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Impact of a mass media campaign on participation rates in a national bowel cancer screening program: a natural experiment

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ABSTRACT

Objectives and Design: This study aimed to examine the effects of a mass media campaign on bowel cancer screening participation rates and the extent to which a higher intensity campaign in one state led to higher screening rates compared to another state that only received limited campaign exposure. **Intervention**: An eight-week television-led mass media campaign was launched in selected regions of Australia in mid-2014 to promote Australia's National Bowel Cancer Screening Program (NBCSP) that posts out faecal occult blood test (FOBT) kits to the homes of age-eligible people. The campaign used paid 30-second television advertising in the entire state of Queensland but not at all in Western Australia. Other supportive campaign elements had national exposure, including print, four-minute television advertorials, digital and online advertising. **Outcome measures**: Monthly kit return and invite data from NBCSP (January 2012 to December 2014). Return rates were determined as completed kits returned for analysis out of the number of people invited to do the FOBT test in the current and past 3 months in each state. **Results**: Analyses adjusted for seasonality and the influence of other national campaigns. The number of kits returned for analysis increased in Queensland (Adjusted Return Rate=20%, 95% CI:1.06-1.35, p<.01) during the months of the campaign and up to two months after broadcast, but only showed a tendency to increase in Western Australia (Adjusted Return Rate=11%, 95% CI:0.99-1.24, p=.087). **Conclusions**: The higher intensity eight-week television-led campaign in Queensland likely resulted in at least 368 (95% CI: 186-550) extra people who tested positive on their FOBT who could seek follow-up, whereas there were marginal effects for the low intensity campaign elements in Western Australia. The low levels of participation in Australia's bowel cancer screening program could be increased by national mass media campaigns, especially those led by higher intensity paid television advertising.

Article summary

Strengths

- Objective behavioural outcome data were used from monthly FOBT invites and returns over the previous two-and-a-half years, compared to those during and after the campaign period
- Adjustment for seasonality and the potential influence of other campaigns, as well examination of the duration of effects
- Ability to compare effects of higher versus lower campaign intensity across entire state populations

Limitations

- Lack of a completely unexposed comparison state
- Examined overall campaign effects, rather than for demographic subgroups
- Campaign effects reported are likely to be conservative, as we examined effects only among those invited in the current or past three months, not those invited earlier, and not among those who may have accessed screening 'outside' of the program (e.g., purchasing FOBT from pharmacy or obtaining a script from GP for non-NBCSP FOBT or colonoscopy)

INTRODUCTION

Bowel cancer (also known as colorectal cancer) is a leading cause of morbidity and mortality in high income nations. For example, it is the second most common cancer diagnosed in both men and women, and is also the second most common cause of cancer death in Australia.[1] Despite this, 90% of bowel cancer cases can be treated successfully if detected early.[2] Screening for bowel cancer via faecal occult blood tests (FOBT) has been shown to reduce bowel cancer mortality by 15-33%.[3, 4] An Australian model suggests that with a 40% biennial participation rate, 59,000 deaths are expected to be prevented over the 2015-2040 period, and if a participation rate of 60% could be achieved, an additional 24,800 bowel cancer deaths could be prevented.[5]

The Australian National Health and Medical Research Council-approved clinical guidelines recommend all asymptomatic people over the age of 50 years who are average risk should be screened for bowel cancer every two years with an FOBT. To facilitate this, the Australian Government commenced the National Bowel Cancer Screening Program (NBCSP) in 2006 where immunochemical FOBT kits are sent directly to people aged 50-74 at home. A study of people diagnosed with bowel cancer between 2006 and 2008 indicated that compared to non-invitees, those invited to participate in the NBCSP (and particularly those who participated) had less advanced bowel cancers when diagnosed and a lower risk of dying from their bowel cancer.[6]

Unfortunately participation in the NBCSP among the Australian population has been disappointing, with only 40.9 % of those invited taking up the opportunity to be screened by the program.[7] Lack of awareness of bowel cancer and the benefits of screening have been found to contribute to poorer screening rates, including among those invited to participate in the NBCSP.[8] Of those strategies trialled in Australia and elsewhere to improve screening rates, there is strong evidence for the important role of primary care practitioners' recommendations to undergo screening in determining whether a patient is screened.[9] Using media education (postcards, letters) within primary care and enhancing primary care practice electronic medical records to include reminder systems can also improve screening rates.[10] Outside primary care, culturally-adapted group education sessions and multi-component interventions (such as education sessions, videos, and special events) have been found to increase screening rates,[11] while telephone outreach modestly increases screening.[12] Financial support and one-on-one education has been found to be less

effective than group education.[11] As the delivery of each of these interventions relies on practitioner, community or cultural group initiatives, they are likely to have limited population reach and so are limited in their capacity to drive increases in the overall population screening rate.

