)	1,533	(0.2)
Mixed White & Black African	347	(0.2)	771	(0.2)	1,118	(0.2)
Mixed White & Asian	351	(0.2)	954	(0.2)	1,305	(0.2)
Mixed Other	508	(0.3)	1,256	(0.3)	1,764	(0.3)
Indian	8,023	(5.0)	26,664	(5.4)	34,687	(5.3)
Pakistani	1,624	(1.0)	4,554	(0.9)	6,178	(0.9)
Bangladeshi	1,135	(0.7)	3,065	(0.6)	4,200	(0.6)
Asian Other	2,591	(1.6)	7,988	(1.6)	10,579	(1.6)
Black Caribbean	6,514	(4.1)	19,093	(3.8)	25,607	(3.9)
Black African	4,962	(3.1)	12,109	(2.4)	17,071	(2.6)
Black Other	406	(0.3)	1,065	(0.2)	1,471	(0.2)
Chinese	1,557	(1.0)	4,693	(0.9)	6,250	(1.0)
Any Other	2,552	(1.6)	7,150	(1.4)	9,702	(1.5)
Missing	63,794	(40.1)	116,244	(23.4)	180,038	(27.5)
Total	159,078	(100.0)	496,438	(100.0)	655,516	(100.0)

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3 Screening attendance in different ethnic groups was assessed using logistic regression, and
4 adjusted for age at invitation, socioeconomic deprivation and screening area. White British
5 women were used as the baseline group. Results were then back transformed to calculate
6 adjusted proportions for each ethnic group. The six individual screening areas were also analysed
7 separately, adjusting for age and socioeconomic deprivation to assess variation in the attendance
8 of specific ethnic groups within them.
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14 15 16 17 **RESULTS**

18 Data on 159078 women were included in the first call analysis, and on 496438 women in the
19 routine recall analysis. Ethnicity information was available for 475478 (72.5%) of women
20 analysed: 95284 (59.9%) of the first call group and 380194 (76.6%) of the routine recall group
21 (Table 1). White British women were the largest known ethnic group (46.8%), followed by Indian
22 women (5.3%) and White Other women (4.6%).
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31 The number of women invited and screened in the two invitation groups are shown overall and for
32 age, screening area and socioeconomic deprivation groups in Table 2. Of the women invited for
33 their first call screening appointment, 96452 (61%) attended. Attendance ranged in the different
34 screening areas from 55% in Central & East London and 56% in the West of London areas, to
35 71% in Barking, Havering, Redbridge & Brentwood. Women resident in the most deprived areas
36 were less likely to attend than those living in more affluent areas. Uptake was higher for women
37 who were invited to a routine recall appointment, with 371848 (75%) women attending having
38 previously attended a screening appointment. Again, attendance was highest in Barking,
39 Havering, Redbridge & Brentwood (82%), while the lowest attendance was in the West of London
40 (72%) and North London (73%) screening areas. Routine recall screening uptake decreased as
41 both age at invitation deprivation of area of residence increased.
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Table 2: Number of women invited and who attended first call and routine recall breast cancer screening appointments, London screening areas

	First call			Routine recall		
	Invited	Attended	(%)	Invited	Attended	(%)
Age						
50	59,484	36,949	(62)			
51	56,044	35,184	(63)			
52	43,550	24,319	(56)			
50-54				72,555	57,399	(79)
55-59				158,787	121,491	(77)
60-64				148,021	110,061	(74)
65-69				117,075	82,897	(71)
Screening area						
North London	33,923	20,686	(61)	107,203	77,850	(73)
West of London	27,504	15,476	(56)	79,081	56,864	(72)
Barking, Havering, Redbridge & Brentwood	16,246	11,554	(71)	55,094	45,316	(82)
Central & East London	25,570	14,047	(55)	62,636	43,539	(70)
South East London	27,052	16,399	(61)	102,491	79,784	(78)
South West London	28,783	18,290	(64)	89,933	68,495	(76)
Deprivation quintile						
1 (most affluent)	20,732	13,604	(66)	76,355	60,651	(79)
2	20,266	13,541	(67)	74,639	58,751	(79)
3	27,145	17,010	(63)	92,749	70,960	(77)
4	40,661	24,384	(60)	123,628	91,339	(74)
5 (most deprived)	50,274	27,913	(56)	129,067	90,147	(70)
Total	159,078	96,452	(61)	496,438	371,848	(75)

The proportions of women attending screening appointments in different ethnic groups, adjusted for age, socioeconomic deprivation and screening area are shown in Figure 1. Compared with White British women, all other ethnic groups were less likely to attend their first call (67%, Figure 1a) and routine recall (78%, Figure 1b) invitation. Variation within each of the broad ethnic groups was also seen. For example, Bangladeshi women were less likely to attend their first call (43%) or routine recall (61%) appointments than Indian women (61% and 74%, respectively), and Black Caribbean women were more likely than Black African women to attend both first call (63% versus 49%) and routine recall (74% versus 64%) appointments.

There was less variation in first call uptake between ethnic groups in some of the screening areas (Figure 2). For example, in the West of London screening area, White Irish, Indian, Asian Other,

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3 Chinese and all of the Mixed groups of women were as likely to attend their first call appointment
4 as White British women. White Irish, Indian, Black Caribbean, Chinese and all Mixed groups also
5 had the same likelihood of attending as White British women in South West London. However,
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7 the biggest difference in attendance was in South East London, where Pakistani (19%) and
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9 Bangladeshi (14%) women had a much lower uptake of their first call invitation than other ethnic
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11 groups (between 40% in Asian Other women and 69% in White British women).
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17 When routine recall uptake was analysed separately for the screening areas (Figure 3), Mixed
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19 White & Asian and Chinese women were as likely to attend their screening appointment as White
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21 British women in four of the areas (North London, West of London, Central & East London, and
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23 South West London). In general, there was less variation between ethnic groups within the
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25 screening areas than overall, although in Barking, Havering, Redbridge & Brentwood and South
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27 East London, White British women were more likely to attend than all other ethnic groups. The
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29 biggest discrepancy was again seen in South East London where Bangladeshi women had a
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31 screening uptake of 36%, which was less than half the highest uptake figure of 82% for White
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33 British women.
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36 37 **DISCUSSION**

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39 In London, White British women are more likely than other ethnic groups to attend screening
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41 appointments as part of the national Breast Screening Programme. This difference is not
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43 explained by socioeconomic deprivation or place of residence. Variation in uptake is also found
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45 for the more specific ethnic groups within the broad Asian, Black and White ethnic groups.
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47 However, within some screening areas, women from several specific ethnic groups had uptake
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49 rates similar to White British women's. These results were found for both the first invitation and
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51 subsequent invitations after women had previously been screened, and were not explained by
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53 differences in socioeconomic deprivation or age.
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3 A previous study of the same region found variation in breast cancer screening attendance
4 between ethnic groups, with areas with large Black populations having lower attendance.[7] The
5 pattern with the Asian group was more complex, and probably a consequence of combining the
6 diverse Indian, Pakistani, Bangladeshi and Asian Other groups into one. The present study's
7 ability to examine the more specific census categories within each broad ethnic group has shown
8 other important differences, for example, the lower uptake in Black African women compared
9 with Black Caribbean women, and in White Other women compared with White British women.
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19 A survey of women in Britain by Moser *et al* showed that while White British women were more
20 likely to report ever having had a mammogram than women from other ethnic groups after
21 adjusting for age, this difference was attenuated after additionally adjusting for region and
22 various socioeconomic factors.[6] However, this measure does not indicate whether a woman
23 has attended routine screening appointments, as any reason for having a mammography was
24 included. As the present study found all other ethnic groups had lower or similar uptake of breast
25 screening to White British women, it may be the difference in measurement that explains the
26 different results between these two studies. Alternatively, the income domain of the Indices of
27 Deprivation used in the present study may not adequately account for explanatory socioeconomic
28 differences, and the multiple measures (including number of cars available to a household,
29 housing tenure, education level and socioeconomic employment classification) used by Moser *et*
30 *al* may be more appropriate.
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45 The present study used self-assigned individual-level data on ethnicity for both women who were
46 invited for and attended breast cancer screening appointments in London for almost four years.
47 However, ethnicity information was not available for all women who were invited for screening. If
48 a woman had never attended a screening appointment there would be no opportunity for her
49 ethnicity to be recorded. There was therefore a higher proportion of women with ethnicity
50 information in the routine recall group, as these women had all previously attended a screening
51 appointment. However, not all women who attend have an ethnic code recorded, so there was
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3 still missing ethnicity information in this group. Using multiple imputation provided similar
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5 results overall and across the screening areas for the different invitation types, suggesting that
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7 this method was as accurate with the different levels of missing ethnicity data.
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11 Although the 16 more specific ethnic groups from the England and Wales 2001 Census were
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13 examined, there are likely to be other factors within these groups that would affect uptake of
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15 screening invitations. The variation in screening uptake found between Asian religio-linguistic
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17 groups in the West Midlands[8] indicates that the analysis of even more specific ethnic groups
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19 would be useful in future studies.
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23 While Bangladeshi women had low uptake of breast cancer screening overall and in most
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25 screening areas, in Central & East London, where the majority of the Bangladeshi population
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27 live,[11] uptake was more similar to other ethnic groups. Several projects to improve screening
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29 uptake in this area were undertaken around the time of data collection for this analysis.[12]
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31 Although some of the initiatives were focused on White British, White Irish and Bangladeshi
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33 women, an improvement in uptake was only seen in Bangladeshi women.[13]
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37 Even in areas where there was less variation in attendance, some ethnic groups had much lower
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39 uptake. While it makes sense to focus on as many of the eligible population as possible to
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41 improve screening uptake, smaller communities should not be forgotten. Collaboration between
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43 different areas to find successful practices for engaging with particular communities would be an
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45 ideal place to start.
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49 London has a greater population turnover rate than other regions in England, and smaller areas
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51 within London have even higher rates.[14] This may impact on the accuracy of General Practice
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53 lists, so that women who no longer live at an address are being invited to screening
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55 appointments. This would lead to a lower uptake level. Eilbert et al[12] found that increasing
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57 population turnover was actually associated with a higher proportion of eligible women who were
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3 screened in the previous three years. However, the data collected were from different sources in
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5 different years and only a small proportion of the variation between areas was explained by
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7 population turnover.
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11 The fact that women from some ethnic groups had low uptake in both first call and routine recall
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13 implies that not only were these women less likely to attend the screening appointment which
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15 was their first contact with the screening service, but that having attended, they were also less
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17 likely to return. Having a negative previous experience can be a factor in women not attending
18
19 subsequent screening appointments,[15, 16] and therefore improving the experience so that it
20
21 matches the expectations of women from these ethnic groups could help to increase screening
22
23 uptake. While the variation in screening attendance found in this study is a concern, the real
24
25 challenge is ensuring a high level of uptake across all ethnic groups. Work to improve screening
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27 uptake in London has continued since the study period for which these self-assigned ethnicity
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29 data first became available. Future studies can now evaluate the influence of improvement
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31 initiatives on these uptake figures and on the variation between them.
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COMPETING INTERESTS

All authors declare they have no competing interests.

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CONTRIBUTORS

RHJ, TR and EAD designed the study.

TR acquired and advised on the data.

1
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3 HM advised on analysis.

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5 RHJ analysed the data and drafted the manuscript.

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7 All authors interpreted the data, commented on the manuscript and had final approval of the
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9 version to be published.

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13 **DATA SHARING STATEMENT**

14 No additional data available.
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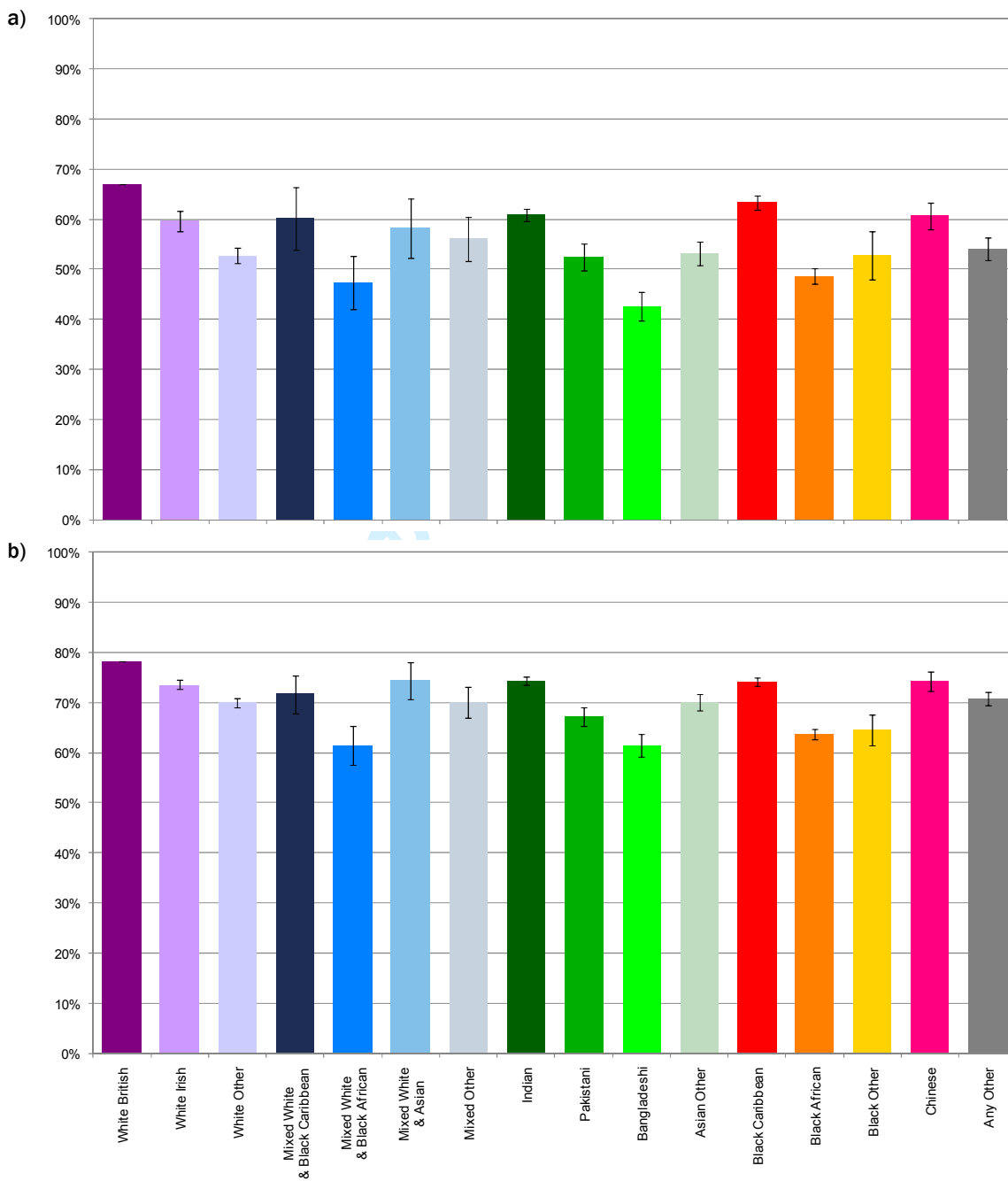
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Figure 1: Uptake of screening invitations in different ethnic groups, London, adjusted for age at invitation, screening area and socioeconomic deprivation. a) first call invites, women aged 50-52 b) routine recall invites, women aged 50-69

