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## ORIGINAL RESEARCH

# Colorectal cancer screening in rural and remote areas: analysis of the National Bowel Cancer Screening Program data for South Australia

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## ABSTRACT

**Introduction:** In Australia, colorectal cancer is the second most commonly diagnosed cancer and cause of death from malignant diseases, and its incidence is rising. The aim of this article was to present an analysis of National Bowel Cancer Screening Program (NBCSP) data for rural and remote South Australia (SA), in order to identify geographical areas and population groups that may benefit from targeted approaches to increase participation rates in colorectal cancer screening.



**Methods:** De-identified data from the NBCSP (February 2007 to July 2008) were provided by Medicare Australia. Mapping and analysis of the NBCSP data was performed using ESRI ArcGIS (<http://www.esri.com/software/arcgis/index.html>) and MapInfo (<http://slp.pbinsight.com/info/mipro-sem-au>). Data were aggregated to postcode and Accessibility/Remoteness Index of Australia (ARIA) and participation was then mapped according to overall participation rates, sex, age, Indigenous status and Socio-Economic Indexes for Areas (SEIFA)-Index of Relative Socio-Economic Disadvantage (IRSD). The participants were South Australians who turned 55 and 65 years between 2007 and 2008 who returned the completed NBCSP test sent to them by Medicare Australia.

**Results:** The overall participation rate was 46.1% in rural and remote SA, although this was statistically significantly different ( $p < .001$ ) according to sex (46.7% for males and 53.3% for females), age (45.2% for those 55 years, and 52% for those 65 years), socio-economic status (from 43% in 'most deprived' quintile to 50% in 'most affluent' quintile) and remoteness (45.6% for metropolitan, 46% for remote and 48.6% for rural areas). Indigenous participation was 0.5%.

**Conclusions:** The findings of this study suggest lower NBCSP participation rates for people from metropolitan and remote areas, compared with those from rural areas. The uptake of cancer screening is lower for older rural and remote residents, men, Indigenous people, lower socioeconomic groups and those living in the Far North subdivision of SA.

**Key words:** age, Australia, bowel cancer screening, geographical location, participation, remote, rural, sex, socioeconomic status.

## Introduction

Globally, Australia and New Zealand, North America, and Northern and Western Europe have the highest incidences of colorectal cancer (CRC)<sup>1-3</sup>. In Australia, CRC is the second most commonly diagnosed cancer and cause of death from malignant diseases<sup>4</sup>, with the CRC crude rate increasing and predicted to rise by approximately 30% between 2002 and 2011<sup>5</sup>.

A number of randomised controlled trials have demonstrated the effectiveness of CRC screening for reducing CRC incidence and mortality<sup>6-8</sup>. However, the impact of screening on CRC incidence and mortality has been limited by a number of factors, including the accuracy of screening technology<sup>9</sup>, the willingness of eligible populations to participate<sup>10</sup>, access to CRC screening<sup>6,7</sup> and primary healthcare practitioners<sup>11</sup>, geographical location<sup>12</sup>, Indigenous status<sup>13-15</sup>, and a range of social, demographic, and economic factors<sup>16,17</sup>.

The Australian CRC population-based screening program, the National Bowel Cancer Screening Program (NBCSP) was first implemented in South Australia (SA) in February 2007. The first phase of the NBCSP (timeframe of this

study) offered free CRC screening in the form of an immunochemical faecal occult blood test (FOBT) test for people turning 55 and 65 years of age between 1 May 2006 and 30 June 2008. A pre-invitation letter and subsequent invitation package including FOBT test kit are posted to eligible participants by Medicare Australia. Invitees are requested to mail their FOBT sample kit to a central pathology service for analysis.

Although the Australian NBCSP provides universal access to the screening program, early findings from the analysis of the NBCSP at the national level demonstrate that there are differences in participation rates among population sub-groups and geographical locations<sup>3,17-19</sup>.

Participation in preventive programs including cancer screening programs has been shown to be associated with geographical location. People living in rural and remote areas are less likely than metropolitan residents to access preventive health services<sup>20,21</sup>, including cancer screening services<sup>22-24</sup>. Overall, poorer health outcomes increase with geographic isolation, and rural and remote residents are less likely to be diagnosed with localised disease, and hence have higher cancer-specific mortality rates<sup>25</sup>.