Increasing the population screening rate will likely require interventions delivered to the broad population through mass dissemination techniques. There is some evidence that tailoring of mail-based interventions with FOBT invitation modestly improves screening above standard FOBT mail-out,[12] while one study has shown celebrity endorsements can increase screening rates.[13] The few studies that have examined the effectiveness of mass media bowel cancer screening campaigns have shown that they can increase population screening rates,[11] but describe the effects as moderate and short lived. This is consistent with the pattern of effects found for mass media campaigns for other health behaviours,[14] such as for smoking cessation.[15]

Research into the effectiveness of mass media in changing other health behaviours has shown that success is closely tied to the extent and timing of exposure, with time-limited effects for 'one-off' campaigns and less impact if there is low message repetition and narrow population exposure.[16] Nonetheless, these studies have shown that small effects can lead to substantial impact on population behaviour change due to exposing many individuals within a population. Consistent with this, a recent study found that specialist referrals increased following a one-off seven-week television-led bowel cancer detection campaign in the UK, and that the increase lasted for three months post-campaign.[17, 18] Illustrating the importance of the extent of population exposure, another study found that as past year exposure to screening information increased from news media and the television-led 'Screen for Life' campaign, levels of screening participation rose.[19] One non-televised medical practice based campaign in the UK (leaflets, DVDs, posters, bookmarks along with practice reminder letters and health professional education materials) was found to increase health professional visits and referrals to FOBT, flexible sigmoidoscopy or colonoscopy, but not more so than the comparison group that implemented only the practice reminder letters and health professional education.[20] Another non-televised campaign in the USA relying on billboards, posters and articles sent to local newspapers, and brochures and posters in clinics produced no differences in bowel cancer screening rates among those in counties exposed to

it compared with those in control counties.[21] The limited effect of these campaigns is likely due to the low population reach of these types of non-televised campaign elements.

As there had been very few widespread Australian television-led mass media campaigns to promote the NBCSP and use of FOBT kits mailed to eligible people's homes, Cancer Council Australia (CCA) launched a mass media campaign in mid-2014. The campaign included a 30-second television commercial (TVC) which aired in three Australian states: all of Queensland, metropolitan Adelaide in South Australia and regional Victoria. Other supportive elements of the campaign had national exposure, including a print, digital and online strategy (full-page print advertisement in *Prevention* magazine; internet search optimisation; native digital content advertising; digital video advertising; website sponsorship) and four-minute televised editorial segments on morning show programs. The primary campaign objective was to increase the number of people aged 50-74 who completed a NBCSP FOBT.

This study aims to identify if NBCSP FOBT completion and return rates increased during and after the CCA bowel cancer screening mass media campaign and the extent to which the higher intensity paid television advertisements led to higher screening rates. This will be achieved by comparing the rate of FOBT completion over the two-and-a-half year period prior to the campaign with rates during and after the campaign. The impact of campaign intensity will be examined by comparing return rates over time in the state with complete exposure to all of the campaign elements including paid 30-second television advertising (Queensland) with a comparison state (Western Australia (WA)) that was only exposed to the lower intensity supportive elements.

METHOD

National Bowel Cancer Screening Program Register data

The NBCSP has had a gradual introduction (Table 1), with full implementation as a two-yearly program to be complete by 2019. Once fully implemented, eligible Australians will be sent an FOBT screening kit and invited to screen every two years between their 50th and 74th birthdays.

