EVIDENCE BASED PUBLIC HEALTH POLICY AND PRACTICE

Socioeconomic deprivation, travel distance, location of service, and uptake of breast cancer screening in North Derbyshire, UK

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Background and aim: This study examined the association between socioeconomic deprivation, travel distance, urban-rural status, location and type of screening unit, and breast screening uptake. Screening was provided at 13 locations—1 fixed and 12 mobile (3 at non-health locations).

Methods: The study examined data from 1998 to 2001 for 34 868 women aged 50–64 years, calculated road travel distance, used 1991 enumeration district level Townsend socioeconomic deprivation scores, and a ward level urban-rural classification.

Results: Odds of attendance for screening decreased with increasing socioeconomic deprivation, with an adjusted odds ratio of 0.64 (95%CI 0.59 to 0.70) in the most deprived relative to the least deprived category. 87% of women lived within 8 km of their screening location. The odds ratio for a 10 km increase in distance was 0.87 (95%CI 0.79 to 0.95). The odds ratios were 1.18 (95%CI 1.08 to 1.28) for screening at a non-health relative to a health location, 1.00 (95%CI 0.94 to 1.07) for the fixed site relative to the mobile unit and 1.00 (95%CI 0.91 to 1.09) for mainly rural relative to mainly urban areas.

Conclusions: Socioeconomic inequality in breast screening uptake seems to persist in an established service. There was a small decrease with increasing distance, no difference between fixed and mobile units, and no difference between urban and rural areas but uptake seemed to be higher at non-health sites. Further work is needed to identify effective methods of decreasing socioeconomic inequalities in uptake and to confirm if non-health locations are associated with higher screening uptake.

The National Health Service Breast Screening Programme provides free breast screening every three years for all women in the UK aged 50 years and over. It is a well established nationally coordinated programme with national standards that are monitored through a national quality assurance framework.[1] It was started in 1990 following the Forrest report[2] and includes the use of mobile screening units to improve geographical access. The NHS Cancer Plan[3] set out further developments for the screening programme. The key changes in policy to be introduced were an increase in the age of women invited for screening from 50–64 years to 50–70 years by 2004 and the use of two view mammography at each visit (that is, at incident screens), rather than at the first visit (prevalent screen) only. This policy change meant that an increase in capacity was likely to be needed to manage the increase in workload.

North Derbyshire Health Authority undertook a work programme to examine options for managing the increase in workload before implementing the policy change. The options included purchasing an additional mobile unit or directing some populations around the main town to screening at the central screening service rather than to the mobile service that served those populations. Socioeconomic deprivation[4–8] and geographical access[4 7 9–12] are recognised factors influencing the uptake of breast cancer screening, with lower uptake in more deprived areas and in areas further away from screening locations. The health authority recognised that it would be useful to take the opportunity to reassess the influence of these two factors on screening uptake as part of its work programme so that they could be taken into account in management decisions in relation to implementation of the national policy change.

Our aim was to examine if there were continuing inequalities in uptake of breast cancer screening in relation to socioeconomic deprivation and travel distance after accounting for any urban-rural differences in uptake. A secondary aim was to examine if the location and type of screening unit had any influence on uptake. The work was undertaken to inform the health authority's management and planning decisions regarding reorganisation of services.

METHODS

North Derbyshire Health Authority had a resident population of 380 000 and covered a mixed area including Chesterfield town, the main town in the area, other smaller urban centres, and a large mainly rural expanse including part of the Peak District National Park. There were also significant areas of deprivation, particularly urban deprivation. Screening for breast cancer was provided at 13 locations. One was a fixed (hospital) site, based at Chesterfield. The other 12 were locations for the mobile breast cancer screening unit and were distributed across the district (fig 1). Nine of these locations were at health facilities and three were at other sites (council tax office, swimming pool, and leisure centre car parks).

We examined anonymised data on women (that is, no names, addresses, or dates of birth) for a three year period from April 1998 to March 2001. Women were aged 50–64 years at the time of invitation to attend for screening and screening was carried out once every three years. The dataset contained the screening location to which women were invited to attend, whether or not they attended, and their postcode of residence. We restricted the dataset to women who were resident in North Derbyshire.

