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Breast screening in NSW, Australia: predictors of non-attendance and irregular attendance

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Abstract

BreastScreen Australia provides free mammography services to women in the target age group of 50 to 69 years. The program uses a variety of measures to recruit women to the service and, subsequently, encourage them to screen at two year intervals. One of the stated aims of the program is to provide equitable access to all women in the target age group. This paper analyses the extent to which systematic variation can be observed amongst women in terms of their screening behaviour, focusing on those who have never screened or are irregular screeners. Data on self-reported utilisation of breast screening services was obtained from the 2002/04 NSW Health Surveys. A multinomial logit (MNL) model was used to examine the role of socioeconomic status, cultural background, education and region of residence on breast screening behaviour. The results show that lower income is associated with a woman never screening or screening irregularly. Region of residence is an important predictor of screening behaviour, although the degree of remoteness was not influential in determining participation. A higher number of hours worked was associated with women being more likely to screen irregularly. These results provide evidence of persistent and systematic variation in screening uptake and regular participation. The results also point towards targeted recruitment and retainment strategies that may provide the greatest potential benefits.

Introduction

Since 1991, Australia has had a national program to encourage women to screen for breast cancer. Under the auspices of the national program, the state based BreastScreen NSW program has a network of 40 regional centres and 18 mobile units that tour NSW. The first screening units became operational in 1989 and state-wide coverage was achieved in 1995 (BreastScreen NSW, 2008). The BreastScreen program offers free screening mammograms to women in the target age group of 50 to 69[1] and encourages them to screen every two years.

The program uses a number of strategies to recruit women to the program and then to retain them by encouraging biennial screening in subsequent years. To aid recruitment, women turning 50 years of age are sent an initial letter of invitation. To help women become regular screeners, a reminder letter is sent when two years have lapsed since the last screen. In addition, some strategies are aimed at both recruiting and retaining women. These include wide ranging media campaigns to provide information about breast cancer, the benefits of screening and details of the BreastScreen program. Such strategies inform, emphasise and remind women about the importance and timeliness of screening and are aimed at changing the perception or expectation of benefits associated with mammography.

Breast screen services abide by a set of nationally determined program objectives (Australian Institute of Health and Welfare, 2000). Two of these are relevant in the context of participation. First, the program aims to achieve a participation rate of 70% amongst women aged 50 to 69 years. Second, the national policy states that the program selects women for screening on the basis of age alone[2]. This implies that amongst

[1] The program does not offer mammography services for diagnostic purposes. Diagnostic mammograms are usually provided in the private sector and subsidised by the Medicare program

[2] From an epidemiological perspective, important variations in risk may occur within the target-age group related to hereditary or other factors. However, program objectives have not identified priority groups within this target age group. Instead, the program's objectives and policies imply that each woman in the age group is deemed to be of equal priority

women in the target age group, participation rates should not be systematically related to any ethnic, economic or geographic factors.

The most recent report on the program's performance, using administrative data, reveals that in 2004 participation amongst women in the target age range was 55.6% nationally. Whilst international comparisons are difficult, Australia's participation rates appear to be low by international standards. In 2003/04, Australia's breast screening rate was well below the OECD average of 69.6%.

Previous reports had shown a positive trend amongst women in the target age group. Between 1996 and 2002 participation rates increased from 50.4% to 57.1% but since 2002 there has been a downward trend (Australian Institute of Health and Welfare, 2007). Compared to the national average, screening rates in NSW have been consistently lower but have exhibited similar trends over time. The latest figures show a participation rate of 50.1% for 2003-04, after having reached 53% in 2001-02.

Administrative data from the Breast Screen Program also show significant regional variation in participation rates. Women living in metropolitan regions were more likely to screen than women living in rural regions. Despite the program offering free mammograms at the point of service, administrative data also show that women residing in the most disadvantaged socio-economic areas were less likely to screen than women living in more affluent areas. There was no discernable pattern amongst any of the other socio-economic groups (Australian Institute of Health and Welfare, 2007). However, results using administrative data are limited by the use of ecological socio-economic status (SES), and are therefore likely to reduce interpersonal variability by assigning regional average SES to individual women.

Analysis using unit record data has revealed a clearer pattern of utilisation. A study using 1997 and 1998 NSW Health Survey data found that SES, measured by imputed income, was positively and significantly related to the likelihood of screening (Birch, 2007). This study was restricted by the lack of income data in the 1997/98 NSW Health Surveys –

which the authors attempted to overcome by using available demographic and socio-economic variables and matching these to the Australian Household Expenditure Survey to impute household income.