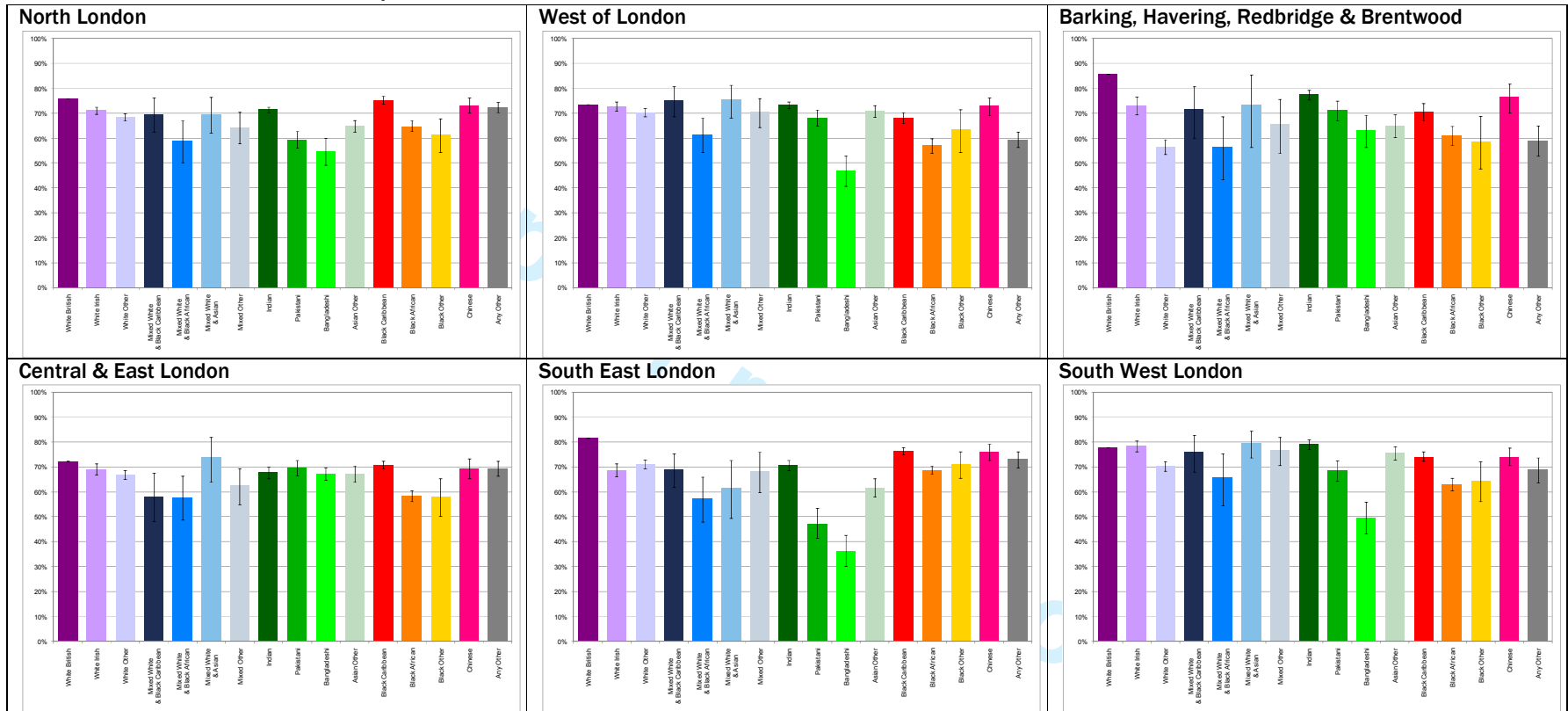


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Figure 2: Uptake of first call screening invitations in different screening areas and ethnic groups, London, women aged 50-52, adjusted for age at invitation and socioeconomic deprivation.



Figure 3: Uptake of routine recall screening invitations in different screening areas and ethnic groups, London, women aged 50-69, adjusted for age at invitation and socioeconomic deprivation.



STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation
Title and abstract	1 Y	(a) Indicate the study's design with a commonly used term in the title or the abstract (b) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction		
Background/rationale	2Y	Explain the scientific background and rationale for the investigation being reported
Objectives	3Y	State specific objectives, including any prespecified hypotheses
Methods		
Study design	4Y	Present key elements of study design early in the paper
Setting	5Y	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants	6 Y	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants (b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case
Variables	7Y	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement	8*Y	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias	9 Y	Describe any efforts to address potential sources of bias
Study size	10 N/A	Explain how the study size was arrived at
Quantitative variables	11 Y	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods	12Y	(a) Describe all statistical methods, including those used to control for confounding (b) Describe any methods used to examine subgroups and interactions (c) Explain how missing data were addressed (d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed <i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed <i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy (e) Describe any sensitivity analyses

Continued on next page

Results		
Participants	13* Y/ N/A	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed (b) Give reasons for non-participation at each stage (c) Consider use of a flow diagram
Descriptive data	14* Y	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders (b) Indicate number of participants with missing data for each variable of interest (c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount) N/A
Outcome data	15* Y	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time Y <i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure <i>Cross-sectional study</i> —Report numbers of outcome events or summary measures
Main results	16Y	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included (b) Report category boundaries when continuous variables were categorized (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17 N/A	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
Discussion		
Key results	Y 18	Summarise key results with reference to study objectives
Limitations	Y 19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation	Y 20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability	Y 21	Discuss the generalisability (external validity) of the study results
Other information		
Funding	Y 22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Breast cancer screening uptake among women from different ethnic groups in London: a population-based cohort study

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3 **Breast cancer screening uptake among women from different ethnic groups in London, a**
4 **population-based cohort study**
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ABSTRACT

Objective: To use newly available self-assigned ethnicity information to investigate variation in breast cancer screening uptake for women from the 16 specific ethnic groups within the broad Asian, Black and White groups that previous studies report.

Setting: National cancer screening programme services within London.

Participants: 655516 female residents aged 50-69, invited for screening between March 2006 and December 2009. Ethnicity information was available for 475478 (72.5%). White British women were the largest group (306,689, 46.8%), followed by Indian (34,687, 5.3%), White Other (30,053, 4.6%), Black Caribbean (25,607, 3.9%), White Irish (17,271, 2.6%), Black African (17,071, 2.6%) and Asian Other (10,579, 1.6%).

Outcome measures: Uptake for women in different ethnic groups aged 50-52 for a first call invitation to the programme, and for women aged 50-69 for a routine recall invitation after a previous mammography. Uptake is reported 1) for London overall, adjusted using logistic regression, for age at invitation, socioeconomic deprivation and geographical screening area, and 2) for individual areas, adjusted for age and deprivation.

Results: White British women attended their first call (67%) and routine recall (78%) invitations most often. Indian women were more likely to attend their first (61%) or routine recall (74%) than Bangladeshi women (43% and 61%, respectively), and Black Caribbean women were more likely than Black African women to attend both first call (63% versus 49%) and routine recall (74% versus 64%). There was less variation between ethnic groups in some screening areas.

Conclusion: Breast cancer screening uptake in London varies by specific ethnic group for first and subsequent invitations, with White British women being more likely to attend. The variation in the uptake for women from the same ethnic groups in different geographical areas suggests that collaboration about the successful engagement of services with different communities could improve uptake for all women.

298 words

Article summary

Strengths and limitations of this study

- Women from different ethnic groups in the UK have differing awareness of NHS cancer screening programmes but studies assessing uptake of breast cancer screening have investigated only the broad Asian, Black and White ethnic groups.
- This study used new self-assigned data on the more specifically defined ethnic groups and investigated different geographical screening areas of a diverse London population which has a low screening uptake.
- The study found significant differences in the uptake of breast cancer screening within each of the broad White, Black and Asian ethnic groups in London.
- The variation in screening uptake found for women from specific ethnic groups between different geographical screening areas of London suggests there are significant opportunities to improve uptake for all women.

INTRODUCTION

The English Breast Screening Programme aims to identify breast cancers at an early stage, therefore improving treatment options and survival.[1, 2] Uptake of breast cancer screening is defined as the proportion of women invited who attend for screening within six months of their invitation. Within England, this has been consistently lower in London than other areas.[3] London is the most ethnically diverse area in England, and previous research has shown that different ethnic groups have varying knowledge of cancer screening programmes[4] and beliefs about their personal risk of breast cancer.[5]

A recent British survey found there was no statistically significant difference in the proportion of White British women and women from any other ethnic group who reported ever having had a mammogram, although White British women were more likely to report having had a cervical smear.[6] Breast screening attendance has been found to vary between the broad White (British, Irish and White Other), Black (Caribbean, African and Black Other) and Asian (Indian, Pakistani, Bangladeshi and Asian Other) groups within London,[7] and uptake is lower in some Asian religio-linguistic groups, particularly Muslim women, compared with non-Asian groups in the West Midlands.[8] Scottish data have shown that after taking age, education, deprivation, long-term illness and urban/rural status into account, White Scottish women were more likely to attend breast cancer screening than women from Other White British, Irish, Other White, Mixed, Indian, Pakistani, Other South Asian, African and Other ethnic groups.[9]

This study aimed to examine the difference in breast cancer screening uptake in London in the 16 more specifically defined ethnic groups from the England and Wales 2001 Census using individual-level self-assigned ethnicity information.

METHODS

Information on women resident in London who had been sent a breast cancer screening invitation between 31/03/2006 and 31/12/2009 was obtained from the London Quality Assurance Reference Centre. Invitations were from six geographical screening areas – North London; West of London; Barking, Havering, Redbridge & Brentwood; Central & East London; South East London; and South West London. Each woman's earliest invitation in this period was examined and the data were split into two groups. Women aged 50-52 who had a first call invitation (a first invite to the national screening programme), and women aged 50-69 who had a routine recall invitation (after previously attending for a screening programme mammography) were analysed separately.

Self-assigned ethnicity was recorded by the screening programme on attendance, including subsequent invitations to the ones studied. If a woman never attended a screening appointment, or chose not to describe her ethnic group, this information was missing. In these cases, multiple imputation was used to estimate this variable. Twenty datasets were imputed for a categorical variable using the statistical software package Stata, based on age when invited, screening area, type of invitation (first call or routine recall), ward of residence, socioeconomic deprivation and screening attendance. The 16 ethnic groups from the England and Wales 2001 Census were analysed (Table 1). Postcodes were used to assign each patient to a lower super output area (LSOA) of residence. Socioeconomic deprivation was measured based on their LSOA using the income domain from the Indices of Deprivation 2007[10] divided into quintiles over the whole of England. Women were assigned to a quintile using their postcode of residence and lower super output area.

Screening attendance in different ethnic groups was assessed using logistic regression, and adjusted for age at invitation, socioeconomic deprivation and screening area. White British women were used as the baseline group. Results were then back transformed to calculate adjusted proportions for each ethnic group. The six individual screening areas were also analysed separately, adjusting for age and

socioeconomic deprivation to assess variation in the attendance of specific ethnic groups within them.

RESULTS

Data on 159078 women were included in the first call analysis, and on 496438 women in the routine recall analysis. Ethnicity information was available for 475478 (72.5%) of women analysed: 95284 (59.9%) of the first call group and 380194 (76.6%) of the routine recall group (Table 1). White British women were the largest known ethnic group (46.8%), followed by Indian women (5.3%) and White Other women (4.6%).

Table 1: Number and percentage of women invited for first call and routine recall breast cancer screening appointments in different ethnic groups, London screening areas

Ethnic group	First call		Routine recall		Total	
	n	(%)	n	(%)	n	(%)
White British	54,941	(34.5)	251,748	(50.7)	306,689	(46.8)
White Irish	2,498	(1.6)	14,773	(3.0)	17,271	(2.6)
White Other	6,838	(4.3)	23,215	(4.7)	30,053	(4.6)
Mixed White & Black Caribbean	437	(0.3)	1,096	(0.2)	1,533	(0.2)
Mixed White & Black African	347	(0.2)	771	(0.2)	1,118	(0.2)
Mixed White & Asian	351	(0.2)	954	(0.2)	1,305	(0.2)
Mixed Other	508	(0.3)	1,256	(0.3)	1,764	(0.3)
Indian	8,023	(5.0)	26,664	(5.4)	34,687	(5.3)
Pakistani	1,624	(1.0)	4,554	(0.9)	6,178	(0.9)
Bangladeshi	1,135	(0.7)	3,065	(0.6)	4,200	(0.6)
Asian Other	2,591	(1.6)	7,988	(1.6)	10,579	(1.6)
Black Caribbean	6,514	(4.1)	19,093	(3.8)	25,607	(3.9)
Black African	4,962	(3.1)	12,109	(2.4)	17,071	(2.6)
Black Other	406	(0.3)	1,065	(0.2)	1,471	(0.2)
Chinese	1,557	(1.0)	4,693	(0.9)	6,250	(1.0)
Any Other	2,552	(1.6)	7,150	(1.4)	9,702	(1.5)
Missing	63,794	(40.1)	116,244	(23.4)	180,038	(27.5)
Total	159,078	(100.0)	496,438	(100.0)	655,516	(100.0)

In the first call group, the proportion of known ethnicity information varied by age (61% in 50 year-olds, 62% in 51 year-olds and 56% in 52 year-olds), socioeconomic deprivation (64% in the most affluent quintile and 56% in the most deprived quintile) and screening area (from 56% in West of London to 73% in Barking, Havering, Redbridge and Brentwood). However, the age and socioeconomic differences were largely due to variation in screening attendance. When examining

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3 only those who attended their screening appointment 91% of 50 and 51 year-olds, 90% of 52 year-
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5 olds, and 91% in each socioeconomic deprivation group had known ethnicity information. There was
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7 still variation between screening areas, with the lowest proportion of known ethnicity in South West
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9 London (83%) and the highest in Barking, Havering, Redbridge and Brentwood and South East
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11 London (97%). Similarly, of women who attended their routine recall screening appointment,
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13 ethnicity was known for 90%-93% of the different age groups and 90%-92% of the different
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15 socioeconomic groups. Women in South West London (82%) were least likely to have a record of
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17 their ethnicity if they attended, and women in South East London (98%) were most likely.
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22 The number of women invited and screened in the two invitation groups are shown overall and for
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24 age, screening area and socioeconomic deprivation groups in Table 2. Of the women invited for their
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26 first call screening appointment, 96452 (61%) attended. Of women who attended this screening
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28 appointment, ethnicity information was available for 87530 (91%) women, while of the 62626 women
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30 who did not attend, ethnicity was known for only 7754 (12%). Attendance ranged in the different
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32 screening areas from 55% in Central & East London and 56% in the West of London areas, to 71% in
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34 Barking, Havering, Redbridge & Brentwood. Women resident in the most deprived areas were less
35
36 likely to attend than those living in more affluent areas. Uptake was higher for women who were
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38 invited to a routine recall appointment, with 371848 (75%) women attending having previously
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40 attended a screening appointment. Ethnicity information was provided by 91% (340001) women who
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42 attended this appointment, and 40193 (32%) women who did not attend. Again, attendance was
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44 highest in Barking, Havering, Redbridge & Brentwood (82%), while the lowest attendance was in the
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46 West of London (72%) and North London (73%) screening areas. Routine recall screening uptake
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48 decreased as both age at invitation deprivation of area of residence increased.
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Table 2: Number of women invited and who attended first call and routine recall breast cancer screening appointments, London screening areas

Age	First call			Routine recall		
	Invited	Attended	(%)	Invited	Attended	(%)
50	59,484	36,949	(62)			
51	56,044	35,184	(63)			
52	43,550	24,319	(56)			
50-54				72,555	57,399	(79)
55-59				158,787	121,491	(77)
60-64				148,021	110,061	(74)
65-69				117,075	82,897	(71)
Screening area						
North London	33,923	20,686	(61)	107,203	77,850	(73)
West of London	27,504	15,476	(56)	79,081	56,864	(72)
Barking, Havering, Redbridge & Brentwood	16,246	11,554	(71)	55,094	45,316	(82)
Central & East London	25,570	14,047	(55)	62,636	43,539	(70)
South East London	27,052	16,399	(61)	102,491	79,784	(78)
South West London	28,783	18,290	(64)	89,933	68,495	(76)
Deprivation quintile						
1 (most affluent)	20,732	13,604	(66)	76,355	60,651	(79)
2	20,266	13,541	(67)	74,639	58,751	(79)
3	27,145	17,010	(63)	92,749	70,960	(77)
4	40,661	24,384	(60)	123,628	91,339	(74)
5 (most deprived)	50,274	27,913	(56)	129,067	90,147	(70)
Total	159,078	96,452	(61)	496,438	371,848	(75)

The proportions of women attending screening appointments in different ethnic groups, adjusted for age, socioeconomic deprivation and screening area are shown in Figure 1. White British women were most likely to attend their first call (67%) and routine recall (78%) invitation. Of the other ethnic groups, first call screening uptake ranged between 43% in Bangladeshi women and 63% in Black Caribbean women (Table 3). Bangladeshi women also had the lowest uptake of routine recall screening invitations (61%), while excluding White British women, Mixed White & Asian women had the highest uptake (75%). Variation within each of the broad ethnic groups was also seen. For example, Indian women were more likely to attend their first call (61%) or routine recall (74%) appointments than Pakistani (52% and 67%, respectively) or Bangladeshi women (43% and 61%, respectively). Black Caribbean women were more likely than Black African women to attend both first call (63% versus 49%) and routine recall (74% versus 64%) appointments.