Road travel distance was calculated from the grid coordinate of the postcode of residence to the grid coordinate of the screening location to which they were invited to attend. We used 1:10,000 resolution road network data to

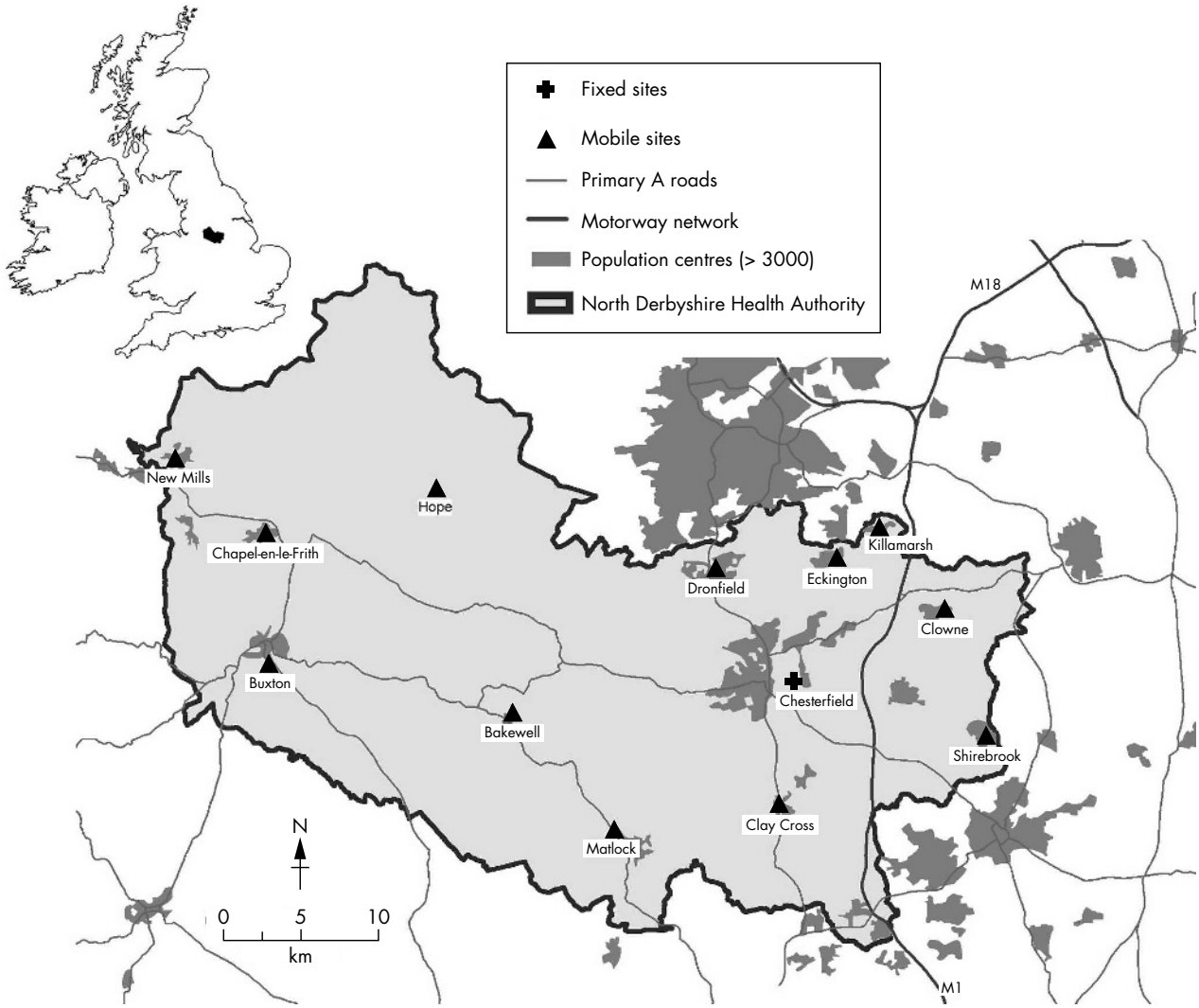

Figure 1 Breast cancer screening locations in North Derbyshire, UK 1998–2001. The inset map shows the location of North Derbyshire within the UK.

calculate shortest road travel distance between each pair of point locations. Travel distances were categorised into 2 km bands and were also examined as a continuous variable.