Taylor et al (2003), using a combination of survey and administrative data, separated their analysis into women who had never screened versus women who were irregular screeners. They found that (1) women living in high income households were more likely to have never screened, whereas (2) those living in low income households were more likely to be irregular screeners. However, these results may be confounded by the fact that younger women in the cohort are more likely to have never used mammography and may also have higher incomes due to higher labour force participation. Further, the study only contained two income brackets; more or less than $40k annual household income which, at the time of the study represented average household income (Australian Bureau of Statistics, 2007).

This study extends previous work in this area. The aim of the paper was to firstly determine which characteristics are associated with screening behaviour. It seeks to compare the predictors of screening between those women who have never had a screening mammogram (never screeners) and those who screen less than two-yearly (irregular screeners) with women who screen every two years (regular screeners). In doing so, we aim to inform potential policy responses directed at boosting breast screening participation rates amongst women aged 50-69.

Methods

Study Data

Data from the 2002 and 2004 NSW Population Health Surveys were used for this analysis. In NSW a Population Health Survey is conducted annually using computer-assisted telephone interviewing (CATI) to study a random sample of NSW residents aged 16 years and over, living in households with private telephones. The survey randomly selects one eligible person from a household. Questions covered a wide range of topics

relating to health and illness, health risks and health care utilisation together with background information including social and demographic characteristics. The 2002 and 2004 surveys included a breast cancer screening module.

Weighting

In each year's data collection, the survey samples 1,000 individuals from each of the seventeen local health regions, referred to as Area Health Services (AHS) in NSW[3], as shown in Figure 1. Due to different population sizes, residents in smaller AHS have a higher probability of selection than those residing in more populated AHS. The use of CATI may impact on a household's probability of being sampled, depending on the number of telephone lines into the home. Finally, household size also affects sampling probability, with individuals in larger households having a smaller probability of selection than those in smaller households.

To compensate for disparities in the probabilities of being selected, the survey sample is weighted according to the number of eligible respondents in the household, the number of residential telephone lines for the household and a sampling fraction in each AHS. Using a weighted sample in analyses of data produces results that are representative of the population in both rural and metropolitan NSW. All results reported in this paper were derived from the weighted sample.

Dependent variable

The 2002 and 2004 surveys asked women aged 40 to 79 questions about (1) whether they had ever had a mammogram; (2) time since their last mammogram; and (3) the reason for the last mammogram. Responses to these questions were used to create a dependent categorical variable indicating screening behaviours; these have been named "never screeners", "regular screeners" and "irregular screeners". In line with BreastScreen Australia benchmarks, women who responded 'no' when asked whether they had ever had a mammogram were categorized as 'never screeners'; those who indicated that the

[3] In 2004, Area Health Services were amalgamated to form eight local regions; for the purposes of this analysis we have persisted with the old Area boundaries.

time since their last mammogram was less than 2 years were categorized as 'regular screeners' and those indicating that more than two years had elapsed since their last mammogram were categorized as 'irregular screeners'.

Inclusion/Exclusion criteria

We excluded males and only included women aged 50 to 69 in our analysis. We also excluded women who indicated that their last mammogram was for diagnostic purposes[4]. The resulting sample comprised of 2,671 observations across the years 2002 and 2004.

Analysis

A multivariate multinomial logit (MNL) model was used for this analysis. The MNL model estimates the importance of a woman's individual characteristics on her screening behaviour. Predicted MNL coefficients indicate how a unit change in the explanatory variable, relative to the reference case will impact on the logit index, measured in units of log odds. The results are more easily interpreted in terms of relative risk ratios which are calculated by taking the exponent of the estimated coefficient.

Explanatory variables

The aim of this study was to test for systematic variation in screening behaviour, including an investigation of the similarities and differences between never screeners and irregular screeners.

Age was inputted as a continuous variable with an age-square component in the model to account for any non-linear dynamics associated with increasing age. Age acts as a control variable because of potential confounding with income and because the Breast Screening program's direct recruitment strategy commences when a woman turns fifty years of age.

[4] Women who undergo a mammogram for diagnostic purposes are eligible for subsidies under the Medicare but not the BreastScreen Australia program. Mammograms were classified as diagnostic if the respondent stated their last mammogram was because of (1) history of breast cancer, and/or (2) breast problems or symptoms at the time the mammogram is taken.

This in turn may affect the never screeners group with younger women in the cohort being more likely to have never screened.

A categorical variable for women from a non-English speaking background was included to determine whether these women face greater barriers to obtaining information about the program compared to their English speaking counterparts. A categorical variable for women who were born overseas was included in the model. It is anticipated that these women are at greater risk of not being recruited by the Breast Screen program because a larger proportion of them may not be on the electoral roll.