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5 There was less variation in first call uptake between ethnic groups in some of the screening areas
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7 (Figure 2 and Table 3). For example, in the West of London screening area, White Irish (57%, 95% CI
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9 53%-62%), Indian (60%, 95% CI 58%-63%), Asian Other (58%, 95% CI 54%-61%), Chinese (57%, 95%
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11 CI 51%-62%) and all of the Mixed groups of women were as likely to attend their first call
12
13 appointment as White British women (60%) (Table 3). White Irish (66%, 95% CI 61%-71%), Indian
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15 (69%, 95% CI 65%-73%), Black Caribbean (65%, 95% CI 61%-68%), Chinese (62%, 95% CI 55%-69%)
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17 and all Mixed groups also had the same likelihood of attending as White British women (67%) in
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19 South West London. However, the biggest difference in attendance was in South East London,
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21 where Pakistani (19%, 95% CI 14%-25%) and Bangladeshi (14%, 95% CI 10%-19%) women had a much
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23 lower uptake of their first call invitation than other ethnic groups (between 40% in Asian Other
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25 women and 69% in White British women).
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31 When routine recall uptake was analysed separately for the screening areas (Figure 3 and Table 4),
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33 Mixed White & Asian and Chinese women were as likely to attend their screening appointment as
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35 White British women in four of the areas (North London, West of London, Central & East London, and
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37 South West London). In general, there was less variation between ethnic groups within the screening
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39 areas than overall, although in Barking, Havering, Redbridge & Brentwood and South East London,
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41 White British women were more likely to attend than all other ethnic groups. The biggest
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43 discrepancy was again seen in South East London where Bangladeshi women had a screening uptake
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45 of 36% (95% CI 30%-43%), which was less than half the highest uptake figure of 82% for White British
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47 women.
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50 51 52 53 **DISCUSSION**

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55 In London, White British women are more likely than other ethnic groups to attend screening
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57 appointments as part of the national Breast Screening Programme. This difference is not explained
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3 by socioeconomic deprivation or place of residence. Variation in uptake is also found for the more
4 specific ethnic groups within the broad Asian, Black and White ethnic groups. However, within some
5 screening areas, women from several specific ethnic groups had uptake rates similar to White British
6 women's. These results were found for both the first invitation and subsequent invitations after
7 women had previously been screened, and were not explained by differences in socioeconomic
8 deprivation or age.
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12 A previous study of the same region found variation in breast cancer screening attendance between
13 ethnic groups, with areas with large Black populations having lower attendance.[7] The pattern with
14 the Asian group was more complex, and probably a consequence of combining the diverse Indian,
15 Pakistani, Bangladeshi and Asian Other groups into one. The present study's ability to examine the
16 more specific census categories within each broad ethnic group has shown other important
17 differences, for example, the lower uptake in Black African women compared with Black Caribbean
18 women, and in White Other women compared with White British women.
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22 A survey of women in Britain by Moser *et al* showed that while White British women were more likely
23 to report ever having had a mammogram than women from other ethnic groups combined after
24 adjusting for age, this difference was attenuated and not statistically significant after additionally
25 adjusting for region and various socioeconomic factors.[6] However, this measure does not indicate
26 whether a woman has attended routine screening appointments, as any reason for having a
27 mammography was included. The income domain of the Indices of Deprivation used in the present
28 study may not adequately account for explanatory socioeconomic differences, and the multiple
29 measures (including number of cars available to a household, housing tenure, education level and
30 socioeconomic employment classification) used by Moser *et al* may be more appropriate. Future
31 analyses could explore the effect of different measures of socioeconomic deprivation.
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3 The present study used self-assigned individual-level data on ethnicity for both women who were
4 invited for and attended breast cancer screening appointments in London for almost four years.
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6 However, ethnicity information was not available for all women who were invited for screening. If a
7
8 woman had never attended a screening appointment there would be no opportunity for her ethnicity
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10 to be recorded. There was therefore a higher proportion of women with ethnicity information in the
11
12 routine recall group, as these women had all previously attended a screening appointment. However,
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14 not all women who attend have an ethnic code recorded, so there was still missing ethnicity
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16 information in this group. Restricting the routine recall analysis to those who had a known ethnicity
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18 had little impact on the results (data not shown). Using multiple imputation provided similar results
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20 overall and across the screening areas for the different invitation types, suggesting that this method
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22 was as accurate with the different levels of missing ethnicity data.
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29 Although the 16 more specific ethnic groups from the England and Wales 2001 Census were
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31 examined, there are likely to be other factors within these groups that would affect uptake of
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33 screening invitations. The variation in screening uptake found between Asian religio-linguistic groups
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35 in the West Midlands[8] indicates that the analysis of even more specific ethnic groups would be
36
37 useful in future studies.
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42 While Bangladeshi women had low uptake of breast cancer screening overall and in most screening
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44 areas, in Central & East London, where the majority of the Bangladeshi population live,[11] uptake
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46 was more similar to other ethnic groups. Several projects to improve screening uptake in this area
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48 were undertaken around the time of data collection for this analysis.[12] Although some of the
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50 initiatives were focused on White British, White Irish and Bangladeshi women, an improvement in
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52 uptake was only seen in Bangladeshi women, the ethnic group with the lowest uptake in London.[13]
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3 Even in areas where there was less variation in attendance, some ethnic groups had much lower
4 uptake. While it makes sense to focus on as many of the eligible population as possible to improve
5 screening uptake, smaller communities should not be forgotten. Collaboration between different
6 areas to find successful practices for engaging with particular communities would be an ideal place to
7 start.
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15 London has a greater population turnover rate than other regions in England, and smaller areas
16 within London have even higher rates.[14] This may impact on the accuracy of General Practice lists,
17 so that women who no longer live at an address are being invited to screening appointments. This
18 would lead to a lower uptake level. Eilbert *et al*[12] found that increasing population turnover was
19 actually associated with a higher proportion of eligible women who were screened in the previous
20 three years. However, the data collected were from different sources in different years and only a
21 small proportion of the variation between areas was explained by population turnover.
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33 The fact that women from some ethnic groups had low uptake in both first call and routine recall
34 implies that not only were these women less likely to attend the screening appointment which was
35 their first contact with the screening service, but that having attended, they were also less likely to
36 return. Having a negative previous experience can be a factor in women not attending subsequent
37 screening appointments,[15, 16] and therefore improving the experience so that it matches the
38 expectations of women from these ethnic groups could help to increase screening uptake. While the
39 variation in screening attendance found in this study is a concern, the real challenge is ensuring a high
40 level of uptake across all ethnic groups. Work to improve screening uptake in London has continued
41 since the study period for which these self-assigned ethnicity data first became available. Future
42 studies can now evaluate the influence of improvement initiatives on these uptake figures and on the
43 variation between them.
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COMPETING INTERESTS

All authors declare they have no competing interests.

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CONTRIBUTORS

RHJ, TR and EAD designed the study.

TR acquired and advised on the data.

HM advised on analysis.

RHJ analysed the data and drafted the manuscript.

All authors interpreted the data, commented on the manuscript and had final approval of the version to be published.

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No additional data available

For peer review only

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Table 3: Fully adjusted percentages (%) and 95% confidence intervals (95% CI) of uptake of first call screening invitations in different ethnic groups by screening areas and overall in London, women aged 50-52

Ethnic group	North London*		West of London*		Barking, Havering, Redbridge & Brentwood*		Central & East London*		South East London*		South West London*		All London†	
	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)
White British‡	67		60		79		59		69		67		67	
White Irish	60	(56, 63)	57	(53, 62)	59	(51, 66)	59	(54, 63)	47	(41, 54)	66	(61, 71)	60	(58, 62)
White Other	51	(49, 54)	52	(50, 55)	39	(35, 44)	53	(50, 56)	52	(49, 55)	55	(52, 58)	53	(51, 54)
Mixed White & Black Caribbean	59	(49, 67)	63	(50, 74)	53	(34, 70)	51	(40, 61)	57	(45, 69)	68	(54, 79)	60	(54, 66)
Mixed White & Black African	43	(33, 53)	51	(42, 61)	40	(23, 59)	41	(32, 51)	43	(32, 55)	56	(43, 68)	47	(42, 53)
Mixed White & Asian	59	(48, 69)	57	(46, 67)	54	(36, 71)	54	(38, 69)	47	(33, 61)	69	(55, 80)	58	(52, 64)
Mixed Other	54	(43, 64)	64	(55, 72)	48	(33, 64)	47	(37, 57)	47	(36, 58)	62	(52, 70)	56	(52, 60)
Indian	60	(58, 62)	60	(58, 63)	67	(63, 70)	51	(47, 54)	50	(46, 55)	69	(65, 73)	61	(60, 62)
Pakistani	45	(40, 50)	53	(48, 58)	68	(62, 74)	58	(53, 62)	19	(14, 25)	53	(45, 60)	52	(50, 55)
Bangladeshi	35	(28, 42)	31	(25, 38)	46	(36, 56)	54	(49, 58)	14	(10, 19)	28	(22, 36)	43	(40, 46)
Asian Other	51	(47, 55)	58	(54, 61)	45	(38, 53)	45	(40, 49)	40	(35, 45)	62	(58, 66)	53	(51, 56)
Black Caribbean	69	(66, 71)	54	(50, 58)	59	(54, 64)	57	(53, 60)	68	(65, 70)	65	(61, 68)	63	(62, 65)
Black African	55	(52, 58)	39	(36, 43)	48	(43, 54)	43	(40, 46)	54	(52, 57)	45	(42, 48)	49	(47, 50)
Black Other	58	(47, 68)	45	(33, 58)	45	(30, 61)	45	(37, 54)	57	(47, 67)	56	(44, 67)	53	(48, 58)
Chinese	61	(56, 65)	57	(51, 62)	62	(53, 70)	60	(54, 65)	61	(54, 67)	62	(55, 69)	61	(58, 63)
Any Other	58	(55, 61)	41	(37, 45)	39	(32, 46)	57	(52, 62)	56	(50, 61)	55	(49, 62)	54	(52, 56)

* Adjusted for age at invitation and socioeconomic deprivation

† Adjusted for age at invitation, socioeconomic deprivation and screening area

‡ Baseline group

Table 4: Fully adjusted percentages (%) and 95% confidence intervals (95% CI) of uptake of routine recall screening invitations in different ethnic groups by screening areas and overall in London, women aged 50-69

Ethnic group	North London*		West London*		of Barking, Havering, Redbridge & Brentwood*		Central & East London*		South London*		East London*		South West London*		All London†	
	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)
White British‡	76		74		86		72		82		78		78			
White Irish	71	(70, 72)	73	(71, 75)	73	(70, 77)	69	(67, 71)	69	(66, 71)	78	(76, 80)	74	(73, 75)		
White Other	68	(67, 70)	70	(69, 72)	56	(53, 59)	67	(65, 69)	71	(69, 73)	70	(68, 72)	70	(69, 71)		
Mixed White & Black Caribbean	70	(62, 76)	75	(69, 81)	71	(60, 81)	58	(48, 68)	69	(62, 75)	76	(68, 83)	72	(68, 75)		
Mixed White & Black African	59	(50, 67)	61	(54, 68)	56	(43, 69)	58	(49, 66)	57	(48, 66)	66	(54, 75)	61	(57, 65)		
Mixed White & Asian	70	(62, 76)	75	(68, 81)	73	(56, 85)	74	(64, 82)	62	(49, 73)	80	(74, 84)	75	(71, 78)		
Mixed Other	64	(58, 70)	70	(64, 76)	66	(54, 76)	63	(55, 69)	68	(60, 76)	77	(71, 82)	70	(67, 73)		
Indian	71	(70, 73)	73	(72, 75)	77	(75, 79)	68	(65, 70)	71	(69, 73)	79	(77, 81)	74	(74, 75)		
Pakistani	59	(56, 63)	68	(65, 71)	71	(67, 75)	70	(67, 73)	47	(41, 54)	69	(64, 72)	67	(65, 69)		
Bangladeshi	55	(49, 60)	47	(41, 53)	63	(56, 69)	67	(65, 70)	36	(30, 43)	50	(43, 56)	61	(59, 64)		
Asian Other	65	(62, 67)	71	(68, 73)	65	(60, 69)	67	(64, 70)	62	(58, 65)	76	(73, 78)	70	(68, 72)		
Black Caribbean	75	(74, 77)	68	(66, 70)	71	(67, 74)	71	(69, 72)	76	(75, 78)	74	(72, 76)	74	(73, 75)		
Black African	65	(63, 67)	57	(54, 60)	61	(57, 65)	58	(56, 60)	69	(67, 70)	63	(60, 66)	64	(63, 65)		
Black Other	61	(54, 68)	63	(54, 72)	59	(48, 69)	58	(50, 65)	71	(66, 76)	65	(56, 72)	65	(61, 68)		
Chinese	73	(70, 76)	73	(69, 76)	76	(70, 82)	69	(65, 73)	76	(73, 79)	74	(71, 78)	74	(72, 76)		
Any Other	72	(70, 74)	59	(56, 63)	59	(53, 65)	69	(66, 72)	73	(70, 76)	69	(64, 74)	71	(70, 72)		

* Adjusted for age at invitation and socioeconomic deprivation

† Adjusted for age at invitation, socioeconomic deprivation and screening area

‡ Baseline group

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FIGURE LEGENDS

Figure 1: Uptake of screening invitations in different ethnic groups, London, adjusted for age at invitation, screening area and socioeconomic deprivation. a) first call invites, women aged 50-52 b) routine recall invites, women aged 50-69

Figure 2: Uptake of first call screening invitations in different screening areas and ethnic groups, London, women aged 50-52, adjusted for age at invitation and socioeconomic deprivation.

Figure 3: Uptake of routine recall screening invitations in different screening areas and ethnic groups, London, women aged 50-69, adjusted for age at invitation and socioeconomic deprivation.