Rural and remote residents are less likely to participate in the CRC screening program compared with their urban counterparts<sup>26</sup>. Lower rates of screening participation in rural areas have been attributed to lower socioeconomic status, lack of access to healthcare services, low health literacy, exclusive reliance on Medicare coverage, and social isolation<sup>25,27</sup>. Inadequate patient-provider communication about CRC screening<sup>26</sup> and distance to travel to a GP<sup>28</sup> have also been found to be barriers to CRC screening in rural primary care.

This article explores participation in the NBCSP for people residing in geographically rural and remote areas of SA. The focus is to identify population groups within these geographical areas who may benefit from targeted programs to increase participation rates in the NBCSP.

## Method

### *Sample*

The target population included NBCSP invitees in SA who turned 55 and 65 years between 2007 and 2008 and were invited by Medicare Australia to complete the FOBT testing kit which had been mailed to them. The NBCSP participants are defined as invitees who undertook the FOBT screening and returned NBCSP Participant Information Form to a central pathology service for analysis, and had a positive or negative test result.

### *Sampling frame*

Data for this study were based on de-identified, South Australian Medicare Australia extract between February 2007 and July 2008 (phase 1 of the program). The dataset for the NBCSP invitees (total number = 92 279) included data on age, sex and postcode; for NBCSP participants it also included data on Indigenous status and language spoken at home. For the purpose of this study, the 17 497 South Australians who participated in the pilot phases of the NBCSP were removed from the dataset because their exposure to NBCSP may have a confounding effect on subsequent NBCSP participation. Therefore, the final dataset for

analysis included 74 782 South Australians who had been invited to undertake screening for the first time by the NBCSP.

### *Ethics approval*

Ethics committee approval was granted by the Ethics Committee of the Commonwealth Department for Health and Ageing, and by the Social and Behavioural Research Ethics Committee of Flinders University.

### *Data analysis*

Medicare data were analysed using the Statistical Package for the Social Sciences (SPSS) v17.0 ([www.spss.com](http://www.spss.com)). Initial analyses were undertaken using  $\chi^2$  testing and univariate regression analyses in order to describe the associations between participation in the NBCSP and the socio-demographic variables: age, sex, postcode, Indigenous status and language spoken at home. All univariate variables found to be associated with the dependent variable, NBCSP participation, at  $p < 0.25$  level<sup>29</sup> were entered as independent variables into a logistic regression analysis (block-enter method). Indigenous status and language spoken at home were not included in the regression model because the data were not available for NBCSP invitees. The final multiple regression model was checked for collinearity and all variables included at the initial step remained statistically significant.

Postcodes were re-coded for the analysis in the following way. First, postcodes were converted into a measure of remoteness, using the Accessibility/Remoteness Index of Australia (ARIA)<sup>30</sup>. This is an index of the proximity of postcodes to service centres, or conversely of remoteness of postcodes. The ARIA has both a 5 point and a 3 point scale. The 3 point scale used in this study includes the following categories: (i) ARIA 0–1.84, indicating highly accessible or metropolitan locations; (ii) ARIA >1.84–5.80 indicating accessible and moderately accessible or rural areas; and (iii) ARIA >5.80–12.0, indicating remote and very remote areas. Second, each postcode was coded according to the Socio-Economic Indexes for Areas (SEIFA)–Index of Relative Socio-Economic Disadvantage (IRSD)<sup>31</sup>, a composite measure based on selected census variables such as income, educational attainment and employment status. The



SEIFA-IRSD scores for each postcode were then grouped into quintiles, where the highest quintile consists of the 20% of postcodes with the highest SEIFA-IRSD scores and represents the least disadvantaged areas; and the lowest quintile consists of the 20% of postcodes with the lowest scores and represents the most disadvantaged areas. Mapping and analysis of the NBCSP data was performed using ArcGIS (<http://www.esri.com/software/arcgis/index.html>), MapInfo (<http://slp.pbinsight.com/info/mipro-sem-au>) and MS Access and Excel.