SES was included in the model using household income and a woman's education attainment. We also included a category for those who did not state their income, which accounted for 22% of the sample. These variables will be used to test for systematic variation and highlight potential inequities in screening rates. The number of hours worked by a woman in the last week was included in the model as a potential measure of the opportunity cost of time. Women who did not have a job in the last week were assigned zero hours.

Regional variables were based on the boundaries of the seventeen AHS in NSW, shown in Figure 1. The Breast Screen program is regionally organised with similar boundaries to the AHS.

In addition, women were categorised as living in one of five geographic locations based on the "Accessibility/Remoteness Index of Australia" (ARIA). ARIA defines remoteness on a geographical basis and calculates accessibility to some 201 service centres based on road distances (see Table I for variable definitions). The ARIA variable enables us to examine the impact of remoteness as a proxy for the opportunity costs of screening. It will also allow us to more clearly isolate the potential role of AHS organisational aspects.

In reporting the results, AHS are grouped into inner metropolitan, outer metropolitan and rural areas to determine whether any systematic variation remains in these regions. The

four inner-metropolitan AHS are geographically small and densely populated while the five AHS in the outer-metropolitan areas are larger in area and have lower population density. The eight remaining AHS make up the rural group. These regions are very large compared to the metropolitan AHS and much more sparsely populated. Finally, a survey year dummy was added to the model to capture potential differences in screening behaviours between the two survey years.

Results

Table 1 contains a summary of screening behaviour categories and the distribution of the sample of women among the three categories. Approximately 12% of women aged 50-69 reported that they never had a mammogram, 75% reported that they had their last screening mammogram less than 2 years ago, and 14% of women indicated that they were irregular screeners (i.e. their last screening mammogram was more than 2 years ago). Note that the proportion of women in the NSW Health survey who reported screening regularly is considerably higher than the proportion reported in the BreastScreen NSW registry data (75% versus 50% respectively).

INSERT TABLE 1 AROUND HERE

Table 2 contains the descriptive statistics for the women in the study sample according to screening behaviour. Never screeners were, on average, younger than their (regular or irregular) screener counterparts by at least 1.5 years. This is not surprising given that the BreastScreen program commences recruitment strategies when a woman turns fifty. Regular screeners worked an average 11.5 hours per week compared to irregular screeners who worked 13.9 hours. Regular screeners were less likely to be born overseas and more likely to speak English at home compared to never or irregular screeners. There were no differences between the three screening groups in terms of household income, education attainment or region of residence. Approximately 90% of the sample population resided in areas that are either accessible or highly accessible in our analysis.

INSERT TABLE 2 AROUND HERE

Table 3 contains the MNL results presented as relative risk ratios. Estimates are reported for the never and irregular screeners categories, with regular screeners as the omitted reference category.

INSERT TABLE 3 AROUND HERE

Age is a significant predictor of screening behaviour amongst the never screeners. Figure 2 shows the average predicted probabilities for women of different ages (within the target age range). Amongst the never screening group, the relative risk ratio for the age square variable is greater than unity ($P < 0.01$), indicating that age has a positive quadratic effect. The age co-efficient was not significant for irregular screeners.

Having been born overseas or speaking a language other than English at home appeared to increase the probability of belonging to the never or irregular screener groups, but neither reached significance. Education only mattered amongst women whose highest level of education was completion of high school between years 7 and 10. The odds of screening irregularly are about 28% lower for a woman in this group relative to a woman with a university degree ($p < 0.10$). None of the education variables reached significance in the never screened group.

Women in higher income households were less likely to screen irregularly, compared to women from households with an annual income of less than $10,000. Figure 2 shows the average predicted probabilities for women in different income groups for the never and irregular screeners. Four out of five income groups were statistically different from unity ($p < 0.10$). Using the regular screeners as the base case, we find a relative risk ratio of 0.61 for the '$20,000 to $40,000' household income group, suggesting that the odds of screening irregularly are about 39% lower for those women compared to women with household income less than $10,000. Further, we find some evidence of a negative income gradient for the irregular screener group, with respective relative risk ratios decreasing with each subsequent increase in household income. By comparison,

household income was not a significant predictor amongst the never screener group, except for women in the $20,000 to $40,000 income category whose odds of never screening fell by 42% relative to a woman living in a household with an annual income of less than $10,000 ($p < 0.05$).

The relative risk ratio for hours worked in the last week were statistically different from unity ($p < 0.05$) in the irregular screeners' group; that is, an extra hour worked in the last week increased a woman's odds of screening irregularly by 1%. Hours worked was not significant in the never screened group.

None of the ARIA variables played a significant role in predicting screening behaviour. Nevertheless, there was evidence of regional differences depending on which AHS a woman resided in. Women living in the outer-metropolitan regions of Wentworth and Illawarra were more likely to have never screened compared to their Northern Sydney counterparts. Women living in the outer metropolitan regions of Wentworth, Sydney South West and the Central Coast tended to have a higher likelihood of being an irregularly screener.