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3 | **Breast cancer screening uptake among women from different ethnic groups in London, a**
4 | **population-based cohort study**
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Article summary

Strengths and limitations of this study

- Women from different ethnic groups in the UK have differing awareness of NHS cancer screening programmes but studies assessing uptake of breast cancer screening have investigated only the broad Asian, Black and White ethnic groups.
- This study used new self-assigned data on the more specifically defined ethnic groups and investigated different geographical screening areas of a diverse London population which has a low screening uptake.
- The study found significant differences in the uptake of breast cancer screening within each of the broad White, Black and Asian ethnic groups in London.
- The variation in screening uptake found for women from specific ethnic groups between different geographical screening areas of London suggests there are significant opportunities to improve uptake for all women.

ABSTRACT

Objective: To use newly available self-assigned ethnicity information to investigate variation in breast cancer screening uptake for women from the 16 specific ethnic groups within the broad Asian, Black and White groups that previous studies report.

Setting: National cancer screening programme services within London.

Participants: 655516 female residents aged 50-69, invited for screening between March 2006 and December 2009. Ethnicity information was available for 475478 (72.5%). White British women were the largest group (306,689, 46.8%), followed by Indian (34,687, 5.3%), White Other (30,053, 4.6%), Black Caribbean (25,607, 3.9%), White Irish (17,271, 2.6%), Black African (17,071, 2.6%) and Asian Other (10,579, 1.6%).

Outcome measures: Uptake for women in different ethnic groups aged 50-52 for a first call invitation to the programme, and for women aged 50-69 for a routine recall invitation after a previous mammography. Uptake is reported 1) for London overall, adjusted using logistic regression, for age at invitation, socioeconomic deprivation and geographical screening area, and 2) for individual areas, adjusted for age and deprivation.

Results: White British women attended their first call (67%) and routine recall (78%) invitations most often. Indian women were more likely to attend their first (61%) or routine recall (74%) than Bangladeshi women (43% and 61%, respectively), and Black Caribbean women were more likely than Black African women to attend both first call (63% versus 49%) and routine recall (74% versus 64%). There was less variation between ethnic groups in some screening areas.

Conclusion: Breast cancer screening uptake in London varies by specific ethnic group for first and subsequent invitations, with White British women being more likely to attend. The variation in the uptake for women from the same ethnic groups in different geographical areas suggests that collaboration about the successful engagement of services with different communities could improve uptake for all women.

2986 words

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INTRODUCTION

The English Breast Screening Programme aims to identify breast cancers at an early stage, therefore improving treatment options and survival.[1, 2] Uptake of breast cancer screening is defined as the proportion of women invited who attend for screening within six months of their invitation. Within England, this has been consistently lower in London than other areas.[3] London is the most ethnically diverse area in England, and previous research has shown that different ethnic groups have varying knowledge of cancer screening programmes[4] and beliefs about their personal risk of breast cancer.[5]

A recent British survey found there was no statistically significant difference in the proportion of White British women and women from any other ethnic group who reported ever having had a mammogram, although White British women were more likely to report having had a cervical smear.[6] Breast screening attendance has been found to vary between the broad White (British, Irish and White Other), Black (Caribbean, African and Black Other) and Asian (Indian, Pakistani, Bangladeshi and Asian Other) groups within London,[7] and uptake is lower in some Asian religio-linguistic groups, particularly Muslim women, compared with non-Asian groups in the West Midlands.[8] Scottish data have shown that after taking age, education, deprivation, long-term illness and urban/rural status into account, White Scottish women were more likely to attend breast cancer screening than women from Other White British, Irish, Other White, Mixed, Indian, Pakistani, Other South Asian, African and Other ethnic groups.[9]

This study aimed to examine the difference in breast cancer screening uptake in London in the 16 more specifically defined ethnic groups from the England and Wales 2001 Census using individual-level self-assigned ethnicity information.

METHODS

Information on women resident in London who had been sent a breast cancer screening invitation between 31/03/2006 and 31/12/2009 was obtained from the London Quality Assurance Reference Centre. Invitations were from six geographical screening areas – North London; West of London; Barking, Havering, Redbridge & Brentwood; Central & East London; South East London; and South West London. Each woman's earliest invitation in this period was examined and the data were split into two groups. Women aged 50-52 who had a first call invitation (a first invite to the national screening programme), and women aged 50-69 who had a routine recall invitation (after previously attending for a screening programme mammography) were analysed separately.

Self-assigned ethnicity was recorded by the screening programme on attendance, [including subsequent invitations to the ones studied](#). ~~but if~~ if a woman never attended a screening appointment, or chose not to describe her ethnic group, this information was missing. In these cases, multiple imputation was used to estimate this variable. [Twenty datasets were imputed for a categorical variable using the statistical software package Stata](#), based on age when invited, screening area, type of invitation (first call or routine recall), ward of residence, socioeconomic deprivation and screening attendance. The 16 ethnic groups from the England and Wales 2001 Census were analysed (Table 1).

[Postcodes were used to assign each patient to a lower super output area \(LSOA\) of residence.](#) Socioeconomic deprivation was measured [based on their LSOA](#) using the income domain from the Indices of Deprivation 2007[10] divided into quintiles over the whole of England. [Women were assigned to a quintile using their postcode of residence and lower super output area.](#)

Screening attendance in different ethnic groups was assessed using logistic regression, and adjusted for age at invitation, socioeconomic deprivation and screening area. White British women were used as the baseline group. Results were then back transformed to calculate adjusted proportions for each ethnic group. The six individual screening areas were also analysed separately, adjusting for age and

socioeconomic deprivation to assess variation in the attendance of specific ethnic groups within them.

RESULTS

Data on 159078 women were included in the first call analysis, and on 496438 women in the routine recall analysis. Ethnicity information was available for 475478 (72.5%) of women analysed: 95284 (59.9%) of the first call group and 380194 (76.6%) of the routine recall group (Table 1). White British women were the largest known ethnic group (46.8%), followed by Indian women (5.3%) and White Other women (4.6%).

Table 1: Number and percentage of women invited for first call and routine recall breast cancer screening appointments in different ethnic groups, London screening areas

Ethnic group	First call		Routine recall		Total	
	n	(%)	n	(%)	n	(%)
White British	54,941	(34.5)	251,748	(50.7)	306,689	(46.8)
White Irish	2,498	(1.6)	14,773	(3.0)	17,271	(2.6)
White Other	6,838	(4.3)	23,215	(4.7)	30,053	(4.6)
Mixed White & Black Caribbean	437	(0.3)	1,096	(0.2)	1,533	(0.2)
Mixed White & Black African	347	(0.2)	771	(0.2)	1,118	(0.2)
Mixed White & Asian	351	(0.2)	954	(0.2)	1,305	(0.2)
Mixed Other	508	(0.3)	1,256	(0.3)	1,764	(0.3)
Indian	8,023	(5.0)	26,664	(5.4)	34,687	(5.3)
Pakistani	1,624	(1.0)	4,554	(0.9)	6,178	(0.9)
Bangladeshi	1,135	(0.7)	3,065	(0.6)	4,200	(0.6)
Asian Other	2,591	(1.6)	7,988	(1.6)	10,579	(1.6)
Black Caribbean	6,514	(4.1)	19,093	(3.8)	25,607	(3.9)
Black African	4,962	(3.1)	12,109	(2.4)	17,071	(2.6)
Black Other	406	(0.3)	1,065	(0.2)	1,471	(0.2)
Chinese	1,557	(1.0)	4,693	(0.9)	6,250	(1.0)
Any Other	2,552	(1.6)	7,150	(1.4)	9,702	(1.5)
Missing	63,794	(40.1)	116,244	(23.4)	180,038	(27.5)
Total	159,078	(100.0)	496,438	(100.0)	655,516	(100.0)

In the first call group, the proportion of known ethnicity information varied by age (61% in 50 year-olds, 62% in 51 year-olds and 56% in 52 year-olds), socioeconomic deprivation (64% in the most affluent quintile and 56% in the most deprived quintile) and screening area (from 56% in West of London to 73% in Barking, Havering, Redbridge and Brentwood). However, the age and socioeconomic differences were largely due to variation in screening attendance. When examining

only those who attended their screening appointment 91% of 50 and 51 year-olds, 90% of 52 year-olds, and 91% in each socioeconomic deprivation group had known ethnicity information. There was still variation between screening areas, with the lowest proportion of known ethnicity in South West London (83%) and the highest in Barking, Havering, Redbridge and Brentwood and South East London (97%). Similarly, of women who attended their routine recall screening appointment, ethnicity was known for 90%-93% of the different age groups and 90%-92% of the different socioeconomic groups. Women in South West London (82%) were least likely to have a record of their ethnicity if they attended, and women in South East London (98%) were most likely.

The number of women invited and screened in the two invitation groups are shown overall and for age, screening area and socioeconomic deprivation groups in Table 2. Of the women invited for their first call screening appointment, 96452 (61%) attended. Of women who attended this screening appointment, ethnicity information was available for 87530 (91%) women, while of the 62626 women who did not attend, ethnicity was known for only 7754 (12%). Attendance ranged in the different screening areas from 55% in Central & East London and 56% in the West of London areas, to 71% in Barking, Havering, Redbridge & Brentwood. Women resident in the most deprived areas were less likely to attend than those living in more affluent areas. Uptake was higher for women who were invited to a routine recall appointment, with 371848 (75%) women attending having previously attended a screening appointment. Ethnicity information was provided by 91% (340001) women who attended this appointment, and 40193 (32%) women who did not attend. Again, attendance was highest in Barking, Havering, Redbridge & Brentwood (82%), while the lowest attendance was in the West of London (72%) and North London (73%) screening areas. Routine recall screening uptake decreased as both age at invitation deprivation of area of residence increased.

Table 2: Number of women invited and who attended first call and routine recall breast cancer screening appointments, London screening areas

Age	First call			Routine recall		
	Invited	Attended	(%)	Invited	Attended	(%)
50	59,484	36,949	(62)			
51	56,044	35,184	(63)			
52	43,550	24,319	(56)			
50-54				72,555	57,399	(79)
55-59				158,787	121,491	(77)
60-64				148,021	110,061	(74)
65-69				117,075	82,897	(71)
Screening area						
North London	33,923	20,686	(61)	107,203	77,850	(73)
West of London	27,504	15,476	(56)	79,081	56,864	(72)
Barking, Havering, Redbridge & Brentwood	16,246	11,554	(71)	55,094	45,316	(82)
Central & East London	25,570	14,047	(55)	62,636	43,539	(70)
South East London	27,052	16,399	(61)	102,491	79,784	(78)
South West London	28,783	18,290	(64)	89,933	68,495	(76)
Deprivation quintile						
1 (most affluent)	20,732	13,604	(66)	76,355	60,651	(79)
2	20,266	13,541	(67)	74,639	58,751	(79)
3	27,145	17,010	(63)	92,749	70,960	(77)
4	40,661	24,384	(60)	123,628	91,339	(74)
5 (most deprived)	50,274	27,913	(56)	129,067	90,147	(70)
Total	159,078	96,452	(61)	496,438	371,848	(75)

The proportions of women attending screening appointments in different ethnic groups, adjusted for age, socioeconomic deprivation and screening area are shown in Figure 1. ~~Compared with~~ White British women, ~~all other ethnic groups~~ were most less likely to attend their first call (67%, ~~Figure 1a~~) and routine recall (78%, ~~Figure 1b~~) invitation. Of the other ethnic groups, first call screening uptake ranged between 43% in Bangladeshi women and 63% in Black Caribbean women (Table 3). Bangladeshi women also had the lowest uptake of routine recall screening invitations (61%), while excluding White British women, Mixed White & Asian women had the highest uptake (75%). Variation within each of the broad ethnic groups was also seen. For example, ~~Bangladeshi-Indian~~ women were less more likely to attend their first call (~~43~~61%) or routine recall (~~61~~74%) appointments than ~~Indian-Pakistani~~ (52% and 67%, respectively) or ~~Bangladeshi~~ women (~~61~~43% and ~~74~~61%,

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3 respectively), and Black Caribbean women were more likely than Black African women to attend
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5 both first call (63% versus 49%) and routine recall (74% versus 64%) appointments.
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10 There was less variation in first call uptake between ethnic groups in some of the screening areas
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12 (Figure 2 and Table 3). For example, in the West of London screening area, White Irish (57%, 95% CI
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14 53%-62%), Indian (60%, 95% CI 58%-63%), Asian Other (58%, 95% CI 54%-61%), Chinese (57%, 95%
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16 CI 51%-62%) and all of the Mixed groups of women were as likely to attend their first call
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18 appointment as White British women (60%) (Table 3). White Irish (66%, 95% CI 61%-71%), Indian
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20 (69%, 95% CI 65%-73%), Black Caribbean (65%, 95% CI 61%-68%), Chinese (62%, 95% CI 55%-69%)
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22 and all Mixed groups also had the same likelihood of attending as White British women (67%) in
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24 South West London. However, the biggest difference in attendance was in South East London,
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26 where Pakistani (19%, 95% CI 14%-25%) and Bangladeshi (14%, 95% CI 10%-19%) women had a much
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28 lower uptake of their first call invitation than other ethnic groups (between 40% in Asian Other
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30 women and 69% in White British women).
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35 When routine recall uptake was analysed separately for the screening areas (Figure 3 and Table 4),
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37 Mixed White & Asian and Chinese women were as likely to attend their screening appointment as
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39 White British women in four of the areas (North London, West of London, Central & East London, and
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41 South West London). In general, there was less variation between ethnic groups within the screening
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43 areas than overall, although in Barking, Havering, Redbridge & Brentwood and South East London,
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45 White British women were more likely to attend than all other ethnic groups. The biggest
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47 discrepancy was again seen in South East London where Bangladeshi women had a screening uptake
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49 of 36% (95% CI 30%-43%), which was less than half the highest uptake figure of 82% for White British
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51 women.
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DISCUSSION

In London, White British women are more likely than other ethnic groups to attend screening appointments as part of the national Breast Screening Programme. This difference is not explained by socioeconomic deprivation or place of residence. Variation in uptake is also found for the more specific ethnic groups within the broad Asian, Black and White ethnic groups. However, within some screening areas, women from several specific ethnic groups had uptake rates similar to White British women's. These results were found for both the first invitation and subsequent invitations after women had previously been screened, and were not explained by differences in socioeconomic deprivation or age.

A previous study of the same region found variation in breast cancer screening attendance between ethnic groups, with areas with large Black populations having lower attendance.[7] The pattern with the Asian group was more complex, and probably a consequence of combining the diverse Indian, Pakistani, Bangladeshi and Asian Other groups into one. The present study's ability to examine the more specific census categories within each broad ethnic group has shown other important differences, for example, the lower uptake in Black African women compared with Black Caribbean women, and in White Other women compared with White British women.

