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Screening mammography uptake within Australia and Scotland in rural and urban populations

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ABSTRACT

Objective. To test the hypothesis that rural populations had lower uptake of screening mammography than urban populations in the Scottish and Australian setting.

Method. Scottish data are based upon information from the Scottish Breast Screening Programme Information System describing uptake among women residing within the NHS Highland Health Board area who were invited to attend for screening during the 2008 to 2010 round (N = 27,416). Australian data were drawn from the 2010 survey of the 1946–51 cohort of the Australian Longitudinal Study on Women's Health (N = 9890 women).

Results. Contrary to our hypothesis, results indicated that women living in rural areas were not less likely to attend for screening mammography compared to women living in urban areas in both Scotland (OR for rural = 1.17, 95% CI = 1.06–1.29) and Australia (OR for rural = 1.15, 95% CI = 1.01–1.31).

Conclusions. The absence of rural–urban differences in attendance at screening mammography demonstrates that rurality is not necessarily an insurmountable barrier to screening mammography.

Introduction

Geographical disparities in the stage of breast cancer at diagnosis have previously been observed, with women living in rural areas more likely to be diagnosed with later stage disease than women living in urban areas (Nguyen-Pham et al., 2014). As mammographic screening of healthy women leads to early detection of asymptomatic breast cancer and subsequent reduced mortality (Gotzsche and Nielsen, 2011), the different delivery of screening mammography health services across rural and urban areas poses a possible explanation for the geographical disparities. Conversely, it may be that the barriers created by rural residence are such that uptake is inevitably going to be lower. However, this claim supposes that rurality will be associated with lower mammography uptake regardless of national settings. The study reported here questions this assumption by comparing and contrasting urban–rural differences of two populations with national contexts very different from the United States, namely Australia and Scotland.

A recent systematic review revealed that women residing in rural areas were less likely to attend for screening mammography (Leung et al., 2014). However, over 70% of existing studies on this topic were conducted in the United States (US). The extent to which findings can be generalized is thus limited given the implications and definitions of rural residence are likely to be different from one national context to another. Various reasons might lead to a contrasting rural–urban screening geography in different countries. The social health care system in the UK, for example, might enable better access to mammography than the more privatized system found in the US. The sociodemographics found in rural areas may also differ with implications for take-up of screening services. The differing health service provision internationally means that findings from the US cannot simply be generalized to other countries.

Scotland and Australia are both countries where large proportions of the population reside outside of major cities (31% and 18%, respectively; Baxter et al., 2011; The Scottish Government, 2011). As such, a significant proportion of the population who live in rural areas, outside of

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major cities, could experience a lack of health service access (Cummings et al., 2002). In terms of breast screening services, the United Kingdom (UK) National Health Service Breast Screening Programme (NHSBSP) in Scotland currently invites women aged 50–70 years (Information Services Division Scotland, 2010) to take part in screening free of charge. NHSBSP has achieved an overall attendance rate of over 70% (Information Services Division Scotland, 2010). Similarly, in Australia, The National Program for Early Detection of Breast Cancer, known as BreastScreen Australia provide free screening mammography services for women aged 40 years and older, targeting women aged 50–69 years (BreastScreen Australia, 2011). The overall screening rate in the targeted age range is over 55% (Australian Institute of Health and Welfare, 2011). In both Scotland and Australia, mobile breast screening units are available to serve the rural populations. That is, both of these countries provide cost-free breast screening services to their respective populations across all levels of rurality. However, epidemiological evidence comparing screening rates across rurality is currently lacking in both Scotland and Australia.

The aim of the study was to conduct a cross-sectional study involving secondary data analyses, to compare the uptake of mammography breast screening by degree of rurality. This rural–urban comparison was conducted in Scotland and Australia. These two settings provide a contrast to the settings used in earlier studies that have largely focussed on the US, given that both Australia and Scotland provide cost-free screening mammography, and facilitate access in rural areas through the use of mobile units. Based on findings from a range of international studies identified in a recent systematic review (Leung et al., 2014), this study hypothesized that the barriers created by rurality would lead to lower mammography uptake in rural compared with urban populations.

Material and methods

Scottish data

Scottish data were drawn from the Scottish Breast Screening Programme Information System (Information Services Division Scotland, 2010). This contains records of all attendances of women invited to screening. All Scottish women aged 50–70 years who are registered with a General Practitioner (GP; or family physician) with their contact details recorded in the Community Health Index (CHI), would receive a postal invitation to attend screening. Invitations are sent to women aged 50–70 every three years. Due to the lag time from invitation to actual screening, some women were over 70 years of age at time of screening. In addition, women over 70 years can self-refer for screening. For this reason, some women who attended screening were over 70 years of age and data from these women were included in analyses.