Table 1. Australian National Bowel Cancer Screening Program implementation

Start date	Ages invited
August 2006	55, 65
July 2008	50, 55, 65
July 2013	50, 55, 60, 65
January 2015	50, 55, 60, 65, 70, 74
January 2016	50, 55, 60, 64, 65, 70, 72, 74
January 2017	50, 54, 55, 58, 60, 64, 68, 70, 72, 74
January 2018	50, 54, 58, 60, 62, 64, 66, 68, 70, 72, 74
January 2019	50, 52, 54, 56, 58, 60, 62, 64, 66, 68, 70, 72, 74

To participate, those invited by the NBCSP need to complete the screening test and post it in the provided post-paid envelope to the NBCSP pathology laboratory for analysis within 14 days of completing the test. Results are then sent to the participant, their nominated primary health-care practitioner and to the NBCSP Register. Those with a positive screening result, indicated by blood in the stool sample, are advised to consult their primary health care practitioner to discuss further diagnostic assessment which in most cases will be a colonoscopy.[6]

De-identified NBCSP monthly data from 1 January 2012 to 31 December 2014 from Queensland and WA were obtained. The data included the number of NBCSP invitations sent out and the number of NBCSP kits returned for analysis within each month and state.

Participant involvement

This research involved secondary analysis of data collected by the NBCSP. In the NBCSP information booklet that is sent to participants with the FOBT kit, it stated that "Your personal details will be used to: monitor and evaluate the effectiveness of the program and its impact on the incidence of bowel cancer. This information booklet also detailed how participants can opt out of the program if they would like to.

Cancer Council Australia mass media campaign

The mass media campaign, run by CCA with Australian government funding, aimed to increase awareness of the preventability of bowel cancer when detected early and to

encourage adults aged 50-74 years to participate in the NBCSP when invited. The proposed creative concepts went through extensive qualitative developmental testing to ensure that they were relevant and likely to be effective with the target audience.[22] A 30-second TVC featured real people who prematurely lost loved ones to bowel cancer reflecting on how much they missed them and how preventable bowel cancer is if detected early. The TVC informed people that "Bowel cancer kills 75 Australians every week", that "If detected early, 90% of bowel cancers are cured" and asked "Are you 50 or over? Do the test. It could save your life". The TVC closed by encouraging people to visit a campaign microsite (bowelcancer.org.au) and Cancer Council Helpline (13 11 20) to find out more.

The TVC aired from 1 June to 26 July 2014 and was estimated by media buyers to reach around three-quarters of the target audience approximately 10-11 times.[23] It was broadcast on Channel Seven, the most popular free-to-air Australian network channel, across the entire state of Queensland. It was also released nationally as a Community Service Announcement and achieved approximately AUD$40,000 in bonus airtime nationally from the Seven Network. A four-minute televised advertorial was also broadcast nationally, being shown 21 times (in The Morning Show and The Daily Edition, which had high potential audience reach among 50+ year olds). A full-page advertisement and editorial coverage were included in the July edition of *Prevention Magazine*, which also had good potential audience reach among 50+ year olds. General practitioners were also targeted with advertisements in the *Medical Journal of Australia* and *Australian Family Physician*. Finally, the campaign included online promotion using Google Adwords search, YouTube, TrueView video, Outbrain, Multi-channel network partnership, and Yahoo!7 Display/Video.

The Jodi Lee Foundation also aired a television-led bowel cancer screening campaign with additional online and news supportive media in September 2014 in metropolitan and rural Queensland and metropolitan WA.

Statistical Analyses

Our outcome measure was the number of FOBT kits returned to the NBCSP for analysis per month. This outcome showed no evidence of autocorrelation, however it was overdispersed (mean=5234; variance=5,769,399) and so negative binomial regression was used in preference to Poisson regression. The pattern of the data was examined in preliminary analyses to examine if there was any seasonality. This examination revealed a lower number

of kits were returned for analysis during each January to February, due to the lower number of invitations that were sent out during the summer high temperature months (i.e., from December to February). In addition, higher numbers of kits were returned for analysis around May, October, November and December each year, due to greater numbers of invitations sent out in March, April, September, October and November each year to compensate for lower numbers in the high temperature months (Figures 1a & 1b).

Insert Figures 1a and 1b about here

We constructed a bivariate variable to denote when the campaign was on air plus two months after the end of the broadcast period (i.e., '0' for non-campaign months (used as the reference) and '1' for June, July, August, September 2014). Previous research has indicated the effects of behaviour change campaigns may last for up to two to three months after broadcast ends,[24-26], and so we limited the potential effect of the CCA campaign to only two months post-broadcast to avoid substantial overlap with the Jodi Lee campaign that began in mid-September 2014.