A survey of women in Britain by Moser *et al* showed that while White British women were more likely to report ever having had a mammogram than women from other ethnic groups combined after adjusting for age, this difference was attenuated and not statistically significant after additionally adjusting for region and various socioeconomic factors.[6] However, this measure does not indicate whether a woman has attended routine screening appointments, as any reason for having a mammography was included. ~~As the present study found all other ethnic groups had lower or similar uptake of breast screening to White British women, it may be the difference in measurement that explains the different results between these two studies. Alternatively,~~ the income domain of the

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3 Indices of Deprivation used in the present study may not adequately account for explanatory
4 socioeconomic differences, and the multiple measures (including number of cars available to a
5 household, housing tenure, education level and socioeconomic employment classification) used by
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7 Moser *et al* may be more appropriate. [Future analyses could explore the effect of different measures](#)
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10 [of socioeconomic deprivation.](#)
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15 The present study used self-assigned individual-level data on ethnicity for both women who were
16 invited for and attended breast cancer screening appointments in London for almost four years.
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18 However, ethnicity information was not available for all women who were invited for screening. If a
19 woman had never attended a screening appointment there would be no opportunity for her ethnicity
20 to be recorded. There was therefore a higher proportion of women with ethnicity information in the
21 routine recall group, as these women had all previously attended a screening appointment. However,
22 not all women who attend have an ethnic code recorded, so there was still missing ethnicity
23 information in this group. [Restricting the routine recall analysis to those who had a known ethnicity](#)
24 [had little impact on the results \(data not shown\).](#) Using multiple imputation provided similar results
25 overall and across the screening areas for the different invitation types, suggesting that this method
26 was as accurate with the different levels of missing ethnicity data.
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41 Although the 16 more specific ethnic groups from the England and Wales 2001 Census were
42 examined, there are likely to be other factors within these groups that would affect uptake of
43 screening invitations. The variation in screening uptake found between Asian religio-linguistic groups
44 in the West Midlands[8] indicates that the analysis of even more specific ethnic groups would be
45 useful in future studies.
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54 While Bangladeshi women had low uptake of breast cancer screening overall and in most screening
55 areas, in Central & East London, where the majority of the Bangladeshi population live,[11] uptake
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3 was more similar to other ethnic groups. Several projects to improve screening uptake in this area
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5 were undertaken around the time of data collection for this analysis.[12] Although some of the
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7 initiatives were focused on White British, White Irish and Bangladeshi women, an improvement in
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9 uptake was only seen in Bangladeshi women, [the ethnic group with the lowest uptake in London](#). [13]
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14 Even in areas where there was less variation in attendance, some ethnic groups had much lower
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16 uptake. While it makes sense to focus on as many of the eligible population as possible to improve
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18 screening uptake, smaller communities should not be forgotten. Collaboration between different
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20 areas to find successful practices for engaging with particular communities would be an ideal place to
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22 start.
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26 London has a greater population turnover rate than other regions in England, and smaller areas
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28 within London have even higher rates.[14] This may impact on the accuracy of General Practice lists,
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30 so that women who no longer live at an address are being invited to screening appointments. This
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32 would lead to a lower uptake level. Eilbert *et al*[12] found that increasing population turnover was
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34 actually associated with a higher proportion of eligible women who were screened in the previous
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36 three years. However, the data collected were from different sources in different years and only a
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38 small proportion of the variation between areas was explained by population turnover.
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44 The fact that women from some ethnic groups had low uptake in both first call and routine recall
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46 implies that not only were these women less likely to attend the screening appointment which was
47
48 their first contact with the screening service, but that having attended, they were also less likely to
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50 return. Having a negative previous experience can be a factor in women not attending subsequent
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52 screening appointments,[15, 16] and therefore improving the experience so that it matches the
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54 expectations of women from these ethnic groups could help to increase screening uptake. While the
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56 variation in screening attendance found in this study is a concern, the real challenge is ensuring a high
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3 level of uptake across all ethnic groups. Work to improve screening uptake in London has continued
4 since the study period for which these self-assigned ethnicity data first became available. Future
5 studies can now evaluate the influence of improvement initiatives on these uptake figures and on the
6 variation between them.
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11 12 13 **ACKNOWLEDGEMENTS**

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15 Centre for his help in securing the data and funding for this study.
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20 21 22 **COMPETING INTERESTS**

23 All authors declare they have no competing interests.
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34 completed with the support of the London Knowledge and Intelligence Team, Public Health England.
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43 44 **CONTRIBUTORS**

45 RHJ, TR and EAD designed the study.
46
47

48 TR acquired and advised on the data.
49

50 HM advised on analysis.
51

52 RHJ analysed the data and drafted the manuscript.
53

54 All authors interpreted the data, commented on the manuscript and had final approval of the version
55 to be published.
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For peer review only

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Table 3: Fully adjusted percentages (%) and 95% confidence intervals (95% CI) of uptake of first call screening invitations in different ethnic groups by screening areas and overall in London, women aged 50-52

Ethnic group	North London*		West of London*		Barking, Havering, Redbridge & Brentwood*		Central & East London*		South East London*		South West London*		All London†	
	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)
White British‡	67		60		79		59		69		67		67	
White Irish	60	(56, 63)	57	(53, 62)	59	(51, 66)	59	(54, 63)	47	(41, 54)	66	(61, 71)	60	(58, 62)
White Other	51	(49, 54)	52	(50, 55)	39	(35, 44)	53	(50, 56)	52	(49, 55)	55	(52, 58)	53	(51, 54)
Mixed White & Black Caribbean	59	(49, 67)	63	(50, 74)	53	(34, 70)	51	(40, 61)	57	(45, 69)	68	(54, 79)	60	(54, 66)
Mixed White & Black African	43	(33, 53)	51	(42, 61)	40	(23, 59)	41	(32, 51)	43	(32, 55)	56	(43, 68)	47	(42, 53)
Mixed White & Asian	59	(48, 69)	57	(46, 67)	54	(36, 71)	54	(38, 69)	47	(33, 61)	69	(55, 80)	58	(52, 64)
Mixed Other	54	(43, 64)	64	(55, 72)	48	(33, 64)	47	(37, 57)	47	(36, 58)	62	(52, 70)	56	(52, 60)
Indian	60	(58, 62)	60	(58, 63)	67	(63, 70)	51	(47, 54)	50	(46, 55)	69	(65, 73)	61	(60, 62)
Pakistani	45	(40, 50)	53	(48, 58)	68	(62, 74)	58	(53, 62)	19	(14, 25)	53	(45, 60)	52	(50, 55)
Bangladeshi	35	(28, 42)	31	(25, 38)	46	(36, 56)	54	(49, 58)	14	(10, 19)	28	(22, 36)	43	(40, 46)
Asian Other	51	(47, 55)	58	(54, 61)	45	(38, 53)	45	(40, 49)	40	(35, 45)	62	(58, 66)	53	(51, 56)
Black Caribbean	69	(66, 71)	54	(50, 58)	59	(54, 64)	57	(53, 60)	68	(65, 70)	65	(61, 68)	63	(62, 65)
Black African	55	(52, 58)	39	(36, 43)	48	(43, 54)	43	(40, 46)	54	(52, 57)	45	(42, 48)	49	(47, 50)
Black Other	58	(47, 68)	45	(33, 58)	45	(30, 61)	45	(37, 54)	57	(47, 67)	56	(44, 67)	53	(48, 58)
Chinese	61	(56, 65)	57	(51, 62)	62	(53, 70)	60	(54, 65)	61	(54, 67)	62	(55, 69)	61	(58, 63)
Any Other	58	(55, 61)	41	(37, 45)	39	(32, 46)	57	(52, 62)	56	(50, 61)	55	(49, 62)	54	(52, 56)

* Adjusted for age at invitation and socioeconomic deprivation

† Adjusted for age at invitation, socioeconomic deprivation and screening area

‡ Baseline group

Table 4: Fully adjusted percentages (%) and 95% confidence intervals (95% CI) of uptake of routine recall screening invitations in different ethnic groups by screening areas and overall in London, women aged 50-69

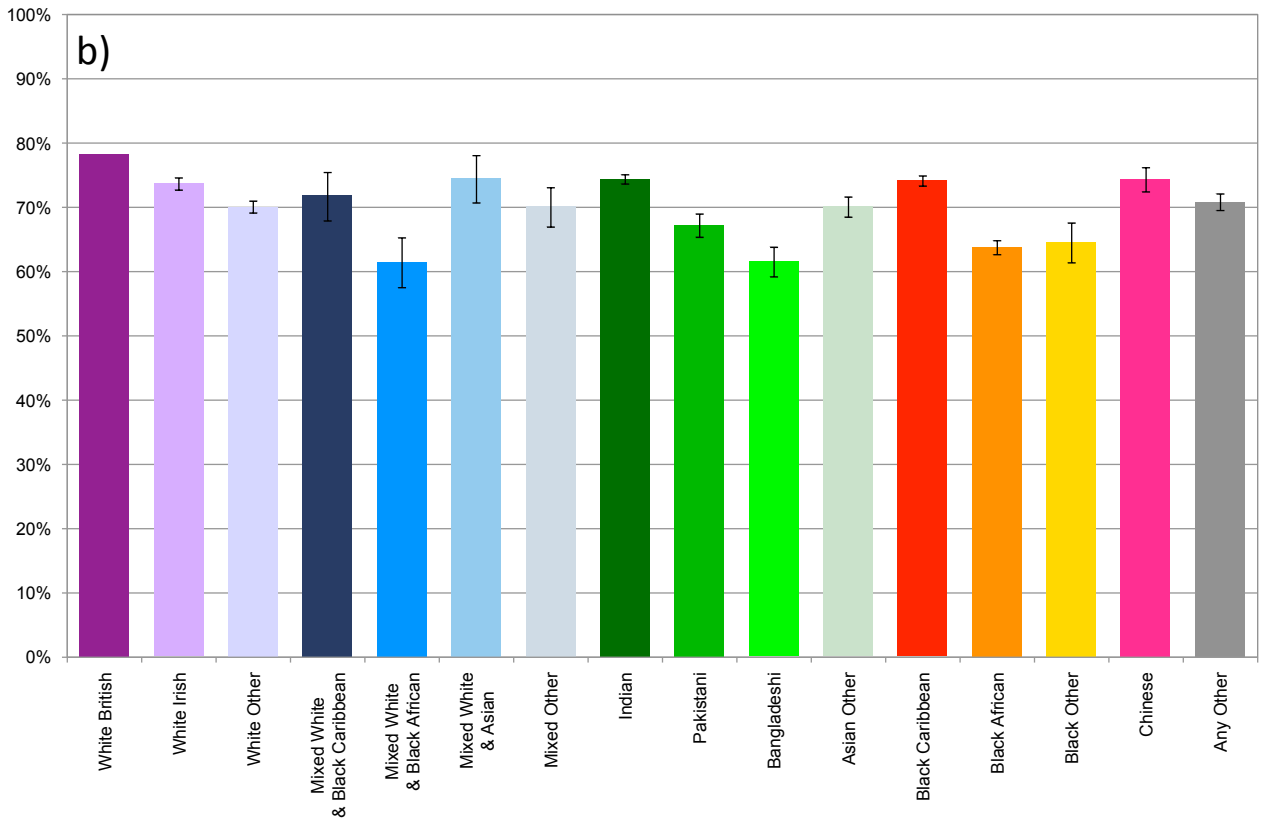
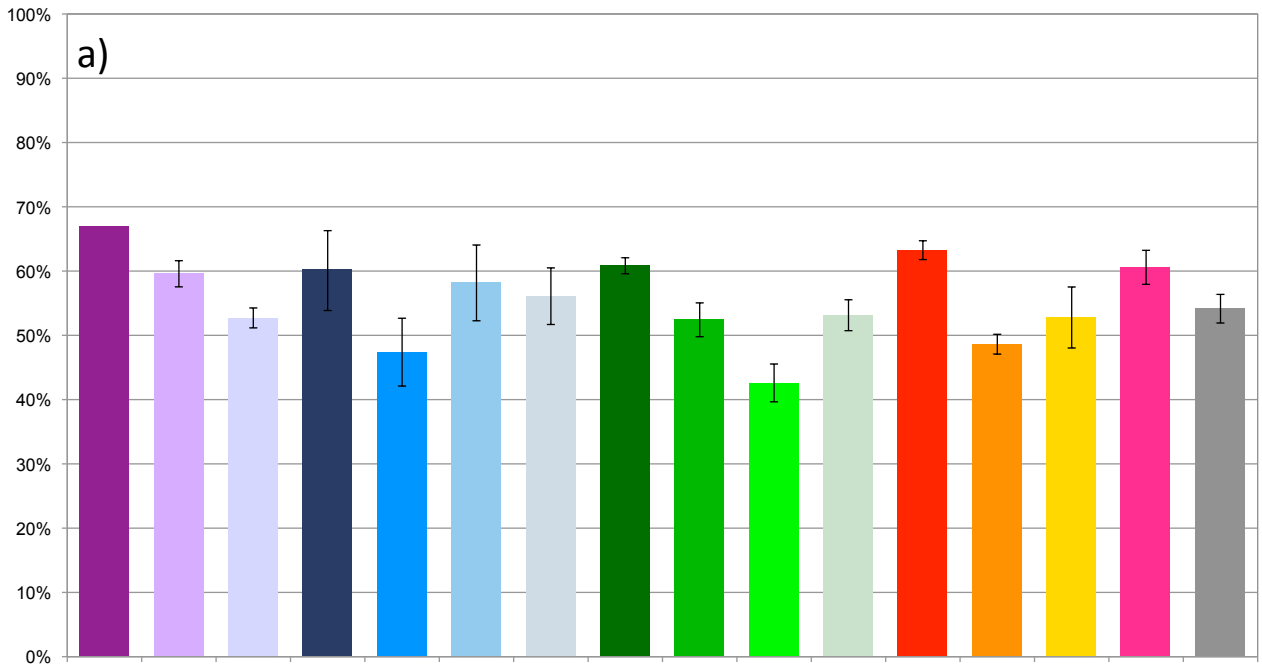
Ethnic group	North London*		West London*		of Barking, Havering, Redbridge & Brentwood*		Central & East London*		South London*		East London*		South West London*		All London†	
	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)
White British‡	76		74		86		72		82		78		78			
White Irish	71	(70, 72)	73	(71, 75)	73	(70, 77)	69	(67, 71)	69	(66, 71)	78	(76, 80)	74	(73, 75)		
White Other	68	(67, 70)	70	(69, 72)	56	(53, 59)	67	(65, 69)	71	(69, 73)	70	(68, 72)	70	(69, 71)		
Mixed White & Black Caribbean	70	(62, 76)	75	(69, 81)	71	(60, 81)	58	(48, 68)	69	(62, 75)	76	(68, 83)	72	(68, 75)		
Mixed White & Black African	59	(50, 67)	61	(54, 68)	56	(43, 69)	58	(49, 66)	57	(48, 66)	66	(54, 75)	61	(57, 65)		
Mixed White & Asian	70	(62, 76)	75	(68, 81)	73	(56, 85)	74	(64, 82)	62	(49, 73)	80	(74, 84)	75	(71, 78)		
Mixed Other	64	(58, 70)	70	(64, 76)	66	(54, 76)	63	(55, 69)	68	(60, 76)	77	(71, 82)	70	(67, 73)		
Indian	71	(70, 73)	73	(72, 75)	77	(75, 79)	68	(65, 70)	71	(69, 73)	79	(77, 81)	74	(74, 75)		
Pakistani	59	(56, 63)	68	(65, 71)	71	(67, 75)	70	(67, 73)	47	(41, 54)	69	(64, 72)	67	(65, 69)		
Bangladeshi	55	(49, 60)	47	(41, 53)	63	(56, 69)	67	(65, 70)	36	(30, 43)	50	(43, 56)	61	(59, 64)		
Asian Other	65	(62, 67)	71	(68, 73)	65	(60, 69)	67	(64, 70)	62	(58, 65)	76	(73, 78)	70	(68, 72)		
Black Caribbean	75	(74, 77)	68	(66, 70)	71	(67, 74)	71	(69, 72)	76	(75, 78)	74	(72, 76)	74	(73, 75)		
Black African	65	(63, 67)	57	(54, 60)	61	(57, 65)	58	(56, 60)	69	(67, 70)	63	(60, 66)	64	(63, 65)		
Black Other	61	(54, 68)	63	(54, 72)	59	(48, 69)	58	(50, 65)	71	(66, 76)	65	(56, 72)	65	(61, 68)		
Chinese	73	(70, 76)	73	(69, 76)	76	(70, 82)	69	(65, 73)	76	(73, 79)	74	(71, 78)	74	(72, 76)		
Any Other	72	(70, 74)	59	(56, 63)	59	(53, 65)	69	(66, 72)	73	(70, 76)	69	(64, 74)	71	(70, 72)		