Residential postcodes were linked to enumeration districts (ED) to attribute 1991 ED level Townsend socioeconomic deprivation scores[13] to women in the dataset. The Townsend score is a commonly used indicator of small area level deprivation in England and is a standardised combination of four 1991 census variables—the proportion of economically active residents who were unemployed; the proportion of households without a car; the proportion of households not owner-occupied; and the proportion of overcrowded households. An ED is the smallest geographical unit at which 1991 census data are available with an average of 420 people per ED. Townsend scores were then categorised by quintile for analysis, with 5 as the most deprived and 1 as the least deprived category.

The urban-rural status of the electoral ward in which the postcode was situated was then linked to each postcode. We used the Office for National Statistics urban-rural classification that used a six point scale based on the percentage of EDs within each ward that were classified as urban in the 1991 census. We then aggregated these into three categories (mainly urban (75% or more EDs urban); intermediate ($\geq$25–$<$75% of EDs urban); mainly rural ($<$25% of EDs urban)) for the analysis.

Statistical analysis was carried out using unconditional logistic regression in SAS (SAS release 9.1, SAS Institute, Cary, NC, 2002). Socioeconomic deprivation was entered as five categories, distance as five categories ($<$2 km to $\geq$8 km), urban-rural status as three categories, and location of the breast cancer screening facility as two categories (health, non-health location). We examined if there was any effect on attendance by type of screening facility (fixed site, mobile unit) after the above factors had been taken into account. We subsequently examined distance as a continuous variable instead of as a categorical variable. Results are presented as odds ratios with 95% confidence intervals (95% CI).

RESULTS

We were provided with a dataset for 36 515 women. Of these, 695 had missing postcodes, 523 had postcodes that could not be georeferenced, 296 were for women who were non-North Derbyshire Health Authority residents, and 133 did not have Townsend scores. These records were excluded and the analysis was based on 34 868 women (95.5% of the dataset provided). Overall uptake was 78%. Table 1 provides the results.

Table 1 Uptake of breast cancer screening in relation to socioeconomic deprivation, road travel distance, urban-rural status, and type and location of screening facility. North Derbyshire, United Kingdom, April 1998–March 2001

	Invited	Attended	Unadjusted uptake (%)	Adjusted odds ratio* (95% confidence interval)
Socioeconomic deprivation category				
5 (most deprived)	7047	5167	73	0.64 (0.59 to 0.70)
4	6927	5372	78	0.80 (0.74 to 0.87)
3	6996	5530	79	0.88 (0.81 to 0.96)
2	6958	5564	80	0.93 (0.86 to 1.02)
1 (least deprived)	6940	5657	82	1
			$\chi^2=141.4$, df=4, p<0.0001	
Distance by category (km)				
⩾8	4641	3575	77	0.89 (0.81 to 0.99)
6–<8	4982	3880	78	0.95 (0.86 to 1.05)
4–<6	7871	6088	77	0.91 (0.83 to 0.99)
2–<4	8068	6318	78	0.95 (0.88 to 1.03)
<2	9306	7429	80	1
			$\chi^2=6.6$, df=4, p=0.16	
Distance (per 10 km increase)	–	–	–	0.87 (0.79 to 0.95)
			$\chi^2=9.6$, df=1, p=0.002	
Urban-rural status				
Mainly rural	4107	3238	79	1.00 (0.91 to 1.09)
Intermediate	3797	2951	78	0.97 (0.89 to 1.06)
Mainly urban	26964	21101	78	1
			$\chi^2=0.5$, df=2, p=0.78	
Screening location				
Non-health facility	4944	4046	82	1.18 (1.08 to 1.28)
Health facility	29924	23244	78	1
			$\chi^2=14.0$, df=1, p=0.0002	
Type of screening facility				
Fixed site	13741	10595	77	1.00 (0.94 to 1.07)
Mobile unit	21127	16695	79	1
			$\chi^2=0.0$, df=1, p=0.95	
All	34868	27290	78	–

*The adjusted model included the following variables: socioeconomic deprivation, travel distance, urban-rural status, screening location, and type of screening facility. Distance was examined as a categorical variable or as a continuous variable in separate models.