## Results

The profile of NBCSP participants in SA indicates that participation varied by place of residence as defined by ARIA classification, age, sex, Indigenous status, language spoken at home and social disadvantage as measured by SEIFA-IRSD (Table 1). Table 2 demonstrates rates of participation in the NBCSP by geographical location.

**Geographical postcode:** Of the 74 782 SA invitees, 34 480 participated in the NBCSP, an overall participation rate of 46.1% (Table 2). Of those participating, 6907 (20%) were from areas classified as rural or remote. Participation rates by place of residence and geographical accessibility as classified by ARIA, were found to be significantly different between SA participants residing in metropolitan locations (45.6%) and those residing in rural and remote areas combined (48.2%). However, compared with metropolitan areas, while NBCSP participation rates are marginally similar in remote areas, they are statistically significantly higher in rural areas (Table 2).

The map of NBCSP participation rates in rural and remote SA (Fig1) reveals a pattern of high participation in screening in Eastern and Southern SA, with screening rates ranging between 60% and 100% in some postcodes. As can be seen, there was insufficient data to calculate participation rates in large sections of the state, particularly in the Far North subdivision of SA.

**Age:** The NBCSP participation rates vary significantly according to participant profile (Tables 3 and 4). Comparing NBCSP

participation by age indicates that rural and remote SA invitees who were aged 55 years were significantly less likely to respond to screening invitation by undertaking FOBT than those aged 65 years, taking into account other participants' variables. There were higher participation rates in the southern and eastern areas of SA for participants aged 65 years (Fig2). Overall, screening rates of 60–100% were three times more in the 65 years age group than in the 55 years age group. Similar patterns of geographical disparity exist, with Far North SA having lower rates of participation in both age groups.

**Sex:** Male participation in NBCSP was significantly lower than among females. There were large differences in participation according to sex (Fig3), with female participation rates of 60–100% being significantly higher than for men, in most areas.

**SEIFA-IRSD:** Participation rates by SEIFA-IRSD were significantly different. Tables 3 and 4 reveal a gradient in participation where the lowest two quintiles, which represent greater social disadvantage, have significantly lower participation rates than the middle and highest quintiles.

**Indigenous race:** Self-reported Aboriginal and Torres Strait Islander status (in this article referred to as Indigenous) was available only for participants who completed the FOBT, with the Indigenous status of invitees who failed to return their FOBT unknown. The total proportion of the Indigenous participants from rural and remote areas was 0.10% (0.06–0.15). Given that Indigenous Australians comprise approximately 1.7% of the South Australian population<sup>32</sup> and, of these, 0.62% are 55 years of age, and 0.47% are 65 years, 7.0% live in remote areas (0.2% of total population), and 2.9% within rural areas (0.4% of total population)<sup>33</sup>, and as this proportion is not within the confidence interval of the sample, the proportion of Indigenous people who participated in the NBCSP was statistically significantly lower than was expected. However, given the insufficient details about the Indigenous status of invitees, it was not possible to calculate an overall participation rate. Significantly, the areas showing unknown participation rates (Fig1) have high Indigenous populations.



**Table 1: Profile of South Australian National Bowel Cancer Screening Program participants by Accessibility/Remoteness Index of Australia**

Profile item	Participants n (%)		Total
	Metropolitan	Rural/ remote	
Sex			
Male	12 447 (45.1)	3223 (46.7)	15 670
Female	15 126 (54.9)	3684 (53.3)	18 810
Age (years)			
55-58	25 700 (56.9)	3705 (53.6)	19 405
65-67	11 869 (43.1)	3202 (46.4)	15 071
Indigenous			
Neither Aboriginal nor Torres Strait Islander	26 489 (96.1)	6612 (95.7)	33 101
Indigenous (Aboriginal, Torres Strait Islander, South Sea)	72 (0.3)	37 (0.5)	109
Not stated	1012 (3.7)	258 (3.7)	1270
Language at home			
English	24 984 (90.6)	6751 (97.7)	31 735
Other	2589 (9.4)	156 (2.3)	2745
SEIFA-IRSD			
Lowest	3863 (14.0)	1245 (18.3)	5108
Low	4610 (16.8)	2417 (35.5)	7027
Middle	5493 (20.0)	2065 (30.3)	7558
High	5720 (20.8)	1036 (15.2)	6756
Highest	7831 (28.5)	52 (0.8)	7883

†SEIFA-IRSD, Socioeconomic Index for Areas -Index of Relative Social Disadvantage.