* Adjusted for age at invitation and socioeconomic deprivation

† Adjusted for age at invitation, socioeconomic deprivation and screening area

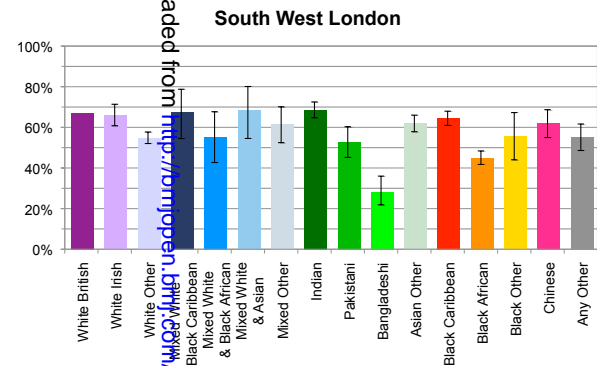
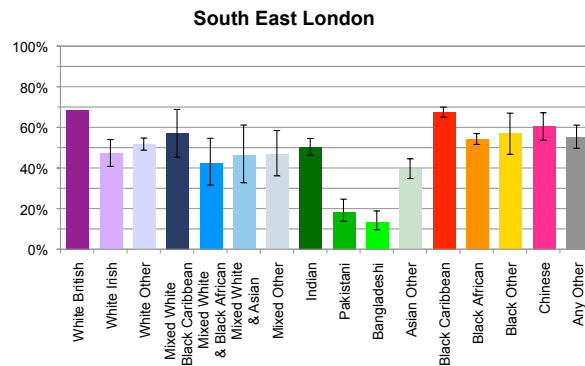
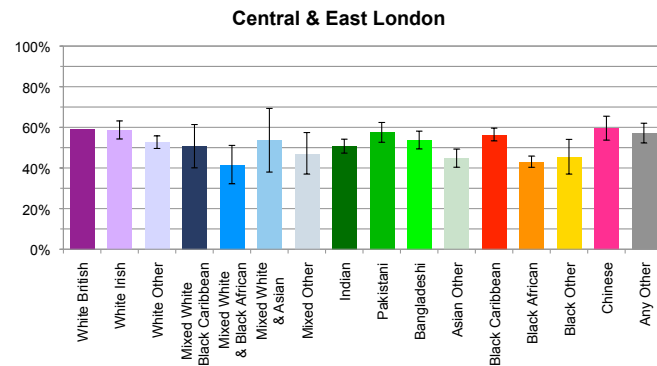
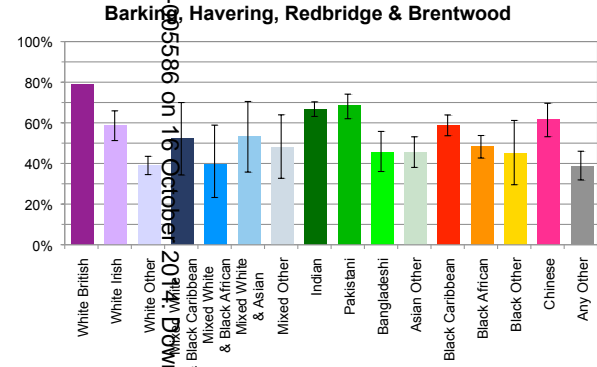
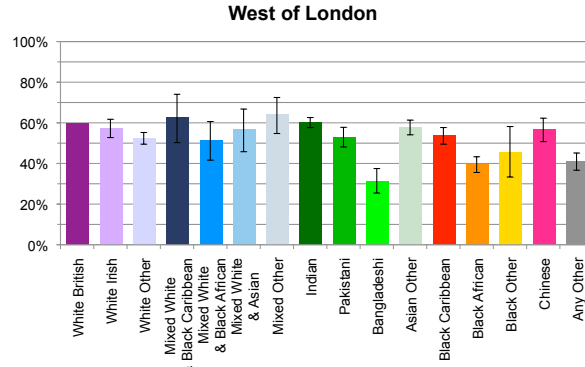
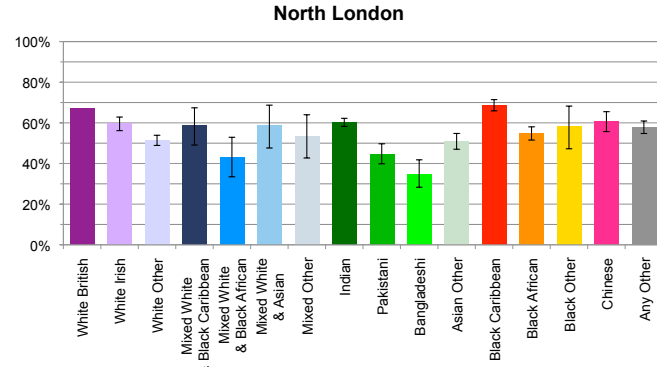
‡ Baseline group

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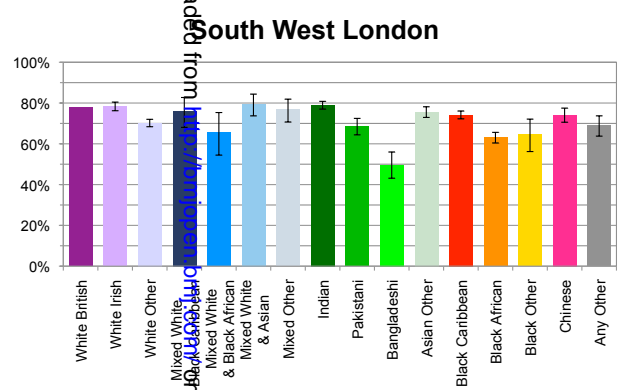
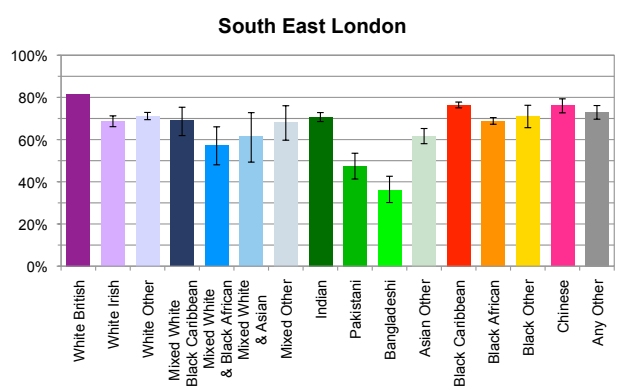
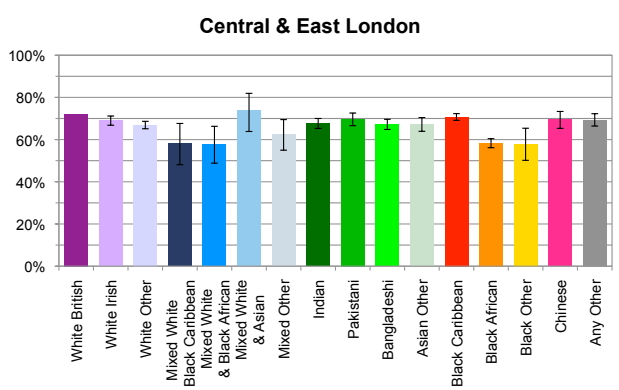
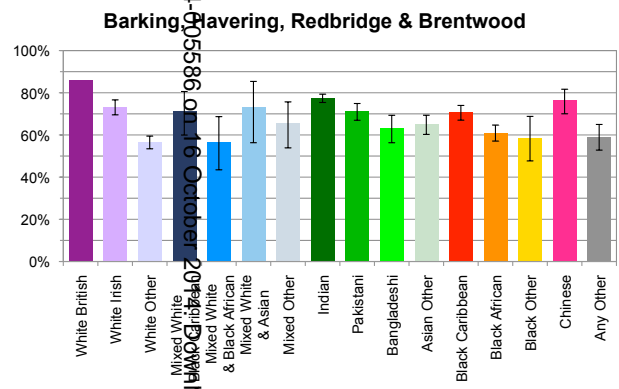
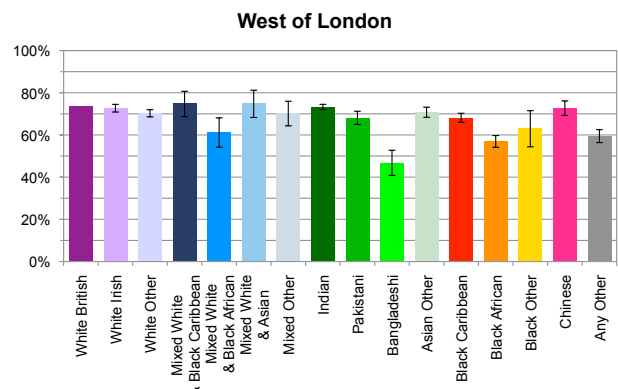
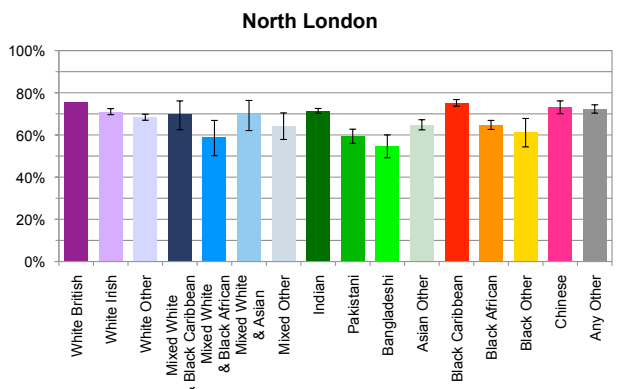
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STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation
Title and abstract	1 Y	(a) Indicate the study's design with a commonly used term in the title or the abstract (b) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction		
Background/rationale	2Y	Explain the scientific background and rationale for the investigation being reported
Objectives	3Y	State specific objectives, including any prespecified hypotheses
Methods		
Study design	4Y	Present key elements of study design early in the paper
Setting	5Y	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants	6 Y	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants (b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case
Variables	7Y	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement	8*Y	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias	9 Y	Describe any efforts to address potential sources of bias
Study size	10 N/A	Explain how the study size was arrived at
Quantitative variables	11 Y	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods	12Y	(a) Describe all statistical methods, including those used to control for confounding (b) Describe any methods used to examine subgroups and interactions (c) Explain how missing data were addressed (d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed <i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed <i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy (e) Describe any sensitivity analyses

Continued on next page

Results		
Participants	13* Y/ N/A	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed <hr/> (b) Give reasons for non-participation at each stage <hr/> (c) Consider use of a flow diagram
Descriptive data	14* Y	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders <hr/> (b) Indicate number of participants with missing data for each variable of interest <hr/> (c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount) N/A
Outcome data	15* Y	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time Y <hr/> <i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure <hr/> <i>Cross-sectional study</i> —Report numbers of outcome events or summary measures
Main results	16Y	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included <hr/> (b) Report category boundaries when continuous variables were categorized <hr/> (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17 N/A	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
Discussion		
Key results	Y 18	Summarise key results with reference to study objectives
Limitations	Y 19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation	Y 20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability	Y 21	Discuss the generalisability (external validity) of the study results
Other information		
Funding	Y 22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Breast cancer screening uptake among women from different ethnic groups in London: a population-based cohort study

Journal:	<i>BMJ Open</i>
Manuscript ID:	bmjopen-2014-005586.R2
Article Type:	Research
Date Submitted by the Author:	19-Aug-2014
Complete List of Authors:	Jack, Ruth; King's College London, Epidemiology and Population Health; Public Health England, Knowledge and Intelligence Team (London) Moller, Henrik; King's College London, Epidemiology and Population Health Robson, Tony; Public Health England, Health and Wellbeing Davies, Elizabeth; King's College London, Cancer Epidemiology and Population Health; Public Health England, Knowledge and Intelligence
Primary Subject Heading:	Public health
Secondary Subject Heading:	Epidemiology, Health services research, Public health
Keywords:	Organisation of health services < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, Epidemiology < ONCOLOGY, PUBLIC HEALTH, PREVENTIVE MEDICINE

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3 Breast cancer screening uptake among women from different ethnic groups in London, a population-
4 based cohort study
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7 Ruth H Jack^{1,2}, Henrik Møller², Tony Robson³, Elizabeth A Davies^{1,2}
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ABSTRACT

Objective: To use newly available self-assigned ethnicity information to investigate variation in breast cancer screening uptake for women from the 16 specific ethnic groups within the broad Asian, Black and White groups that previous studies report.

Setting: National cancer screening programme services within London.

Participants: 655516 female residents aged 50-69, invited for screening between March 2006 and December 2009. Ethnicity information was available for 475478 (72.5%). White British women were the largest group (306,689, 46.8%), followed by Indian (34,687, 5.3%), White Other (30,053, 4.6%), Black Caribbean (25,607, 3.9%), White Irish (17,271, 2.6%), Black African (17,071, 2.6%) and Asian Other (10,579, 1.6%).

Outcome measures: Uptake for women in different ethnic groups aged 50-52 for a first call invitation to the programme, and for women aged 50-69 for a routine recall invitation after a previous mammography. Uptake is reported 1) for London overall, adjusted using logistic regression, for age at invitation, socioeconomic deprivation and geographical screening area, and 2) for individual areas, adjusted for age and deprivation.

Results: White British women attended their first call (67%) and routine recall (78%) invitations most often. Indian women were more likely to attend their first (61%) or routine recall (74%) than Bangladeshi women (43% and 61%, respectively), and Black Caribbean women were more likely than Black African women to attend both first call (63% versus 49%) and routine recall (74% versus 64%). There was less variation between ethnic groups in some screening areas.

Conclusion: Breast cancer screening uptake in London varies by specific ethnic group for first and subsequent invitations, with White British women being more likely to attend. The variation in the uptake for women from the same ethnic groups in different geographical areas suggests that collaboration about the successful engagement of services with different communities could improve uptake for all women.

298 words

Article summary

Strengths and limitations of this study

- Women from different ethnic groups in the UK have differing awareness of NHS cancer screening programmes but studies assessing uptake of breast cancer screening have investigated only the broad Asian, Black and White ethnic groups.
- This study used new self-assigned data on the more specifically defined ethnic groups and investigated different geographical screening areas of a diverse London population which has a low screening uptake.
- The study found significant differences in the uptake of breast cancer screening within each of the broad White, Black and Asian ethnic groups in London.
- The variation in screening uptake found for women from specific ethnic groups between different geographical screening areas of London suggests there are significant opportunities to improve uptake for all women.

INTRODUCTION

The English Breast Screening Programme aims to identify breast cancers at an early stage, therefore improving treatment options and survival.[1, 2] Uptake of breast cancer screening is defined as the proportion of women invited who attend for screening within six months of their invitation. Within England, this has been consistently lower in London than other areas.[3] London is the most ethnically diverse area in England, and previous research has shown that different ethnic groups have varying knowledge of cancer screening programmes[4] and beliefs about their personal risk of breast cancer.[5]

A recent British survey found there was no statistically significant difference in the proportion of White British women and women from any other ethnic group who reported ever having had a mammogram, although White British women were more likely to report having had a cervical smear.[6] Breast screening attendance has been found to vary between the broad White (British, Irish and White Other), Black (Caribbean, African and Black Other) and Asian (Indian, Pakistani, Bangladeshi and Asian Other) groups within London,[7] and uptake is lower in some Asian religio-linguistic groups, particularly Muslim women, compared with non-Asian groups in the West Midlands.[8] Scottish data have shown that after taking age, education, deprivation, long-term illness and urban/rural status into account, White Scottish women were more likely to attend breast cancer screening than women from Other White British, Irish, Other White, Mixed, Indian, Pakistani, Other South Asian, African and Other ethnic groups.[9]

This study aimed to examine the difference in breast cancer screening uptake in London in the 16 more specifically defined ethnic groups from the England and Wales 2001 Census using individual-level self-assigned ethnicity information.