The unadjusted uptake of breast cancer screening progressively decreased with increasing socioeconomic deprivation. The uptake was 73% in the most deprived category compared with 82% in the least deprived category. After adjustment for distance, urban-rural status, location, and type of screening facility, there was a clear association between socioeconomic deprivation and the odds of attendance for breast cancer screening ($\chi^2 = 141.4$, df = 4, p<0.0001) with an odds ratio of 0.64 (95% CI 0.59 to 0.70) in the most deprived relative to the least deprived category. The test for trend was also significant ($\chi^2 = 124.6$, df = 1, p<0.0001).

Eighty seven per cent of women lived within 8 km of the screening location to which they were invited. Unadjusted uptake tended to be lower with increasing distance from the breast screening location, but the trend was inconsistent across distance categories. The uptake was 77% among women living ⩾8 km from their screening location compared with 80% in women living <2 km of their screening location. After adjustment for deprivation, urban-rural status, location, and type of screening facility, the overall effect of distance categories on odds of attendance was marginal ($\chi^2 = 6.6$, df = 4, p = 0.16). The odds ratio for attendance among women living ⩾8 km away from their screening location was 0.89 (95% CI 0.81 to 0.99) relative to women living within 2 km of their screening location. The test for trend was also not significant ($\chi^2 = 2.6$, df = 1, p = 0.11)

When analysed as a continuous variable, there was a significant but small decrease in uptake with increasing distance ($\chi^2 = 9.6$, df = 1, p = 0.002), with an adjusted odds ratio of 0.87 (95% CI 0.79 to 0.95) for a 10 km increase in distance. With regard to the effect of location of the screening facility on uptake, the unadjusted uptake of screening seemed to be higher for screening based at a non-health facility (82%) compared with screening located at a health facility (78%). The adjusted odds ratio for attendance was 1.18 (95% CI 1.08 to 1.28) at a non-health facility relative to a health facility ($\chi^2 = 14$, df = 1, p = 0.0002).

The type of screening facility had no evidence of effect on attendance after adjustment for the other variables, with an odds ratio of 1.00 (95% CI 0.94 to 1.07) for attendance at the fixed site relative to the mobile unit. Similarly, after adjustment, urban-rural status had no evidence of effect on uptake, with an odds ratio of 1.00 (95% CI 0.91 to 1.09) in mainly urban relative to mainly rural areas.

DISCUSSION

We found that uptake of breast cancer screening decreased with increasing levels of socioeconomic deprivation. We

What is already known on the topic

Socioeconomic deprivation and geographical access are recognised factors influencing the uptake of breast cancer screening, with lower uptake in more deprived areas and in areas further away from screening locations.

What this paper adds

- There is continuing socioeconomic inequality in breast cancer screening uptake and a small negative impact of road travel distance on uptake in a well established screening service.
- Breast screening uptake seems to be higher when screening is located at non-health sites but seems to be no different for fixed and mobile units.

found a small negative effect of distance from the screening location on uptake of screening. We saw that uptake of screening was higher when the screening facility was located at a non-health facility. After adjustment for the above factors, there seemed to be no difference in attendance between the fixed site and mobile sites and no difference between urban and rural areas.

The continuing clear association between decreased likelihood of attendance for breast cancer screening with increasing socioeconomic deprivation is consistent with previous studies.[4–8] Two of these UK studies used the Carstairs deprivation index,[5 6] one used the Townsend deprivation index,[8] and two used home ownership, or home and car ownership as measures of socioeconomic deprivation.[4 7] A study using the Australian index of social disadvantage, however, found little evidence of a negative effect of deprivation on attendance for breast cancer screening.[10] Much work has been undertaken regarding the evaluation of interventions to increase breast screening uptake.[14 15] However, little has been done to evaluate interventions to increase uptake specifically within the context of socioeconomic deprivation, and more research is required in this area.