**Table 2: South Australian participation rates by Accessibility/Remoteness Index of Australia**

ARIA classification	NBCSP			Odds Ratio (95% CI)	P value
	Invitees	Participants	Participation %		
Metropolitan	60 449	27 573	45.6	1.00	
Rural†	12 096	5878	48.6	1.19 (1.15-1.24)	<0.001
Remote†	2237	1029	46.0	1.03 (0.94-1.12)	0.559
Total	74 782	34 480	46.1	-	

ARIA, Accessibility/Remoteness Index of Australia; NBCSP, National Bowel Cancer Screening Program.

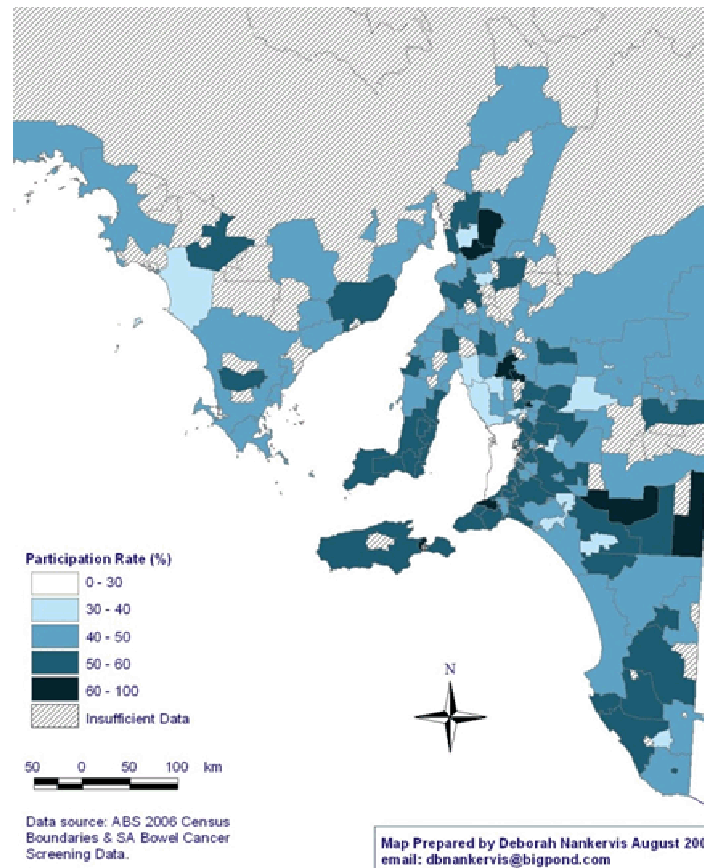
†Rural (Accessible & moderately accessible ARIA >1.84-5.80); remote (Remote & Very Remote ARIA >5.80-12.0).

**Languages spoken at home:** In rural and remote areas 2.3% of participants reported speaking a language other than English at home. Australian Bureau of Statistics 2006 statistics show this population for Northern SA as 7.1%, and Murraylands 6.2%<sup>34</sup>. Given the ABS statistics, this participation is lower than could be expected.

### *Limitation of the data*

It was not possible to ascertain if South Australians who had been invited to undertake screening for the first time by the NBCSP had previously been offered, or participated in, CRC screening other than the NBCSP.