Similar to prior research examining the effects of mass media campaigns on screening rates,[27] negative binomial regression analyses were conducted to compare rates of kits returned for analysis over time and in both states each year. To enable detection of the effects prompted by the campaign on return rates among those recently sent an invitation, we used the average monthly number of people invited to do the FOBT test in the current and past 3 months as the offset term.[28, 29]

Seasonally adjusted models were run, with additional adjustment for the month associated with the Jodi Lee campaign and the two months after that campaign went off air (September-November 2014). The first set of negative binomial models examined the overall effect of the CCA campaign in Queensland and WA together (including a State indicator as a covariate). The second set of models examined whether there was an interaction between state and campaign, with subsequent models categorising the state and campaign period separately (1=WA, non-campaign months; 2=WA, campaign months; 3=QLD, non-campaign months; 4=QLD, campaign months), to examine state-specific return rates and rate ratios. Sensitivity analyses examined effects of specifying the duration of CCA campaign effect as lasting up to one month after broadcast, instead of up to two months after broadcast. Examination of the

duration of effects beyond two months was not possible due to overlap with the Jodi Lee campaign.

RESULTS

Over both Queensland and WA, the CCA campaign was associated with an increase in the number of returned kits among those invited in the current and past 3 months (IRR=1.15, 95% CI: 1.05-1.27, p<.01). The seasonally-adjusted average number of monthly kits returned and analysed during non-CCA campaign months were 6631 in QLD and 3805 in WA and during CCA campaign months were 7945 in QLD and 4213 in WA. As Table 2 shows, the number of kits returned for analysis increased by 20% in Queensland during the months of the national CCA campaign and up to two months after broadcast, but only showed a tendency to increase in WA (11%, p=.087). Given the similar direction of movement (albeit non-significant in WA), there was no indication of an interaction between State and the CCA campaign (X^2 = 1.07, p=.300) and there was no significant difference between the Queensland and WA increase in rate of change (RR-difference=1.08, 95% CI: 0.93-1.26). The sensitivity analyses examining the length of campaign effects indicated that the overall campaign effect was non-significant when configured to last for only 1 month after broadcast (IRR=1.10, 95% CI: 0.99-1.22), however the effect for Queensland was significant by then (IRR=1.15, 95% CI: 1.00-1.33, p=.046).

Table 2. Unadjusted and Adjusted estimates of average monthly FOBT kits returned for analysis, Rate Ratios associated with the CCA Bowel Cancer Screening campaign, in Queensland and WA from January 2012 to December 2014.

	Monthly Return Rate % Average Monthly Kit Returns[a] (Invitations[b])		Seasonally Adjusted[c] Return Rate % (95% CI) Seasonally Adjusted[c] Kit Returns (95% CI) Adjusted[c] Rate Ratio associated with the CCA campaign (95% CI)	
	QLD	**WA**	**QLD**	**WA**
Non-campaign months	34.8% 6,243 (17,919)	39.1% 3,595 (9,203)	34.3% (31.3%-37.7%) 6,631 (6,372-6,890) 1	38.6% (35.3%-42.2%) 3,805 (3,638-3,973) 1
CCA campaign months[d]	38.1% 11,057 (29,000)	39.5% 5,883 (14,894)	41.2% (35.5%-47.7%) 7,945 (7,035-8,855) 1.20 (1.06-1.35)**	42.7% (37.2%-49.2%) 4,213 (3,773-4,652) 1.11 (0.99-1.24)^

^p<.10, **p<.01
a. Average monthly FOBT kits returned and analysed.
b. Average monthly number of people invited to screen over the current and past 3 months.
c. Adjusted for seasonality and Jodi Lee Campaign (September to November 2014).
d. Campaigns months=June, July, August, September 2014 (months the CCA campaign was on air plus two additional months after campaign end).