Discussion

Participation rates based on administrative data are typically found to be lower than those in self-reported surveys. In our case, self reported data from the NSW Health survey indicates an overall participation rate of 73.7% compared to the 50.1% rate indicated by administrative data. There may be several explanations for this apparent discrepancy. First, survey data may be capturing mammograms provided under the Medicare program in addition to those provided by Breast Screen Australia. In 2003 and 2004, Medicare subsidised over 650,000 mammograms and it is feasible that a proportion of these may be reported in the survey data as screening mammograms. Second, women's recall of whether their last screening mammogram occurred in the last two years may be imprecise and third, respondents may be over-stating their use of mammography for screening. It is of course possible that the administrative data are also imprecise.

Given the large discrepancies in participation rates these should be treated with caution, particularly in judging the performance of the BreastScreen program. Despite the differences between self-reported and administrative data, survey data may still be valid in analysing participation if no systematic variation in over (or under reporting) exists amongst sub-populations. A study by Zapka et al (1996) which compared self-reported mammography use with program data found no biases in self-reporting accuracy amongst women of various ages, income or level of education. Whilst no such tests can be undertaken here, the results from Zapka et al (1996) lends support to the use of survey data for the purpose of analysing the distribution of participation.

Information on household income was missing for 22% of the sample, similar to the proportion missing in the overall NSW Health Survey. Missing income data is not unusual for household surveys that are not specifically designed to elicit information on income or wealth (Doiron, Jones, & Savage, 2008). However, to avoid selection bias, we included a dummy variable in the analysis for women who did not report their household income. To check the potential influence of measurement error, we re-estimated the model excluding observations with missing income. None of the income coefficients changed significantly.

We found evidence that income was negatively related to the likelihood of a woman screening regularly. In other words, women in higher income households were more likely to screen regularly. A similar trend amongst the never screeners was found but did not reach statistical significance except for the $20,000 to $40,000 income group, who were less likely to have never screened compared to women in the lowest income group (<$10,000). These results are consistent with Birch (2007) and the AIHW (2007) although neither study report result which separate late screeners from never screeners in their analysis. However, the results are at odds with Taylor et al (2003) who found that women with household income greater than $40,000 were significantly more likely to belong to either the never screened or irregular screeners groups. The discrepancy may be explained by the use of only two categorical income variables (less than or greater

than $40k). In addition, Taylor et al (2003) use administrative data to measure participation. As recognised by the authors, these data do not capture mammograms funded under the Medicare program. Whilst this program is intended to fund diagnostic mammograms only, it is likely that sometimes it used for screening purposes.

From an economics perspective, there are two potential reasons that could explain the systematic variation amongst women in different socio-economic groups. First, the opportunity cost of screening may differ across groups. For example, the cost of travel and time away from everyday activities and duties may vary amongst women. However, it is not immediately obvious which socio-economics groups face higher opportunity costs. On one hand women in higher socio-economic groups may face a higher opportunity cost of time away from work due to higher wage rates. On the other, women in lower socio-economic groups may have less flexible workplace arrangements and therefore find it more difficult to make appointments.

The second possible reason for variation is women's perceptions of the utility (and disutility) associated with breast screening. For example, some women may feel more strongly than others about the short-term inconvenience and discomfort of mammograms. Furthermore, women's perceptions of the long term benefits of mammography may also vary. Such factors may explain why some women screen and others do not. However, it does not explain why we observe systematic variation amongst socio-economic groups. For systematic variation to occur on the basis of differences in preferences a second condition needs to be met. That is, there would need to be some homogeneity of preferences amongst similar (socio-economic) groups and heterogeneity of preferences amongst different groups. Such a situation would arise if, for example, women in higher socio-economic groups are more risk averse than those in lower SES groups. There is a considerable theoretical and empirical body of work that supports the notion that SES affects health behaviours (Lantz, House, Lepkowski, Williams, Mero, & Chen, 1998; Lantz, Lynch, House, Lepkowski, Mero, Musick et al., 2001; Singh, Miller, & Hankey, 2002; Wardle, McCaffery, Nadel, & Atkin, 2004). Link et al (1998) argue that SES

embodies resources like knowledge, money, power and prestige which enhance opportunities to adopt healthy lifestyles and behaviours.