Scottish women included in the analysis were aged 50–75 years at time of mammography. Data were drawn from the 2008–2010 round (N = 28,795). Screening mammography uptake was defined by the proportion of women resident within North NHS Highland who participated in screening. North NHS Highland is served by the North of Scotland Breast Screening Service, and comprises 73% of the population in the Highland region (Information Services Division Scotland, 2010).

Degree of rurality in Scotland was defined using the 8-fold Scottish Urban–Rural classification tool, determining rurality using postcode of residence (The Scottish Government, 2013). A complete postcode was required to derive rurality scoring. Individuals with a missing or incomplete postcode, therefore, were excluded from the analysis, resulting in a loss of 196 participants (0.7%). Within the geographical area of NHS Highland, the catchment area from which these data were procured, very few postcodes fall within large urban areas or accessible small towns (n = 1183, 4.1%). The women from these two folds were excluded, as they do not fit in with the other urban category. A final sample of 27,416 women was included in the analysis. 'Remote small town', 'very remote small town', 'accessible rural', 'remote rural', and 'very remote rural' were defined as rural, and 'other urban areas' was classed as urban (The Scottish Government, 2013).

Degree of deprivation was measured using the Scottish Index of Multiple Deprivation (SIMD) which encompasses several different domains, and again uses postcode of residence to derive a deprivation score (The Scottish Government, 2012). Based on the scores, participants were split into quintiles from 1 (most deprived) to 5 (least deprived).

Australian data

The Australian data were drawn from The Australian Longitudinal Study on Women's Health (ALSWH). The ALSWH is a prospective study of the health and well-being of three cohorts of women who were aged 18–23 years (1973–1978 birth cohort), 45–50 years (1946–1951 birth cohort) and 70–75 years (1921–1926 birth cohort) when recruited in 1996. The study sample was selected randomly from the Medicare Australia database, which covers all citizens and permanent residents of Australia, including refugees and immigrants. Indigenous Australians are under-represented in the ALSWH (Lee et al., 2005). Therefore, results cannot be generalized to the Indigenous populations, which have lower screening mammography uptake (O'Byrne et al., 2000). Women from rural and remote areas were sampled at twice the rate of women in urban areas in order to achieve a sufficient sample-size. The project uses postal questionnaires to collect self-reported data on health and related variables every three years. Details of the ALSWH recruitment and study design have been fully described elsewhere (Lee et al., 2005). Participation is voluntary and the ALSWH is approved by the University of Newcastle and University of Queensland Human Research Ethics Committees.

Australian women included in the analysis were aged 59–64 years at time of survey. Data were drawn from the 2010 survey of the 1946–1951 ALSWH birth cohort (N = 10,011). Retention rate of this survey was very high at 82%. Non-respondents were more likely to be separated, divorced or widowed, be from non-English speaking countries, or report difficulties in managing their income. Response rate did not differ by rural or urban residence (Lee et al., 2005). Screening mammography uptake in the past two years was self-reported. Missing data on mammography (1.2%) were excluded, resulting in a final sample of 9890 Australian women.

Degree of rurality was measured using the Accessibility/Remoteness Index of Australia Plus (ARIA+) (Australian Bureau of Statistics, 2011). The ARIA+ was derived based on an area's distance to service centers. It is the standard measure of remoteness used by the Australian Government. Service centers are defined as localities with more than 1000 persons in the population and containing basic level of services such as health, education, and retail. Geographic areas are classified according to the road distance to service towns. 'Major cities' and 'inner regional' areas were defined as urban, and 'outer regional' and 'remote' or 'very remote' areas were defined as rural.

Degree of deprivation based on area level was measured by the Socio-Economic Indexes for Areas (SEIFA) Index of Relative Socio-Economic Disadvantage (IRSD) quintiles (Australian Bureau of Statistics, 2006). Based on the scores, participants were split into quintiles from 1 (most deprived) to 5 (least deprived).

Statistical analysis

Descriptive statistics were estimated for all variables included in the analyses. The explanatory variable was rural or urban residence of the women. The outcome variable was the uptake of screening mammography. The control variables included age and degree of deprivation.

We estimated the percentages, and 95% confidence intervals, of screening mammography uptake in the urban and rural population. To do this, we conducted cross-tabulations on screening mammography

uptake by area of residence. Two separate analyses were conducted using the Scottish and Australian data.

Binary logistic regression analyses were conducted to estimate the odds of screening mammography uptake in women residing in rural areas, compared to the odds of screening in women residing in urban areas. Unadjusted odds were estimated, with separate analyses conducted using the Scottish and Australian data. Then, the logistic regression analyses were repeated, with adjusted odds estimated controlling for age and deprivation. Analyses were conducted using SPSS Version 21.