**Figure 1: National Bowel Cancer Screening Program participation rates (% ranges) in rural and remote South Australia by postcode.**

**Table 3: Univariate odds ratios for National Bowel Cancer Screening Program (National Phase 1) participation rates in rural and remote South Australia, by Accessibility/Remoteness Index of Australia and participant profile**

Participants	NBSP			Odds Ratio (95% CI)	P value
	Invitees <sup>†</sup>	Participants <sup>‡</sup>	Participation %		
Sex					
Male	7330	3223	44.0	1.00	
Female	7003	3684	52.6	1.41 (1.32-1.51)	<0.001
Age (years)					
55-58	8193	3705	45.2	1.00	
65-67	6140	3202	52.1	1.32 (1.24-1.41)	<0.001
SEIFA-IRSD quintile					
Lowest	2873	1245	43.3	1.00	
Low	4978	2417	48.6	1.23 (1.13-1.35)	<0.001
Middle	4076	2065	50.7	1.34 (1.22-1.48)	<0.001
High	2101	1036	49.3	1.27 (1.14-1.42)	<0.001
Highest	103	52	50.5	1.33 (0.90-1.98)	0.152

<sup>†</sup>Total rural/remote invitees=14 333; <sup>‡</sup> participants n=6907.

NBSP, National Bowel Cancer Screening Program; SEIFA-IRSD, Socioeconomic Index for Areas- Index of Relative Social Disadvantage.