As one of the program's aims is to ensure equity amongst women in the target age group, the systematic variations found amongst income groups in this study calls for additional policy responses. However, the appropriate response will depend on the underlying reason for the systematic variation. If the cause is opportunity costs, the policy response may require additional efforts to reduce travel and waiting times or provide services with flexible opening hours (e.g. evenings or weekends). However, if the cause is related to women's preferences, the appropriate response will include information targeted at specific population groups who are known to under utilise services[5] about the benefits of the program, as well as targeted and specific recruitment and follow-up activities. More research is needed to help identify the cause(s) of systematic variation amongst socioeconomic groups as well as the cost-effectiveness of additional interventions to boost participation within the context of an existing national screening program.

The results demonstrate that women residing in outer metropolitan Area Health Services are less likely to screen although the degree of the remoteness (as measured by ARIA of a woman's place of residence) was not significant. However, when ARIA was excluded from the model, the relative risk ratios of four additional rural AHS became significant for the never screened group. Women living in these rural AHS were more than twice as likely to have never screened compared to women living in Northern Sydney. This indicates that remoteness may be a factor in explaining participation for women living those three rural areas. It should be noted that whilst ARIA is a commonly used indicator of service access, it is not specific to screening services. Thus ARIA scores may deviate from screening service access.

The AHS effects might be explained by variation in the availability and accessibility of Breast Screen facilities. Further research which links supply-side data (e.g. information

[5] To increase overall participation rates (rather than remove systematic variation), the policy response would be to reduce opportunity costs and to increase awareness and recruitment activities for all women.

about the availability and use of fixed and mobile screening sites within AHS over time) with NSW Health Survey data would provide insights into the likely impact that improved access to screening services will have on participation rates amongst women overall as well as its effect on different socio-economic groups.

Whilst the variable "born overseas" did not reach statistical significance ($p<0.12$) the coefficient indicated that women born overseas were more likely to have never screened. This result warrants closer scrutiny because of the program's reliance on electoral rolls to recruit women to the program. The electoral roll is a relatively reliable source of data but excludes those who are ineligible to vote. In 2006, 26% of people born overseas and residing in Australia for over two years had not taken out Australian citizenship and were therefore not on the electoral roll (Australian Bureau of Statistics., 2006). This suggests that other means of recruiting women born overseas may need to be examined. It should be noted that the 'overseas born' variable is an imperfect proxy for non-citizenship. Importantly, this study found no evidence that people who spoke a language other than English at home screened at a lower rate than their English speaking counterparts, indicating that there are no significant language barriers to screening in NSW.

The study also showed that the number of hours worked by a woman her increased the likelihood that she would be an irregular screener. This may be due to working women having less flexibility to take time during working hours to attend breast screening services. The potential that longer opening hours and location of screening services closer to places of work will increase screening rates required investigation.

Younger women in the cohort are significantly more likely to have never screened. This result is likely to be a reflection of the Breast Screen program's policy to commence inviting women at age 50. However, the results also provide some evidence that the program can improve participation rates through recruitment strategies aimed at the younger cohort. Age was not found to be significant amongst the irregular screening group.

There is evidence that systemic programs such as Breast Screen Australia have a positive impact on overall participation (Legler, Meissner, Coyne, Breen, Chollette, & Rimer, 2002) as well as reduction of inequalities (Birch, 2007; Reuben, Bassett, Hirsch, Jackson, & Bastani, 2002). However, it should be noted that substantial improvements in participation rates within an existing program may be relatively difficult to achieve (Page, Morrell, Chiu, Taylor, & Tewson, 2006). This suggests that careful selection and targeting of future policies is required to ensure the most effective and efficient methods to boost participation are implemented. This paper provides some insights into what policies could be evaluated in terms of their potential to reduce systematic variation in breast screening participation and also details the type of research that could aid the development of the most effective and efficient strategies to reduce these inequalities.

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Table 1: Dependent variable definition and selected sample distribution

Screening behaviour	Definition	Frequency (weighted)	Percentage of total
Never screeners	Never had a mammogram	312	11.7
Regular screeners	Last mammogram was less than 2 years ago	1994	74.7
Irregular screeners	Last mammogram was more than 2 years ago	365	13.7
Total		2,671	100

Table 2: Variable specification and descriptive statistics for target age women by screening behaviour