METHODS

Information on women resident in London who had been sent a breast cancer screening invitation between 31/03/2006 and 31/12/2009 was obtained from the London Quality Assurance Reference Centre. Invitations were from six geographical screening areas – North London; West of London; Barking, Havering, Redbridge & Brentwood; Central & East London; South East London; and South West London. Each woman's earliest invitation in this period was examined and the data were split into two groups. Women aged 50-52 who had a first call invitation (a first invite to the national screening programme), and women aged 50-69 who had a routine recall invitation (after previously attending for a screening programme mammography) were analysed separately.

Self-assigned ethnicity was recorded by the screening programme on attendance, including subsequent invitations to the ones studied. If a woman never attended a screening appointment, or chose not to describe her ethnic group, this information was missing. In these cases, multiple imputation was used to estimate this variable. Twenty datasets were imputed for a categorical variable using the statistical software package Stata, based on age when invited, screening area, type of invitation (first call or routine recall), ward of residence, socioeconomic deprivation and screening attendance. The 16 ethnic groups from the England and Wales 2001 Census were analysed (Table 1). Postcodes were used to assign each patient to a lower super output area (LSOA) of residence. Socioeconomic deprivation was measured based on their LSOA using the income domain from the Indices of Deprivation 2007[10] divided into quintiles over the whole of England. Women were assigned to a quintile using their postcode of residence and lower super output area.

Screening attendance in different ethnic groups was assessed using logistic regression, and adjusted for age at invitation, socioeconomic deprivation and screening area. White British women were used as the baseline group. Odds ratios results were then back transformed to calculate adjusted proportions for each ethnic group. The six individual screening areas were also analysed separately,

adjusting for age and socioeconomic deprivation to assess variation in the attendance of specific ethnic groups within them.

RESULTS

Data on 159078 women were included in the first call analysis, and on 496438 women in the routine recall analysis. Ethnicity information was available for 475478 (72.5%) of women analysed: 95284 (59.9%) of the first call group and 380194 (76.6%) of the routine recall group (Table 1). White British women were the largest known ethnic group (46.8%), followed by Indian women (5.3%) and White Other women (4.6%).

Table 1: Number and percentage of women invited for first call and routine recall breast cancer screening appointments in different ethnic groups, London screening areas

Ethnic group	First call		Routine recall		Total	
	n	(%)	N	(%)	n	(%)
White British	54,941	(34.5)	251,748	(50.7)	306,689	(46.8)
White Irish	2,498	(1.6)	14,773	(3.0)	17,271	(2.6)
White Other	6,838	(4.3)	23,215	(4.7)	30,053	(4.6)
Mixed White & Black Caribbean	437	(0.3)	1,096	(0.2)	1,533	(0.2)
Mixed White & Black African	347	(0.2)	771	(0.2)	1,118	(0.2)
Mixed White & Asian	351	(0.2)	954	(0.2)	1,305	(0.2)
Mixed Other	508	(0.3)	1,256	(0.3)	1,764	(0.3)
Indian	8,023	(5.0)	26,664	(5.4)	34,687	(5.3)
Pakistani	1,624	(1.0)	4,554	(0.9)	6,178	(0.9)
Bangladeshi	1,135	(0.7)	3,065	(0.6)	4,200	(0.6)
Asian Other	2,591	(1.6)	7,988	(1.6)	10,579	(1.6)
Black Caribbean	6,514	(4.1)	19,093	(3.8)	25,607	(3.9)
Black African	4,962	(3.1)	12,109	(2.4)	17,071	(2.6)
Black Other	406	(0.3)	1,065	(0.2)	1,471	(0.2)
Chinese	1,557	(1.0)	4,693	(0.9)	6,250	(1.0)
Any Other	2,552	(1.6)	7,150	(1.4)	9,702	(1.5)
Missing	63,794	(40.1)	116,244	(23.4)	180,038	(27.5)
Total	159,078	(100.0)	496,438	(100.0)	655,516	(100.0)

In the first call group, the proportion of known ethnicity information varied by age (61% in 50 year-olds, 62% in 51 year-olds and 56% in 52 year-olds), socioeconomic deprivation (64% in the most affluent quintile and 56% in the most deprived quintile) and screening area (from 56% in West of London to 73% in Barking, Havering, Redbridge and Brentwood). However, the age and socioeconomic differences were largely due to variation in screening attendance. When examining

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3 only those who attended their screening appointment 91% of 50 and 51 year-olds, 90% of 52 year-
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5 olds, and 91% in each socioeconomic deprivation group had known ethnicity information. There was
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7 still variation between screening areas, with the lowest proportion of known ethnicity in South West
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9 London (83%) and the highest in Barking, Havering, Redbridge and Brentwood and South East
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11 London (97%). Similarly, of women who attended their routine recall screening appointment,
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13 ethnicity was known for 90%-93% of the different age groups and 90%-92% of the different
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15 socioeconomic groups. Women in South West London (82%) were least likely to have a record of
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17 their ethnicity if they attended, and women in South East London (98%) were most likely.
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22 The number of women invited and screened in the two invitation groups are shown overall and for
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24 age, screening area and socioeconomic deprivation groups in Table 2. Of the women invited for their
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26 first call screening appointment, 96452 (61%) attended. Of women who attended this screening
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28 appointment, ethnicity information was available for 87530 (91%) women, while of the 62626 women
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30 who did not attend, ethnicity was known for only 7754 (12%). Attendance ranged in the different
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32 screening areas from 55% in Central & East London and 56% in the West of London areas, to 71% in
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34 Barking, Havering, Redbridge & Brentwood. Women resident in the most deprived areas were less
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36 likely to attend than those living in more affluent areas. Uptake was higher for women who were
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38 invited to a routine recall appointment, with 371848 (75%) women attending having previously
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40 attended a screening appointment. Ethnicity information was provided by 91% (340001) women who
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42 attended this appointment, and 40193 (32%) women who did not attend. Again, attendance was
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44 highest in Barking, Havering, Redbridge & Brentwood (82%), while the lowest attendance was in the
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46 West of London (72%) and North London (73%) screening areas. Routine recall screening uptake
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48 decreased as both age at invitation deprivation of area of residence increased.
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Table 2: Number of women invited and who attended first call and routine recall breast cancer screening appointments, London screening areas

Age	First call			Routine recall		
	Invited	Attended	(%)	Invited	Attended	(%)
50	59,484	36,949	(62)			
51	56,044	35,184	(63)			
52	43,550	24,319	(56)			
50-54				72,555	57,399	(79)
55-59				158,787	121,491	(77)
60-64				148,021	110,061	(74)
65-69				117,075	82,897	(71)
Screening area						
North London	33,923	20,686	(61)	107,203	77,850	(73)
West of London	27,504	15,476	(56)	79,081	56,864	(72)
Barking, Havering, Redbridge & Brentwood	16,246	11,554	(71)	55,094	45,316	(82)
Central & East London	25,570	14,047	(55)	62,636	43,539	(70)
South East London	27,052	16,399	(61)	102,491	79,784	(78)
South West London	28,783	18,290	(64)	89,933	68,495	(76)
Deprivation quintile						
1 (most affluent)	20,732	13,604	(66)	76,355	60,651	(79)
2	20,266	13,541	(67)	74,639	58,751	(79)
3	27,145	17,010	(63)	92,749	70,960	(77)
4	40,661	24,384	(60)	123,628	91,339	(74)
5 (most deprived)	50,274	27,913	(56)	129,067	90,147	(70)
Total	159,078	96,452	(61)	496,438	371,848	(75)

The proportions of women attending screening appointments in different ethnic groups, adjusted for age, socioeconomic deprivation and screening area are shown in Figure 1 (for odds ratios see Table 3). White British women were most likely to attend their first call (67%) and routine recall (78%) invitation. Of the other ethnic groups, first call screening uptake ranged between 43% in Bangladeshi women and 63% in Black Caribbean women. Bangladeshi women also had the lowest uptake of routine recall screening invitations (61%), while excluding White British women, Mixed White & Asian women had the highest uptake (75%). Variation within each of the broad ethnic groups was also seen. For example, Indian women were more likely to attend their first call (61%) or routine recall (74%) appointments than Pakistani (52% and 67%, respectively) or Bangladeshi women (43% and 61%, respectively). Black Caribbean women were more likely than Black African women to attend both first call (63% versus 49%) and routine recall (74% versus 64%) appointments.

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5 There was less variation in first call uptake between ethnic groups in some of the screening areas
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7 (Figure 2 for percentages and Table 3 for odds ratios). For example, in the West of London screening
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9 area, White Irish (57%, 95% CI 53%-62%), Indian (60%, 95% CI 58%-63%), Asian Other (58%, 95% CI
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11 54%-61%), Chinese (57%, 95% CI 51%-62%) and all of the Mixed groups of women were as likely to
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13 attend their first call appointment as White British women (60%). White Irish (66%, 95% CI 61%-71%),
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15 Indian (69%, 95% CI 65%-73%), Black Caribbean (65%, 95% CI 61%-68%), Chinese (62%, 95% CI 55%-
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17 69%) and all Mixed groups also had the same likelihood of attending as White British women (67%) in
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19 South West London. However, the biggest difference in attendance was in South East London,
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21 where Pakistani (19%, 95% CI 14%-25%) and Bangladeshi (14%, 95% CI 10%-19%) women had a much
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23 lower uptake of their first call invitation than other ethnic groups (between 40% in Asian Other
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25 women and 69% in White British women).
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32 When routine recall uptake was analysed separately for the screening areas (Figure 3 and Table 4 for
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34 odds ratios), Mixed White & Asian and Chinese women were as likely to attend their screening
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36 appointment as White British women in four of the areas (North London, West of London, Central &
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38 East London, and South West London). In general, there was less variation between ethnic groups
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40 within the screening areas than overall, although in Barking, Havering, Redbridge & Brentwood and
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42 South East London, White British women were more likely to attend than all other ethnic groups. The
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44 biggest discrepancy was again seen in South East London where Bangladeshi women had a screening
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46 uptake of 36% (95% CI 30%-43%), which was less than half the highest uptake figure of 82% for White
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48 British women.
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53 DISCUSSION

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55 In London, White British women are more likely than other ethnic groups to attend screening
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57 appointments as part of the national Breast Screening Programme. This difference is not explained
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3 by socioeconomic deprivation or place of residence. Variation in uptake is also found for the more
4 specific ethnic groups within the broad Asian, Black and White ethnic groups. However, within some
5 screening areas, women from several specific ethnic groups had uptake rates similar to White British
6 women's. These results were found for both the first invitation and subsequent invitations after
7 women had previously been screened, and were not explained by differences in socioeconomic
8 deprivation or age.
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12 A previous study of the same region found variation in breast cancer screening attendance between
13 ethnic groups, with areas with large Black populations having lower attendance.[7] The pattern with
14 the Asian group was more complex, and probably a consequence of combining the diverse Indian,
15 Pakistani, Bangladeshi and Asian Other groups into one. The present study's ability to examine the
16 more specific census categories within each broad ethnic group has shown other important
17 differences, for example, the lower uptake in Black African women compared with Black Caribbean
18 women, and in White Other women compared with White British women.
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35 A survey of women in Britain by Moser *et al* showed that while White British women were more likely
36 to report ever having had a mammogram than women from other ethnic groups combined after
37 adjusting for age, this difference was attenuated and not statistically significant after additionally
38 adjusting for region and various socioeconomic factors.[6] However, this measure does not indicate
39 whether a woman has attended routine screening appointments, as any reason for having a
40 mammography was included. The income domain of the Indices of Deprivation used in the present
41 study may not adequately account for explanatory socioeconomic differences, and the multiple
42 measures (including number of cars available to a household, housing tenure, education level and
43 socioeconomic employment classification) used by Moser *et al* may be more appropriate. Future
44 analyses could explore the effect of different measures of socioeconomic deprivation.
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3 The present study used self-assigned individual-level data on ethnicity for both women who were
4 invited for and attended breast cancer screening appointments in London for almost four years.
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6 However, ethnicity information was not available for all women who were invited for screening. If a
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8 woman had never attended a screening appointment there would be no opportunity for her ethnicity
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10 to be recorded. There was therefore a higher proportion of women with ethnicity information in the
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12 routine recall group, as these women had all previously attended a screening appointment. However,
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14 not all women who attend have an ethnic code recorded, so there was still missing ethnicity
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16 information in this group. Restricting the routine recall analysis to those who had a known ethnicity
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18 had little impact on the results (data not shown). Using multiple imputation provided similar results
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20 overall and across the screening areas for the different invitation types, suggesting that this method
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22 was as accurate with the different levels of missing ethnicity data.
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29 Although the 16 more specific ethnic groups from the England and Wales 2001 Census were
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31 examined, there are likely to be other factors within these groups that would affect uptake of
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33 screening invitations. The variation in screening uptake found between Asian religio-linguistic groups
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35 in the West Midlands[8] indicates that the analysis of even more specific ethnic groups would be
36
37 useful in future studies.
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41 While Bangladeshi women had low uptake of breast cancer screening overall and in most screening
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43 areas, in Central & East London, where the majority of the Bangladeshi population live,[11] uptake
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45 was more similar to other ethnic groups. Several projects to improve screening uptake in this area
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47 were undertaken around the time of data collection for this analysis.[12] Although some of the
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49 initiatives were focused on White British, White Irish and Bangladeshi women, an improvement in
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51 uptake was only seen in Bangladeshi women, the ethnic group with the lowest uptake in London.[13]
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3 Even in areas where there was less variation in attendance, some ethnic groups had much lower
4 uptake. While it makes sense to focus on as many of the eligible population as possible to improve
5 screening uptake, smaller communities should not be forgotten. Collaboration between different
6 areas to find successful practices for engaging with particular communities would be an ideal place to
7 start.
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15 London has a greater population turnover rate than other regions in England, and smaller areas
16 within London have even higher rates.[14] This may impact on the accuracy of General Practice lists,
17 so that women who no longer live at an address are being invited to screening appointments. This
18 would lead to a lower uptake level. Eilbert *et al*[12] found that increasing population turnover was
19 actually associated with a higher proportion of eligible women who were screened in the previous
20 three years. However, the data collected were from different sources in different years and only a
21 small proportion of the variation between areas was explained by population turnover.
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33 The fact that women from some ethnic groups had low uptake in both first call and routine recall
34 implies that not only were these women less likely to attend the screening appointment which was
35 their first contact with the screening service, but that having attended, they were also less likely to
36 return. Having a negative previous experience can be a factor in women not attending subsequent
37 screening appointments,[15, 16] and therefore improving the experience so that it matches the
38 expectations of women from these ethnic groups could help to increase screening uptake. While the
39 variation in screening attendance found in this study is a concern, the real challenge is ensuring a high
40 level of uptake across all ethnic groups. Work to improve screening uptake in London has continued
41 since the study period for which these self-assigned ethnicity data first became available. Future
42 studies can now evaluate the influence of improvement initiatives on these uptake figures and on the
43 variation between them.
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COMPETING INTERESTS

All authors declare they have no competing interests.

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CONTRIBUTORS

RHJ, TR and EAD designed the study.

TR acquired and advised on the data.

HM advised on analysis.

RHJ analysed the data and drafted the manuscript.

All authors interpreted the data, commented on the manuscript and had final approval of the version to be published.