DISCUSSION

Compared to non-campaign months, the television-led CCA campaign was found to increase the numbers of age-eligible people returning their NBCSP kits for analysis by 15% across these two Australian states, and by 20% in Queensland where the paid television advertisements were broadcast. This increase occurred during the months of the campaign and for two months following the end of the campaign. The findings of this study build on previous research that has indicated bowel cancer screening campaigns can increase bowel cancer screening rates.[11] The higher intensity campaign that included the paid television advertisement in Queensland that reached around 75% of the target audience approximately 10-11 times, plus the supportive media (i.e., 21 four-minute advertorials, plus online and

digital media) generated a substantial increase in the rate of kits returned for analysis. However, within WA where only the supportive media was used there was a smaller and non-significant increase. The interaction analysis indicated that the increased rate of return in Queensland was not significantly different from that in WA, suggesting that this lower intensity media mix in WA led to an increase in return rates that was less reliable and smaller in magnitude.

Among the 7.0% who tested positive on the FOBT in 2014 and who had a follow-up diagnostic assessment,[30] 0.7% were ultimately confirmed cancers, 2.4% were suspected cancers, 6.9% were advanced adenomas and 7.1% were non-advanced adenomas and 23.2% were polyps awaiting histopathology. Our results suggest that the Queensland CCA campaign mix that included the paid television advertising component was associated with an extra 1,314 (95% CI: 663-1,965) kits being returned per month, meaning that 5,256 (95% CI: 2,652-7,860) extra kits were returned in Queensland over the 2 campaign months and 2 months post campaign. Extrapolating these figures, the CCA campaign is estimated to have led directly to an extra 368 (range 186-550) people who tested positive on the FOBT. With around 73.4% of these having follow-up diagnostic assessment (n=270, range 137-404),[30] the CCA campaign in Queensland may therefore have led directly to the detection of around an extra 2 (range 1-3) people with confirmed cancer, an extra 6 (range 3-10) with suspected cancer, an extra 19 (range 9-28) people with advanced adenomas, an extra 19 (range 10-29) people with non-advanced adenomas, and an extra 63 (32-94) people with polyps awaiting histopathology, in that state alone.

It is important to note that this clinically significant result is due to a single two-month campaign burst in one state and would be magnified if the campaign was rolled out nationally and repeated several times each year. Similar campaigns could lead to five-fold increases in these population effects, given Queensland only accounts for 20% of the Australian population. There is also a cumulative benefit given monitoring records show that 76.9% of these people will do the test again when next invited.[7] These findings highlight the importance of widespread population exposure, which is mostly reliably facilitated through paid television advertisement broadcasts combined with other supportive media channels, especially for this older demographic which still consumes many hours of television content.[31] It is possible those studies which found little impact of non-televised campaigns[21] may have suffered from inadequate population penetration.

Study limitations and strengths

There are several study limitations. First, we did not have an unexposed comparison state, given the presence of other public relations and lower level campaign activity in other Australian states. In addition, our analyses were limited to examining overall effects of campaign presence and was unable to examine the impact of the campaign by age, gender, location or socio-economic status (SES) as some previous work on the effects of mass media cancer screening campaigns has done.[27, 32] Future research should aim to examine effects by SES and location, gender and age-group, given the evidence that lower SES and remote people, males and younger age groups (50-59 year olds) are less likely to participate in the NBCSP.[30]

In addition, this study only examined the effect this campaign had on the NBCSP kit returns and among those who were invited in the current or past three months (our offset term). A minority retain the uncompleted test at home for longer than this time period, so kit returns due to the campaign could have been higher. Our offset term was therefore cautious. In Australia there is a significant proportion of people aged 50-74 who access screening 'outside' of the program, either by purchasing an FOBT from a pharmacy, obtaining a script from their GP for a non-NBCSP FOBT, or by colonoscopy.[23] Thus, while this campaign may have had a broader effect on bowel cancer screening, the present results are limited to effects only on those recently invited to complete an FOBT through the NBCSP. Finally, the estimated proportions that tested positive and undertook follow up assessment are based on information reported back by pathology providers to the NBCSP Register. As reporting back to the NBCSP Register is not mandatory, the data is incomplete and may be an underrepresentation.[30] The level of under-reporting is unknown. Therefore, it is possible the number of people who tested positive on the FOBT and who completed follow up assessment may be higher than the extrapolated numbers described above, meaning the outcomes for those assessed (i.e. proportion of confirmed cancers, suspected cancers, adenomas) likely represent an underestimate.