Variable	Never		Regular		Irregular		Definition
	Mean	St. Dev	Mean	St. Dev	Mean	St. Dev	
Demographic and cultural							
Age	57.2	6.4	58.7	5.4	58.8	5.6	Age in years
Born overseas	32.6%	47.0%	26.3%	44.0%	31.5%	46.5%	1 = yes; 0 = no
Speak language other than English at home	10.8%	31.0%	8.6%	28.0%	12.4%	33.0%	1 = yes; 0 = no
Highest qualification							
Primary school	2.6%	16.0%	3.5%	18.4%	3.8%	19.1%	1 = yes; 0 = no
Year 7 to Year 10	33.6%	47.3%	34.3%	47.5%	28.9%	45.4%	1 = yes; 0 = no
Year 12, TAFE or other	46.1%	49.9%	43.8%	49.6%	46.5%	49.9%	1 = yes; 0 = no
University (base)	17.7%	38.3%	18.4%	38.7%	20.9%	40.7%	1 = yes; 0 = no
Household income and hours worked							
Less than $10,000 (base)	8.4%	27.8%	6.3%	24.4%	9.3%	29.0%	1 = yes; 0 = no
$10,000 to 20,000	19.3%	39.5%	17.4%	37.9%	20.8%	40.6%	1 = yes; 0 = no
$20,000 to 40,000	13.8%	34.6%	17.7%	38.2%	18.4%	38.8%	1 = yes; 0 = no
$40,000 to 60,000	13.5%	34.2%	13.8%	34.5%	15.0%	35.7%	1 = yes; 0 = no
$60,000 to 80,000	10.6%	30.8%	8.3%	27.7%	6.4%	24.5%	1 = yes; 0 = no
Greater than $80,000	12.9%	33.6%	11.2%	31.6%	11.6%	32.0%	1 = yes; 0 = no
Income not stated	21.5%	41.2%	25.2%	43.4%	18.7%	39.0%	1 = yes; 0 = no
Hours worked in last week	12.9	19.1	11.5	18.2	13.9	18.8	Number of hours
Region of residence							
Inner-Metropolitan							
Northern Sydney (base)	7.9%	27.0%	12.5%	33.1%	8.9%	28.5%	1 = yes; 0 = no
Central Sydney	6.2%	24.1%	6.4%	24.4%	7.3%	26.1%	1 = yes; 0 = no
Western Sydney	9.6%	29.5%	8.7%	28.2%	8.7%	28.3%	1 = yes; 0 = no
South Eastern Sydney	11.9%	32.4%	11.9%	32.4%	11.1%	31.4%	1 = yes; 0 = no
Outer-Metropolitan							
South Western Sydney	13.9%	34.7%	9.5%	29.3%	13.1%	33.8%	1 = yes; 0 = no
Hunter	5.4%	22.6%	9.4%	29.2%	8.7%	28.2%	1 = yes; 0 = no
Wentworth	5.3%	22.5%	3.8%	19.2%	5.2%	22.2%	1 = yes; 0 = no
Illawarra	8.8%	28.4%	5.7%	23.3%	5.4%	22.7%	1 = yes; 0 = no
Central Coast	4.6%	21.0%	4.6%	20.9%	6.6%	24.8%	1 = yes; 0 = no
Rural							
Northern Rivers	4.8%	21.4%	5.5%	22.9%	6.4%	24.5%	1 = yes; 0 = no
Mid North Coast	4.5%	20.8%	6.1%	23.9%	4.8%	21.5%	1 = yes; 0 = no
New England	1.8%	13.4%	3.5%	18.3%	2.3%	15.0%	1 = yes; 0 = no
Mid Western	4.1%	19.8%	2.8%	16.4%	2.2%	14.5%	1 = yes; 0 = no
Far West	1.2%	10.7%	0.8%	8.8%	0.9%	9.2%	1 = yes; 0 = no
Greater Murray	5.0%	21.9%	3.8%	19.2%	3.8%	19.1%	1 = yes; 0 = no
Southern	2.9%	16.8%	3.4%	18.2%	3.4%	18.2%	1 = yes; 0 = no
Macquarie	2.1%	14.2%	1.6%	12.4%	1.3%	11.3%	1 = yes; 0 = no
Remoteness Quintiles							
Q1 - highly accessible (base)	69.4%	46.2%	70.0%	45.9%	69.8%	46.0%	1 = yes; 0 = no
Q2 - accessible	20.8%	40.6%	20.0%	40.0%	19.9%	40.0%	1 = yes; 0 = no
Q3 - moderately accessible	8.0%	27.2%	8.8%	28.4%	9.2%	29.0%	1 = yes; 0 = no
Q4 - remote	1.7%	12.9%	1.1%	10.6%	1.0%	9.8%	1 = yes; 0 = no
Q5 - very remote	0.1%	3.3%	0.1%	3.1%	0.1%	3.5%	1 = yes; 0 = no
Year of survey							
2004	42.1%	49.5%	44.3%	49.7%	49.2%	50.1%	1 = yes; 0 = no