DATA SHARING STATEMENT

No additional data available

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Table 3: Fully adjusted odds ratios (OR) and 95% confidence intervals(95% CI) of attending first call screening appointment, women aged 50-52

Ethnic group	North London*		West of London*		Barking, Havering, Redbridge & Brentwood*		Central & East London*		South East London*		South West London*		All London†	
	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)
White British‡	1.00		1.00		1.00		1.00		1.00		1.00		1.00	
White Irish	0.72	(0.63, 0.83)	0.90	(0.75, 1.09)	0.37	(0.28, 0.51)	0.97	(0.81, 1.17)	0.41	(0.32, 0.54)	0.97	(0.76, 1.23)	0.73	(0.67, 0.79)
White Other	0.52	(0.47, 0.57)	0.74	(0.66, 0.83)	0.17	(0.14, 0.20)	0.76	(0.67, 0.86)	0.49	(0.44, 0.55)	0.60	(0.53, 0.67)	0.55	(0.52, 0.59)
Mixed White & Black Caribbean	0.69	(0.47, 1.01)	1.14	(0.68, 1.92)	0.29	(0.14, 0.61)	0.70	(0.46, 1.08)	0.62	(0.38, 1.01)	1.04	(0.59, 1.82)	0.75	(0.58, 0.97)
Mixed White & Black African	0.37	(0.25, 0.55)	0.71	(0.48, 1.04)	0.17	(0.08, 0.38)	0.48	(0.33, 0.71)	0.34	(0.21, 0.55)	0.61	(0.37, 1.03)	0.44	(0.36, 0.55)
Mixed White & Asian	0.69	(0.45, 1.08)	0.88	(0.57, 1.36)	0.30	(0.15, 0.63)	0.80	(0.42, 1.54)	0.40	(0.22, 0.72)	1.08	(0.59, 1.98)	0.69	(0.54, 0.88)
Mixed Other	0.56	(0.37, 0.87)	1.20	(0.82, 1.77)	0.24	(0.13, 0.47)	0.61	(0.40, 0.92)	0.41	(0.26, 0.64)	0.79	(0.54, 1.15)	0.63	(0.53, 0.76)
Indian	0.74	(0.68, 0.81)	1.02	(0.92, 1.13)	0.53	(0.45, 0.62)	0.70	(0.61, 0.81)	0.47	(0.39, 0.55)	1.08	(0.90, 1.30)	0.77	(0.73, 0.81)
Pakistani	0.40	(0.32, 0.48)	0.76	(0.63, 0.92)	0.57	(0.43, 0.75)	0.93	(0.76, 1.13)	0.10	(0.07, 0.15)	0.55	(0.41, 0.75)	0.54	(0.49, 0.61)
Bangladeshi	0.26	(0.19, 0.35)	0.31	(0.23, 0.40)	0.22	(0.15, 0.33)	0.79	(0.67, 0.95)	0.07	(0.05, 0.11)	0.20	(0.14, 0.28)	0.37	(0.32, 0.41)
Asian Other	0.51	(0.43, 0.59)	0.92	(0.79, 1.07)	0.22	(0.16, 0.30)	0.55	(0.46, 0.66)	0.30	(0.24, 0.37)	0.80	(0.68, 0.95)	0.56	(0.51, 0.62)
Black Caribbean	1.08	(0.94, 1.22)	0.78	(0.66, 0.92)	0.38	(0.30, 0.47)	0.89	(0.78, 1.01)	0.95	(0.85, 1.07)	0.89	(0.77, 1.04)	0.85	(0.80, 0.91)
Black African	0.59	(0.52, 0.68)	0.44	(0.37, 0.51)	0.24	(0.20, 0.31)	0.52	(0.46, 0.58)	0.54	(0.49, 0.61)	0.40	(0.35, 0.46)	0.47	(0.44, 0.50)
Black Other	0.68	(0.44, 1.05)	0.56	(0.34, 0.94)	0.21	(0.11, 0.41)	0.57	(0.40, 0.80)	0.61	(0.40, 0.93)	0.63	(0.39, 1.01)	0.55	(0.46, 0.67)
Chinese	0.76	(0.61, 0.93)	0.88	(0.69, 1.11)	0.42	(0.30, 0.60)	1.01	(0.79, 1.29)	0.71	(0.53, 0.94)	0.81	(0.60, 1.08)	0.76	(0.68, 0.85)
Any Other	0.67	(0.59, 0.76)	0.47	(0.39, 0.56)	0.17	(0.12, 0.22)	0.91	(0.75, 1.11)	0.57	(0.45, 0.72)	0.61	(0.46, 0.79)	0.58	(0.53, 0.64)

* Adjusted for age at invitation and socioeconomic deprivation

† Adjusted for age at invitation, socioeconomic deprivation and screening area

‡ Baseline group

Table 4: Fully adjusted odds ratios (OR) and 95% confidence intervals (95% CI) of attending routine call screening appointment

Ethnic group	North London*		West of London*		Barking, Havering, Redbridge & Brentwood*		Central & East London*		South East London*		South West London*		All London†	
	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)
White British‡	1.00		1.00		1.00		1.00		1.00		1.00		1.00	
White Irish	0.79	(0.73, 0.84)	0.96	(0.88, 1.05)	0.45	(0.38, 0.54)	0.86	(0.77, 0.95)	0.49	(0.44, 0.55)	1.03	(0.91, 1.17)	0.78	(0.74, 0.81)
White Other	0.69	(0.65, 0.74)	0.85	(0.78, 0.92)	0.21	(0.19, 0.24)	0.78	(0.72, 0.84)	0.55	(0.51, 0.60)	0.67	(0.61, 0.73)	0.65	(0.62, 0.68)
Mixed White & Black Caribbean	0.74	(0.53, 1.02)	1.09	(0.79, 1.50)	0.41	(0.25, 0.68)	0.54	(0.36, 0.80)	0.50	(0.36, 0.68)	0.91	(0.61, 1.36)	0.71	(0.59, 0.85)
Mixed White & Black African	0.46	(0.32, 0.65)	0.57	(0.43, 0.77)	0.21	(0.13, 0.36)	0.53	(0.37, 0.76)	0.30	(0.21, 0.44)	0.54	(0.34, 0.87)	0.44	(0.38, 0.52)
Mixed White & Asian	0.74	(0.52, 1.03)	1.10	(0.77, 1.55)	0.45	(0.21, 0.96)	1.09	(0.68, 1.74)	0.36	(0.22, 0.60)	1.11	(0.80, 1.54)	0.81	(0.67, 0.99)
Mixed Other	0.58	(0.44, 0.76)	0.86	(0.65, 1.14)	0.31	(0.19, 0.51)	0.64	(0.47, 0.88)	0.49	(0.33, 0.71)	0.94	(0.69, 1.29)	0.65	(0.56, 0.75)
Indian	0.80	(0.75, 0.85)	0.99	(0.92, 1.05)	0.56	(0.50, 0.63)	0.81	(0.72, 0.90)	0.54	(0.49, 0.60)	1.07	(0.95, 1.20)	0.81	(0.77, 0.84)
Pakistani	0.47	(0.41, 0.54)	0.77	(0.67, 0.89)	0.40	(0.33, 0.49)	0.88	(0.77, 1.02)	0.20	(0.16, 0.26)	0.62	(0.51, 0.75)	0.57	(0.52, 0.62)
Bangladeshi	0.39	(0.31, 0.48)	0.32	(0.25, 0.40)	0.28	(0.21, 0.37)	0.79	(0.71, 0.88)	0.13	(0.10, 0.17)	0.28	(0.22, 0.36)	0.44	(0.40, 0.49)
Asian Other	0.59	(0.53, 0.66)	0.87	(0.78, 0.98)	0.30	(0.25, 0.37)	0.79	(0.68, 0.92)	0.36	(0.31, 0.42)	0.88	(0.77, 1.02)	0.65	(0.60, 0.70)
Black Caribbean	0.97	(0.89, 1.06)	0.77	(0.70, 0.85)	0.40	(0.33, 0.47)	0.93	(0.86, 1.00)	0.73	(0.67, 0.79)	0.82	(0.74, 0.91)	0.79	(0.76, 0.83)
Black African	0.59	(0.54, 0.65)	0.48	(0.42, 0.53)	0.26	(0.22, 0.30)	0.54	(0.49, 0.59)	0.50	(0.46, 0.53)	0.49	(0.43, 0.54)	0.49	(0.47, 0.51)
Black Other	0.51	(0.38, 0.67)	0.62	(0.43, 0.90)	0.23	(0.15, 0.36)	0.53	(0.39, 0.73)	0.56	(0.43, 0.72)	0.52	(0.36, 0.74)	0.50	(0.44, 0.58)
Chinese	0.87	(0.75, 1.02)	0.96	(0.81, 1.14)	0.53	(0.38, 0.73)	0.88	(0.72, 1.06)	0.71	(0.60, 0.86)	0.82	(0.68, 0.98)	0.80	(0.73, 0.89)
Any Other	0.84	(0.76, 0.92)	0.53	(0.46, 0.60)	0.24	(0.18, 0.31)	0.87	(0.76, 1.00)	0.61	(0.51, 0.72)	0.63	(0.50, 0.80)	0.67	(0.63, 0.72)

* Adjusted for age at invitation and socioeconomic deprivation

† Adjusted for age at invitation, socioeconomic deprivation and screening area

‡ Baseline group

FIGURE LEGENDS

Figure 1: Uptake of screening invitations in different ethnic groups, London, adjusted for age at invitation, screening area and socioeconomic deprivation. a) first call invites, women aged 50-52 b) routine recall invites, women aged 50-69

Figure 2: Uptake of first call screening invitations in different screening areas and ethnic groups, London, women aged 50-52, adjusted for age at invitation and socioeconomic deprivation.

Figure 3: Uptake of routine recall screening invitations in different screening areas and ethnic groups, London, women aged 50-69, adjusted for age at invitation and socioeconomic deprivation.

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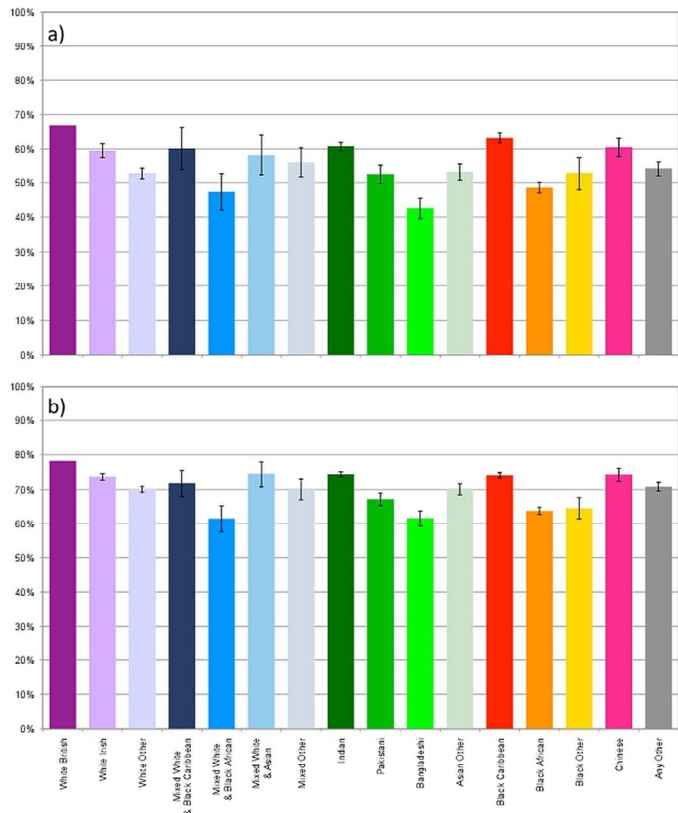


Figure 1: Uptake of screening invitations in different ethnic groups, London, adjusted for age at invitation, screening area and socioeconomic deprivation. a) first call invites, women aged 50-52 b) routine recall invites, women aged 50-69
90x127mm (300 x 300 DPI)

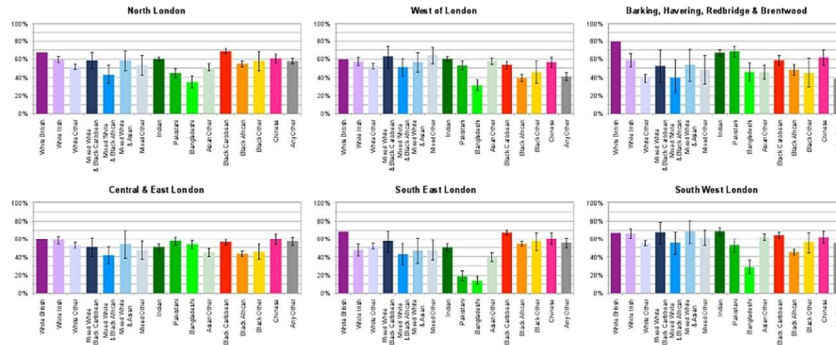


Figure 2: Uptake of first call screening invitations in different screening areas and ethnic groups, London, women aged 50-52, adjusted for age at invitation and socioeconomic deprivation. 90x63mm (300 x 300 DPI)

Review only

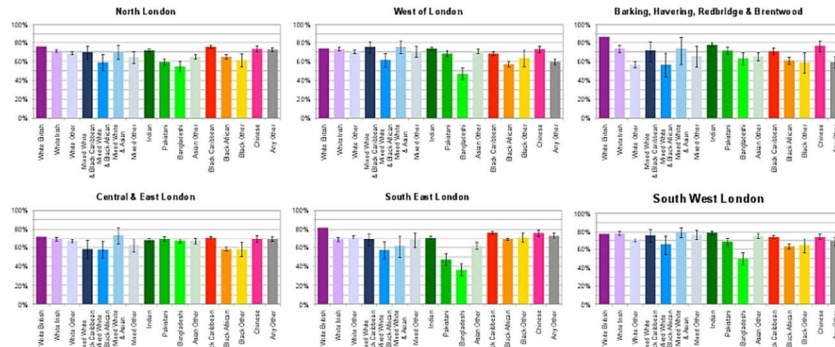


Figure 3: Uptake of routine recall screening invitations in different screening areas and ethnic groups, London, women aged 50-69, adjusted for age at invitation and socioeconomic deprivation. 90x63mm (300 x 300 DPI)

Review only

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation
Title and abstract	1 Y	(a) Indicate the study's design with a commonly used term in the title or the abstract (b) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction		
Background/rationale	2Y	Explain the scientific background and rationale for the investigation being reported
Objectives	3Y	State specific objectives, including any prespecified hypotheses
Methods		
Study design	4Y	Present key elements of study design early in the paper
Setting	5Y	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants	6 Y	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants (b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case
Variables	7Y	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement	8*Y	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias	9 Y	Describe any efforts to address potential sources of bias
Study size	10 N/A	Explain how the study size was arrived at
Quantitative variables	11 Y	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods	12Y	(a) Describe all statistical methods, including those used to control for confounding (b) Describe any methods used to examine subgroups and interactions (c) Explain how missing data were addressed (d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed <i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed <i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy (e) Describe any sensitivity analyses

Continued on next page

Results		
Participants	13* Y/ N/A	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed <hr/> (b) Give reasons for non-participation at each stage <hr/> (c) Consider use of a flow diagram
Descriptive data	14* Y	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders <hr/> (b) Indicate number of participants with missing data for each variable of interest <hr/> (c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount) N/A
Outcome data	15* Y	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time Y <hr/> <i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure <hr/> <i>Cross-sectional study</i> —Report numbers of outcome events or summary measures
Main results	16Y	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included <hr/> (b) Report category boundaries when continuous variables were categorized <hr/> (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17 N/A	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
Discussion		
Key results	Y 18	Summarise key results with reference to study objectives
Limitations	Y 19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation	Y 20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability	Y 21	Discuss the generalisability (external validity) of the study results
Other information		
Funding	Y 22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.