Results

Descriptive statistics of the Scottish and Australian sample are presented in Table 1. Overall levels of screening mammography uptake were very positive. Percentages of women who have conducted a screening mammogram were 75% in Scotland and 83% in Australia. The Scottish sample included 21% of women residing in urban areas and 79% of women residing in rural areas. This proportion is in accordance with the population distribution, with the Scottish data sourced from NHS Highland. The Australian sample included 78% of women residing in urban areas and 22% residing in rural areas. The mean age was 59.57 (SD = 5.98) and 61.53 (SD = 1.46) in the Scottish and Australian women, respectively. Although there was not a large age difference between the Scottish and Australian datasets, we included age as a control variable in the adjusted analyses to strengthen the robustness of results. A spread of degree of deprivation levels was observed across the sample. This was also included as a control variable to estimate the effects of rural location on screening, independent of potential deprivation effects.

The percentages of screening mammography uptake are presented in Fig. 1. Percentages of uptake were 74% (95% CI = 72%–75%) in urban Scotland, compared to 76% (95% CI = 75%–76%) in rural Scotland. Screening uptake was observed to be slightly higher in the rural population compared to the urban population. A consistent trend was observed in Australian women. Percentages of uptake were 83% (95% CI = 82%–84%) in urban Australia, compared to 84% (95% CI = 83%–86%) in rural Australia.

Logistic regression results estimating the odds of screening in rural, compared to urban, women are presented in Table 2. Contrary to our hypothesis, residing in rural areas was not associated with lower odds of screening. Unadjusted results showed that the odds of screening mammography were not lower in the rural Scottish (OR = 1.11 [95% CI = 1.04–1.19]) or Australian (OR = 1.10 [95% CI = 0.96–1.25]) populations, compared to their corresponding urban populations. After adjusting for age and deprivation, the odds of screening mammography uptake were slightly higher in the rural areas, in both Scotland (OR = 1.17, 95% CI = 1.06–1.29) and Australia (OR = 1.15, 95% CI = 1.01–1.31).

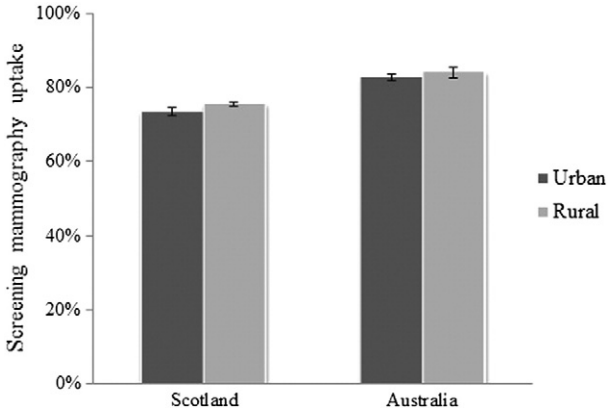

Fig. 1. Percentages of screening mammography uptake in urban and rural areas, in Scotland and Australia.

Discussion

This study examined screening mammography uptake between women residing in rural and urban areas based on large retrospective datasets from Australian and Scottish populations. Evidence indicated no rural disadvantage in screening mammography uptake. In fact, contrary to the hypothesis, in both Scotland and Australia, the rate of screening mammography uptake was slightly higher in the rural populations than in the urban populations. The odds of screening in the rural populations compared to the urban population, between the Scottish and Australian analyses were similar. These findings are of interest, given the differences in data types and data collection methods, and despite the different nature of rurality in the two countries. The consistency of results emphasizes that rural residence is not necessarily an obstacle to engagement with screening services.

Our findings are notable given their contrast with findings of a systematic review on rural and urban differences in mammography uptake from 24 observational studies (Leung et al., 2014). The systematic review found that in most of the existing literature (generally drawn from studies in the US; 20 out of 28 studies), lower uptake rates were observed in the rural population compared to the urban population. In the US, recent data showed breast screening rates reached over 90% in certain populations (Alford et al., 2015). However, recent data also showed that women who resided in rural areas were less likely to have repeat visits to mammography breast screening (Drake et al., 2015). Several possible reasons are to explain why the current findings contrast with existing evidence. In the US, not all women are eligible for cost-free screening mammography (Centers for Disease Control and Prevention, 2014). The health care systems in Scotland and Australia are different from those in the US. In both Scotland and Australia, breast screening services are available cost-free to all women in the screening age group (BreastScreen Australia,

Table 1
Descriptive statistics of the Scottish and Australian women.