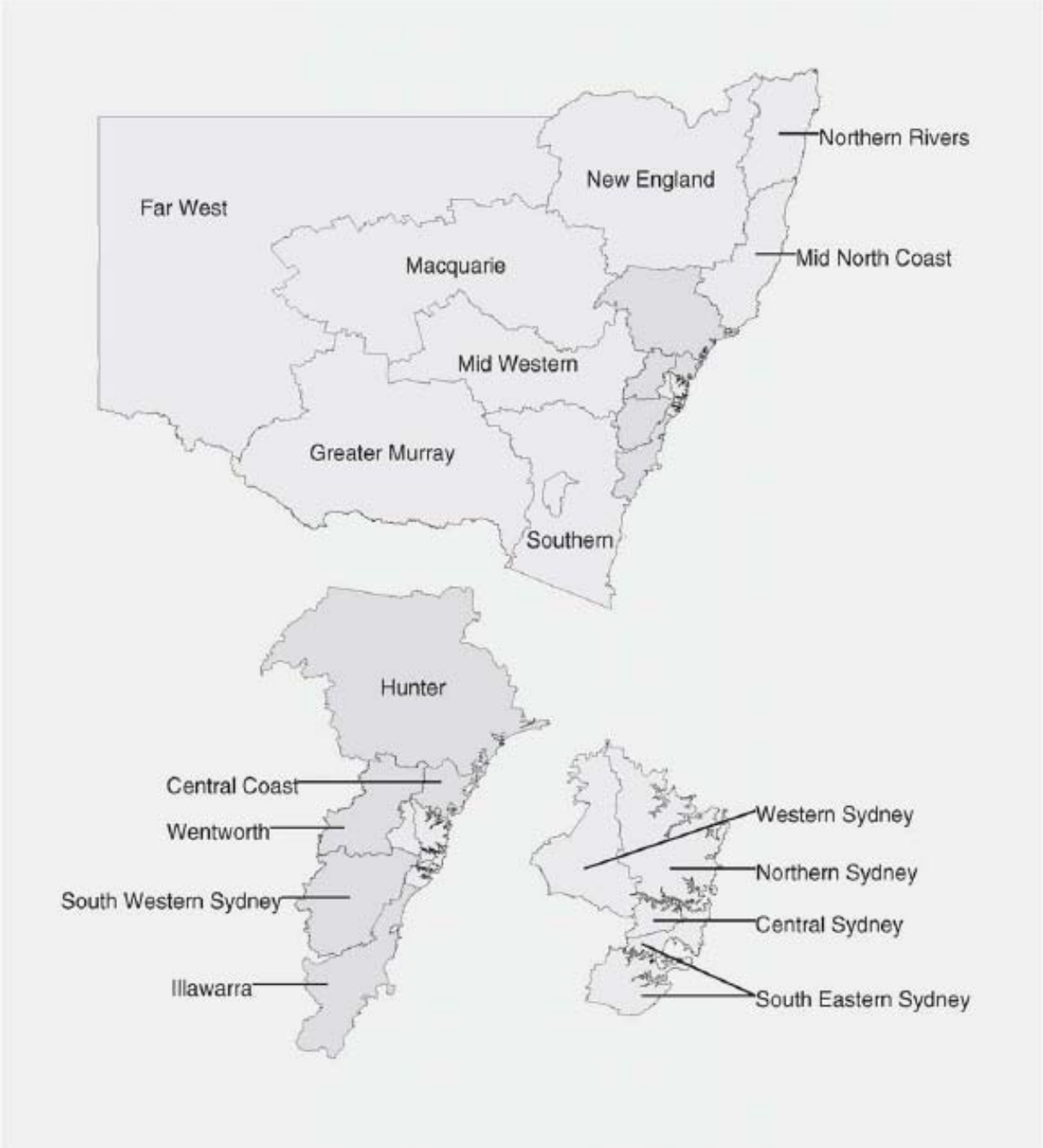
Table 3: Multinomial logit model empirical result