The strengths of this research include the use of an objective behavioural outcome to examine the impact of the campaign and statistical adjustment for the number of people who were invited to complete the FOBT kit within the current and past 3 months. Confidence in these findings is also strengthened by adjusting for seasonality and the potential influence of the

presence of the other campaigns, as well as testing for the length of effects in the sensitivity analyses.

Conclusions

Overall this study suggests that the low levels of national bowel cancer screening rates in Australia may be increased by future national mass media campaigns, especially those led by paid television advertising. Regularly repeated broadcasting of wide-reaching mass media bowel cancer screening campaigns could educate new cohorts about the NBCSP as they age into eligibility, and remind those already eligible about the risks of bowel cancer and the benefits of screening, helping to maximise participation and ultimately prevent many thousands of bowel cancer deaths.

Acknowledgments

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Competing interest statement

SD, KB and MW are employed as researchers by Cancer Council Victoria, a state-based organisation affiliated with Cancer Council Australia which developed and ran the mass media campaign. MJS and all other authors have no other competing interests.

Author contributions

SD and MW contributed to the conception and design of the study. KB contributed to the acquisition of data and interpretation of the work. SD, MS and MW contributed to data analysis and interpretation. SD drafted and revised the paper, while MW, KB, and MS revised the paper. All authors provided approval for the final version of the paper to be published.

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28. Australian Bureau of Statistics. 3101.0 Australian Demographic Statistics. TABLE 55. Estimated Resident Population By Single Year Of Age, Western Australia. Canberra, Australia: Australian Bureau of Statistics, 2015.

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Figure 1a. Monthly number of invitations sent, January 2012 to December 2014, by State.

Figure 1b. Monthly number of kits returned and analysed, January 2012 to December 2014, by State.