	Scotland		Australia	
	n	%	n	%
Total	27,416	100%	9860	100%
Age				
Mean (SD)	59.57 (5.98)		61.53 (1.46)	
Degree of deprivation				
1 (most deprived)	1809	7%	2071	21%
2	6470	24%	2564	26%
3	9376	34%	3845	39%
4	7293	27%	1873	19%
5 (least deprived)	2467	9%	493	5%
Urban or rural residence				
Urban	5645	21%	7691	78%
Rural	21,771	79%	2169	22%
Mammography				
Yes	20,586	75%	8210	83%
No	6830	25%	1650	17%

Table 2
Logistic regression results showing odds ratios of screening mammography uptake in rural population compared to urban populations.

	Scotland (N = 27,416)		Australia (N = 9890)	
	OR	(95% CI)	OR	(95% CI)
Unadjusted				
Urban (reference)	1.00		1.00	
Rural	1.11	(1.04–1.19)	1.10	(0.96–1.25)
Adjusted[a]				
Urban (reference)	1.00		1.00	
Rural	1.17	(1.06–1.29)	1.15	(1.01–1.31)

[a] Adjusted for age and degree of deprivation.

2011; Information Services Division Scotland, 2010). Further, in both Scotland and Australia, mobile screening units together with local publicity and invitation letters are used in rural areas to promote and ensure the accessibility of breast screening service (BreastScreen Australia, 2011; Information Services Division Scotland, 2010). Mobile breast screening units may only be within rural areas for relatively short periods. Thus women living in rural areas may be more inclined to attend screening while it is there, which can save them from having to travel further afield for a missed appointment.

These issues are centrally focussed on access to screening services, for both rural and urban populations. Rural health in developed countries has received increasing attention in recent years given disadvantage identified for residents of rural areas (Smith et al., 2008). The findings in this paper demonstrate that, in some countries, rural residence is not necessarily associated with a disadvantage in accessing preventive screening. Understanding the mechanisms which effect health inequities can aid the development of policies that reduce these inequities. For example, is the explanation in the health care system generally, or are more specific interventions such as the use of mobile clinics required? Findings may also provide insight beyond breast cancer screening. If the health care systems of Australia and Scotland underpin the higher uptake in rural relative to urban areas, then enabling access to screening that is not dependent on personal economic resources becomes a health equity issue. If the use of mobile screening enables economically and socially deprived women to access preventive services, then a case can be made for similar initiatives for other health-related conditions, for both men and women.

Several limitations should be considered when interpreting the results of this study. The Scottish data were drawn from the Scottish Breast Screening Programme Information System, while the Australian data were drawn from a self-reported survey. Differences in the data collection methods limited direct cross-country comparison. However, this was the not aim of the study. Rather, the aim was to compare mammography uptake between geographic locations within the two countries examined. Further, we used standard measures of rurality endorsed and commonly utilized by the governments within Scotland and Australia (Australian Bureau of Statistics, 2011; The Scottish Government, 2013). This also applies to measures of deprivation used in this study (Australian Bureau of Statistics, 2006; The Scottish Government, 2012). Hence, the measures of rurality and deprivations within the country are valid measures and can be directly translated for health-care intervention and evaluation purposes. The consistent results showing a lack of lower mammography uptake in the rural populations across the two countries, given the difference in data collection, provides support for the robustness of the findings that rural populations may not necessarily have lower levels of service use. Future research to develop methods of cross-country comparisons for rural–urban studies is required to enable a global view of health service access attributable to rurality (Smith et al., 2008).

In the Australian survey data, as with all surveys, self-report bias is a limitation. The Australian survey sample is in general a slightly healthier subpopulation in terms of physical health, psychological health, and health behaviors, and is also more likely to be of higher socio-economic status than the general population (Lee et al., 2005). Indeed, the prevalence of screening mammography uptake in the Australian sample in this study (82%–84%) is an overestimation of the screening mammography uptake rate in the Australian general population (55%–82%; Australian Institute of Health and Welfare, 2011). However, this overestimation is likely to be occurring in both urban and rural women, therefore our rural–urban comparison results on mammography rates are unlikely to be biased (Australian Institute of Health and Welfare, 2011).

Conclusions

The absence of rural–urban differences in screening mammography rates demonstrates that rurality is not necessarily an insurmountable barrier to the use of screening mammography services. Understanding why rurality has different implications for screening uptake in different national contexts can provide insights that aid policy development that more effectively enables screening uptake, whether that be design of health care systems or more micro-level initiatives to enable access, such as the use of mobile clinics.

Conflict of interest statement

R.H. is employed by NHS Highland and as part of his role support efforts to raise awareness of Scottish Breast Screening Programme among eligible women resident within the area served by NHS Highland.

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