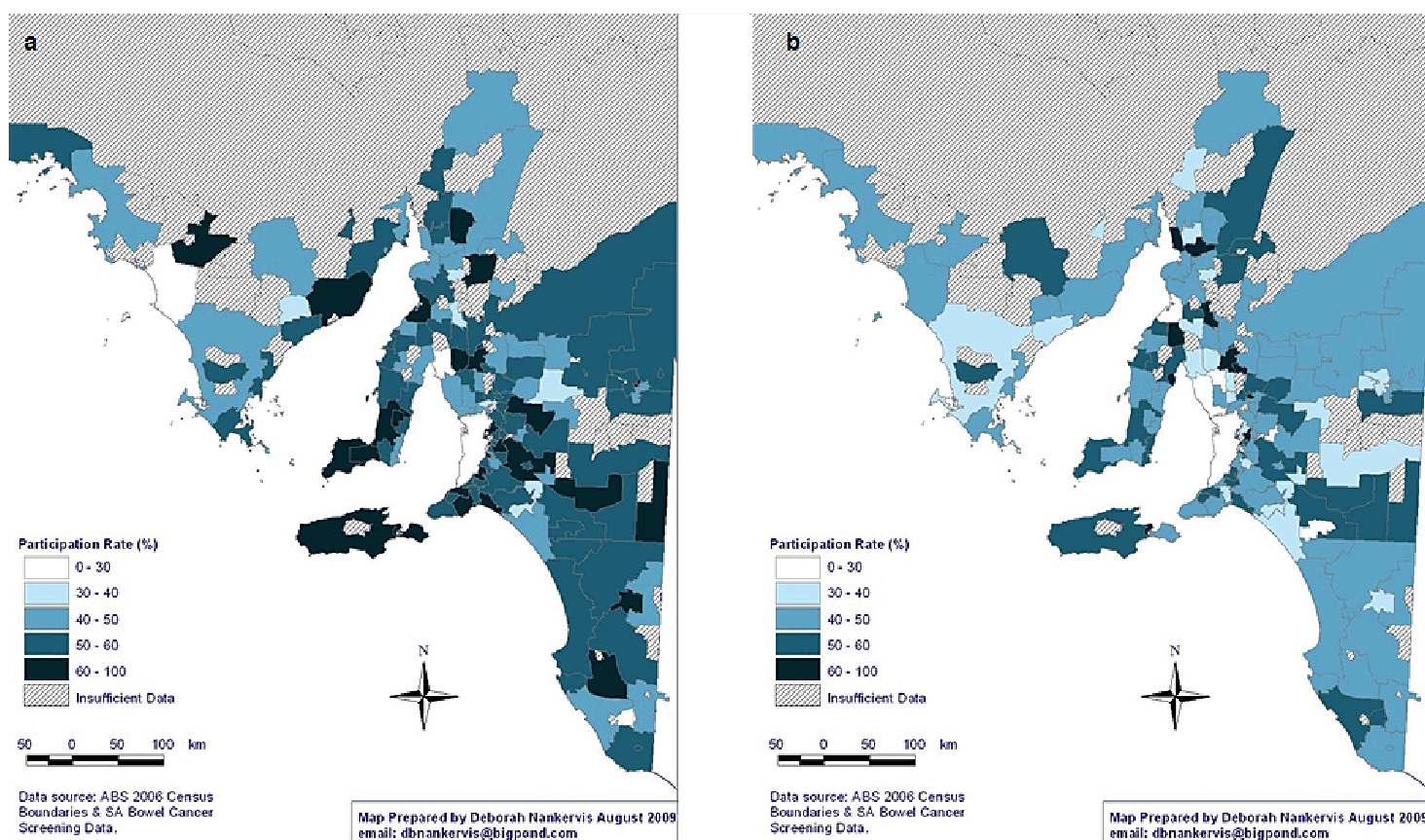


**Table 4: Multivariate odds ratios for participation in National Phase 1 in rural and remote areas<sup>29</sup>**

Participant	OR	P value
Sex		
Male	1.00	
Female	1.42 (1.33-1.52)	<0.001
Age (years)		
55-58	1.00	
65-67	1.33 (1.24-1.42)	<0.001
SEIFA-IRSD quintile		
Lowest	1.00	
Low	1.25 (1.14-1.38)	<0.001
Middle	1.36 (1.23-1.49)	<0.001
High	1.30 (1.16-1.46)	<0.001
Highest	1.38 (0.93-2.06)	0.107

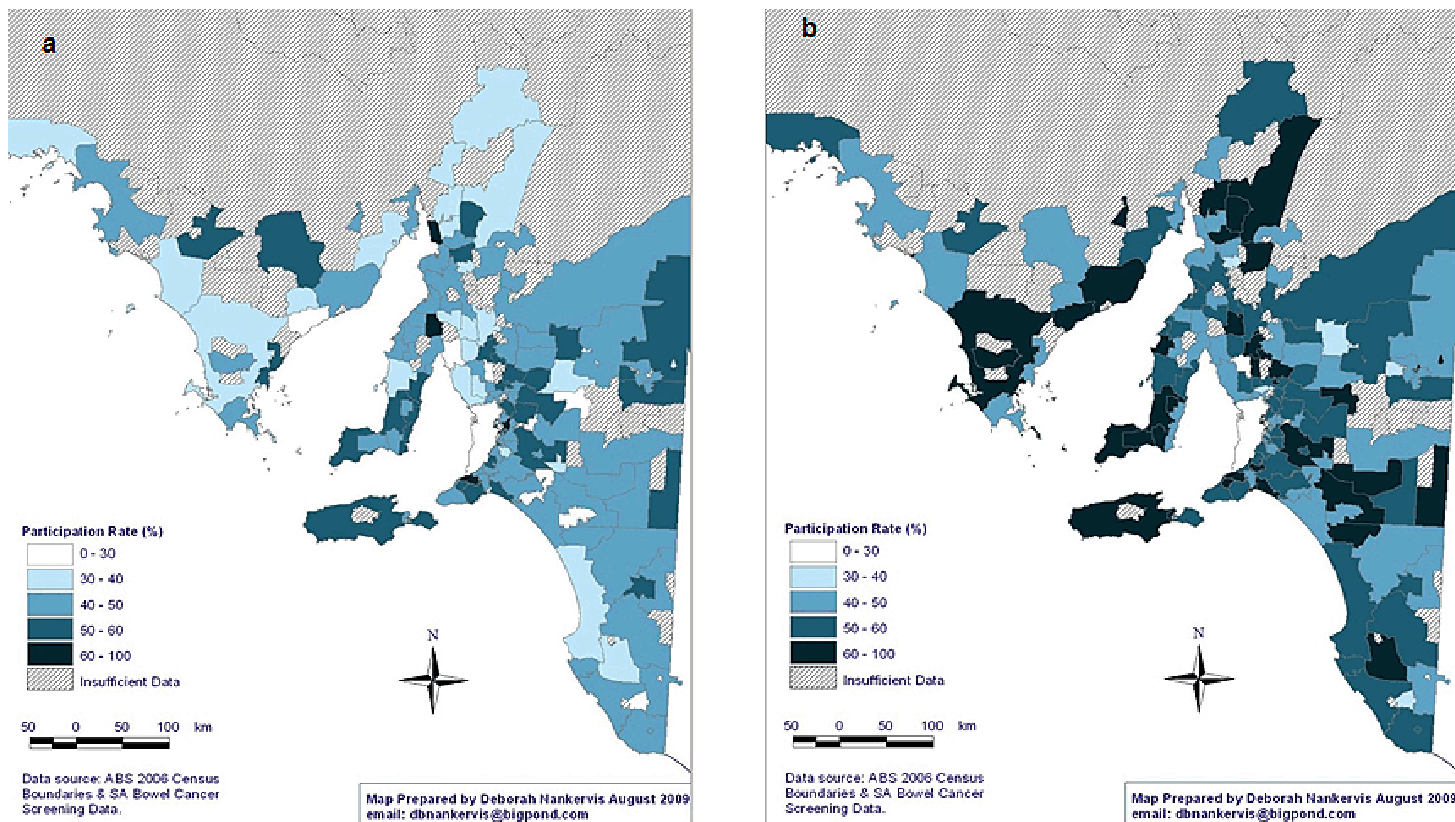
SEIFA-IRSD, Socioeconomic Index for Areas -Index of Relative Social Disadvantage.