We found that with the use of the mobile screening unit in addition to the fixed site unit, 87% of the population of women invited for screening had a road travel distance of less than 8 km (5 miles) to their screening location. The effect of distance from the screening location on attendance for screening was small, after adjustment for the other variables. Several studies have reported a negative relation between geographical accessibility and attendance at a breast screening service.[4 7 9–12] Predicted attendance fell sharply at a threshold distance of 2.5–3 km in an Australian study of the potential effects of relocating clinics.[10] Observed attendance in Scotland decreased from 41% for women living within 6 miles from the screening location to 19% for women living over 10 miles away.[9] The odds ratio for attendance among Medicare beneficiaries in rural Kansas was 0.97 for every five mile increment of distance.[11] In a study in Switzerland, the odds ratio for non-attendance was 1.37 (95% CI 1.16 to 1.62) for those living more than 5 km from the screening site, after adjustment for other predictors of attendance.[12] A 10% increase in distance was predicted to lead to a 2.4% decrease in attendance rates in Scotland,[4] and each kilometre travelled was associated with a 2% decrease in Bolton.[7] Possible explanations as to why we did not find a greater effect include a smaller overall range of distances examined and the population examined having greater access to transport, our study period being relatively more recent than those for previous studies.

With regard to the location of the screening facility, we expected to find that attendance would generally be higher when the screening facility was located at a health site, such as a hospital or clinic, than when it was based at a non-health site. However, we found that attendance was higher at non-health sites. Further work is needed to confirm our finding as it has implications regarding the locations at which mobile units might be based.

It is interesting to note that we found no difference in uptake between the fixed site and the mobile sites once other factors had been taken into account. A previous study found that predicted attendance was marginally lower for mobile units.[16] Mobile units have the benefit of increasing geographical access and may therefore be preferred when breast cancer screening services are being reconfigured. However, there are other factors that may need to be considered, including the additional cost and complexity of mobile services. These include the costs of the trailer and transport, additional staff transport costs (although patient transport costs are reduced), and the complexity of finding suitable accessible and secure sites for a large vehicle. In addition, the mammography films cannot usually be developed and their quality confirmed until after the end of the screening session.

There are a number of potential limitations that need to be considered. We attributed a small area level socioeconomic deprivation score to all women within the area, which could have resulted in misclassification at the individual level. This would generally tend to bias associations towards the null and the deprivation effect may have been greater than we have seen. There may have been errors in distance calculations because of inaccuracies in georeferencing. It could be argued that travel time may be a better measure of geographical access but this would have been difficult to assess as we did not have information on mode of transport. Other factors, such as general practice related factors,[5 17] may affect uptake of breast cancer screening, and confounding attributable to these factors cannot be ruled out. We examined data for a single breast cancer screening service for a defined area, and the possibility that there are factors peculiar to the organisation and delivery of this service or to the area served that influenced the results cannot be ruled out. However, the uptake of 78% was similar to the uptake of 75%–76% in 1998–2001 in England[18] and we found no evidence that urban-rural status affected uptake after other factors had been taken into account. A further limitation is that the data we were provided with did not allow us to differentiate between incident and prevalent screens or to examine the effect of age on uptake. In England in 2003–4, uptake among women invited for their first screen was 71% while uptake among women who had already been screened in a previous round was 88%.[18] Uptake tended to be similar across age groups within the 50–64 age band.[18] We also had no information on the use of private mammography services. In view of the limitations, caution needs to be exercised when generalising from our results.

In summary, we found that socioeconomic inequality in uptake of breast cancer screening persists in a well established screening service. There was a small effect of distance from the screening location on uptake within the range of distances examined. Uptake seemed to be higher at non-health sites but we found no difference between fixed and mobile units. Further work needs to be carried out to identify effective methods of decreasing socioeconomic inequalities in the uptake of breast cancer screening and to confirm if non-health locations are associated with higher screening uptake.

Policy implications

- Further research is needed to identify effective methods of reducing socioeconomic inequality in uptake of breast cancer screening.
- The findings that breast screening uptake seems to be higher at non-health sites and that there is no difference between fixed and mobile sites need to be confirmed as they may influence policy decisions.

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CONTRIBUTORS

DB chaired the North Derbyshire Breast Screening Extension Plan Sub-Group which RM attended. RM and TP analysed the data. HJ

provided background information. RM wrote the paper with contributions from all co-authors. RM and DB are guarantors for the study.

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APHORISM OF THE MONTH

Public health is investment not cost

In the future, public activities will need to be looked on to a large extent as investments comparable to financial investments. Health investment analysts will need to develop skills in mediation, arbitration, and negotiation to ensure that health outcomes are optimised from a wide range of investment—governmental, private, and communal. These investments, in such areas as housing, transport, agriculture, energy, culture, media, and sport, mean that the days of looking on public health as a cost are limited.

Lowell Levin and JRA