Variable	Never screeners		Irregular screeners	
	RRR	St. Err	RRR	St. Err
Demographic and cultural				
Age	0.16*	0.04	0.98	0.26
Age-Sq	1.02*	0.00	1.00	0.00
Born overseas	1.37	0.27	1.12	0.18
Speak language other than English at home	1.00	0.35	1.32	0.32
Highest qualification				
Primary school	0.67	0.27	0.79	0.29
Year 7 to Year 10	1.06	0.24	0.72***	0.14
Year 12, TAFE or other	1.06	0.23	0.90	0.16
University	-	-	-	-
Household income and hours worked				
Less than $10,000	-	-	-	-
$10,000 to 20,000	0.90	0.2	0.78	0.17
$20,000 to 40,000	0.58***	0.16	0.61**	0.15
$40,000 to 60,000	0.64	0.19	0.62***	0.16
$60,000 to 80,000	0.82	0.29	0.42*	0.13
Greater than $80,000	0.72	0.31	0.56***	0.17
Income not stated	0.65***	0.17	0.45*	0.11
Hours worked in last week	1.00	0.01	1.01**	0.00
Region of residence				
Inner-Metropolitan				
Northern Sydney	-	-	-	-
Central Sydney	1.31	0.56	1.60	0.56
Western Sydney	1.46	0.62	1.42	0.53
South Eastern Sydney	1.51	0.65	1.32	0.45
Outer-Metropolitan				
South Western Sydney	1.92	0.84	1.90***	0.67
Wentworth	2.03***	0.80	1.93***	0.68
Hunter	0.89	0.38	1.38	0.47
Illawarra	2.34**	0.91	1.36	0.47
Central Coast	1.42	0.59	2.11**	0.72
Rural				
Northern Rivers	1.23	0.51	1.57	0.53
Mid North Coast	1.00	0.44	1.02	0.39
New England	0.74	0.34	0.81	0.34
Mid Western	1.94	0.84	1.04	0.41
Far West	1.66	1.09	1.67	0.86
Greater Murray	1.84	0.78	1.32	0.52
Southern	1.20	0.50	1.34	0.49
Macquarie	1.65	0.75	1.05	0.43
Remoteness Index				
Q1- highly accessible	-	-	-	-
Q2- accessible	1.26	0.29	1.12	0.23
Q3- moderately accessible	1.22	0.38	1.21	0.32
Q4- remote	1.50	0.93	0.95	0.44
Q5- very remote	1.56	1.46	1.37	0.98
Year of survey				
Year 2004	0.87	0.15	1.16	0.16

Pseudo R^2	4.1%
Log *L*	-2811.7
Observations	3955
Sum of weights	2671

* $p \leq 0.01$
** $p \leq 0.05$
*** $p \leq 0.10$

Figure 1: Map of seventeen Area Health Services in NSW by inner and outer metropolitan and rural regions



Taken from NSWHealth NSW Public Health Bulletin Supplement
The NSW Health Adult Health Survey 2002.

pg. 15 Map of NSW area health services
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Figure 2: Average predicted probability of never and irregular screening by household income

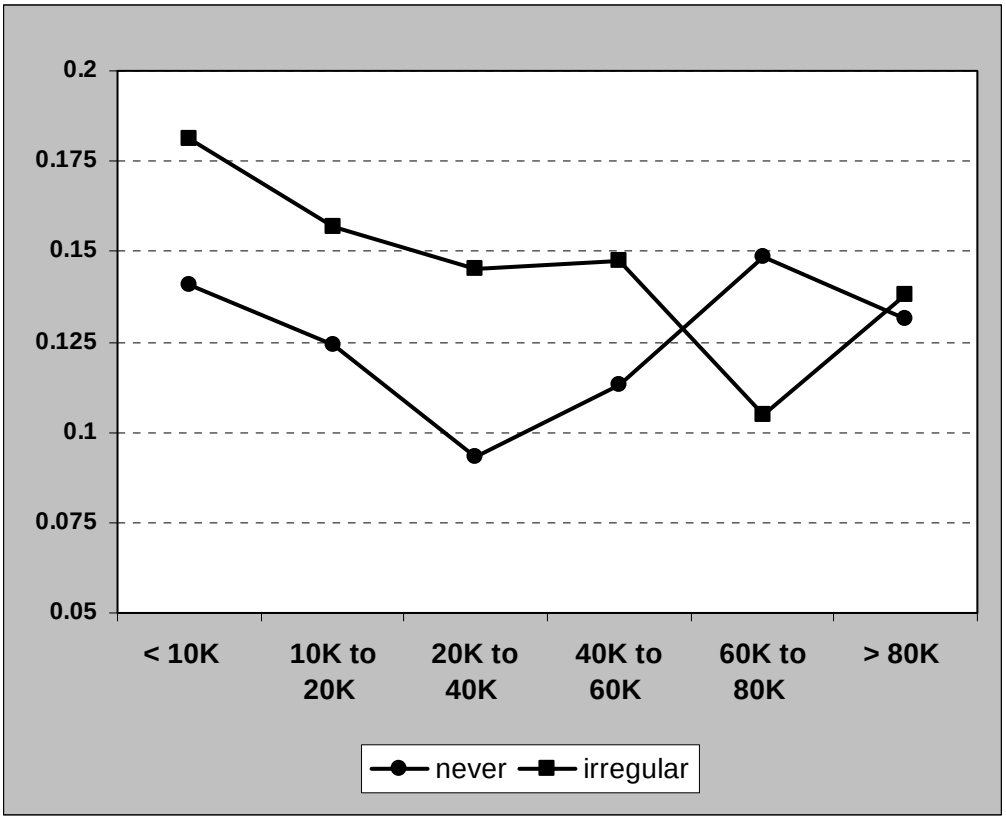

Figure 3: Average predicted probability of never and irregular screening within target age