Model is stable  $\chi^2 = 7.274, p = 0.51$  [29].



**Figure 2: National Bowel Cancer Screening Program participation rates in rural and remote South Australia at age: (a) 55 years, and (b) 65 years.**





**Figure 3: National Bowel Cancer Screening Program participation rates in rural and remote South Australia according to sex: (a) male, and (b) female.**

## Discussion

Overall, the analyses revealed lower NBCSP participation rates for people from metropolitan and remote areas compared with those from rural areas. Within these areas, lower participation rates were found for men compared with women, those 55 years compared with 65 year olds, and socio-economically disadvantaged groups compared with more affluent groups. Among invitees who participated in the NBCSP, comparison with the most recent Australian Census data indicated that South Australians who reported speaking a language other than English at home and those who reported an Indigenous background were under-represented. These differences in participation rates were consistent for CRC screening in the SA metropolitan state capital Adelaide<sup>12</sup>, and NBCSP national data<sup>35-37</sup>. These

findings are also consistent with results from other cancer screening programs which suggest that inequitable patterns of participation may arise from a variety of factors including those associated with sex<sup>38,39</sup>, age, socio-economic status<sup>40,41</sup> and Indigenous status<sup>42,43</sup>. The finding of increasing participation in rural areas was inconsistent with much of the literature where evidence shows that non-attendance at screening was positively associated with living in a rural area<sup>23,24</sup>.

Significantly, the data suggests inequitable patterns of participation across geographical lines within rural and remote SA. Geographically, the pattern of high participation in CRC screening in Eastern and Southern SA, compared with the significantly large areas of low participation rates in Far North SA, are identified by the most recent ABS



census<sup>34</sup> as areas with large Indigenous and more socially disadvantaged populations.

While the national monitoring of the NBCSP<sup>44</sup> is useful, it does not provide the necessary details at a state-based level (and lower levels of aggregation such as postcodes) required to inform service planning. Moreover, it does not highlight the specific geographical areas that might benefit from renewed attempts at targeted interventions designed to improve participation. The maps of NBCSP participation rates provided in this study (Figs 1, 2 & 3) reveal differences among South Australian postcodes in terms of rural and remote area participation rates, although these differences may have been accounted for in part by the above variables.

The greatest disparities in CRC screening in rural and remote SA were associated with socioeconomic disadvantage, sex, age and Indigenous status factors. Therefore, population-based screening programs that target these identified groups will offer rural and remote residents the same opportunity access to CRC screening.

## Conclusion

The early detection of CRC is a major clinical and public health concern. The findings indicate that residing in rural and remote areas can affect uptake of cancer screening, with sex, age, Indigenous status and SEIFA-IRSD having a particularly negative impact on screening. Older rural and remote residents, men, Indigenous peoples and those living in Far North SA need specifically targeted preventive screening services. The special challenges that geographically isolated areas present highlight the need for more research in order to understand the reasons for disparities in screening participation and areas of insufficient data.

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