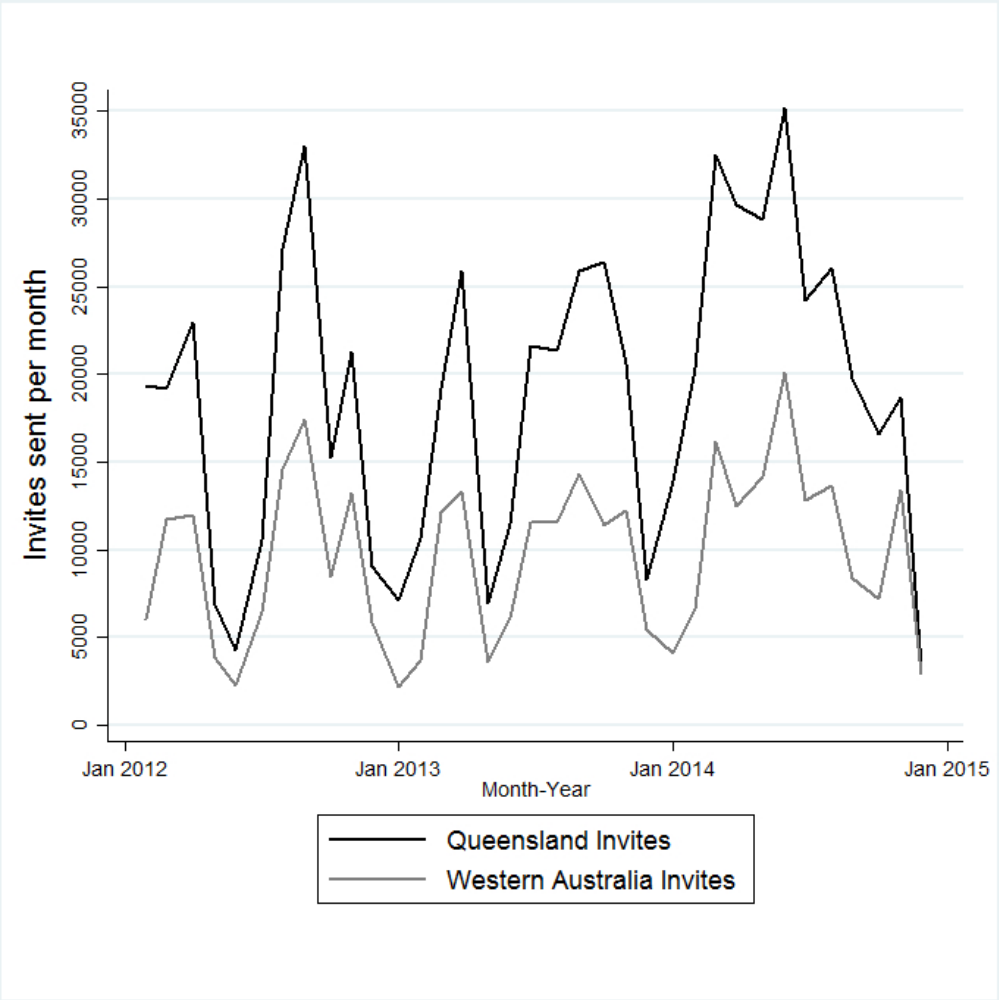

Figure 1a. Monthly number of invitations sent, January 2012 to December 2014, by State.

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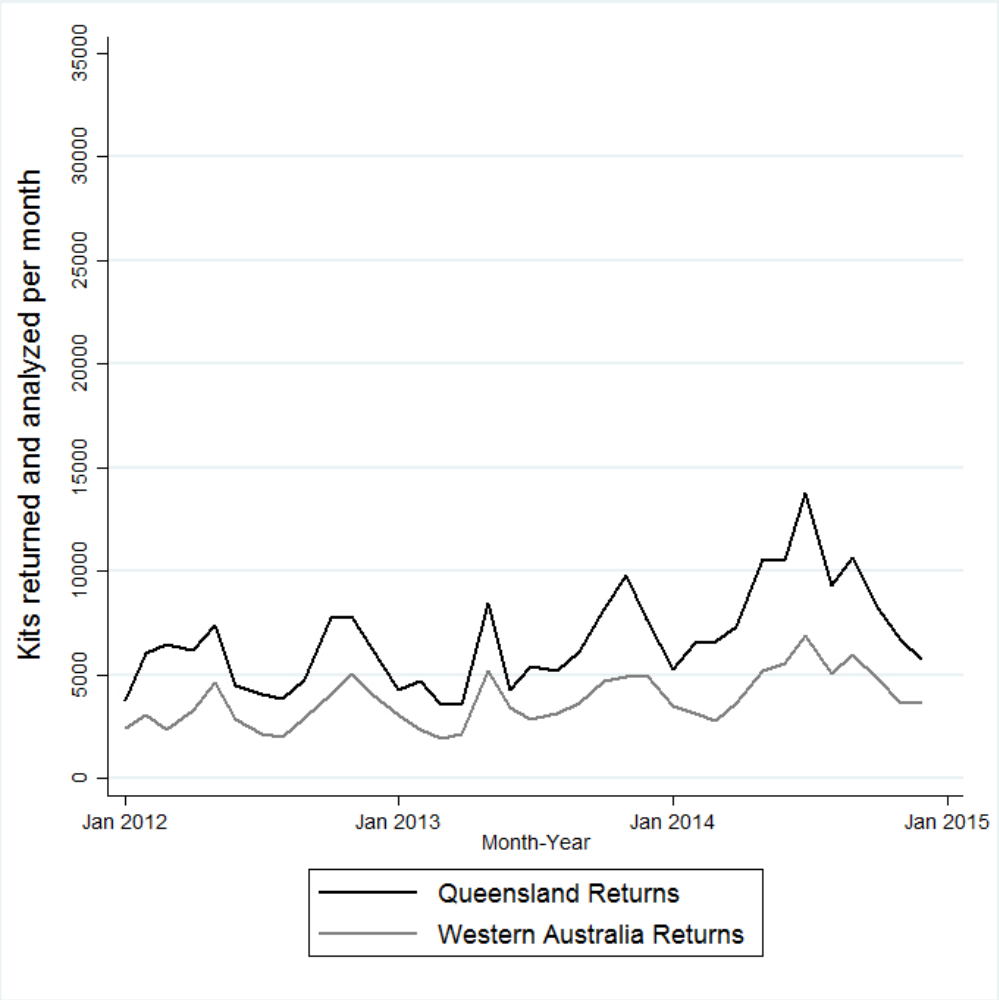

Figure 1b. Monthly number of kits returned and analysed, January 2012 to December 2014, by State.

240x240mm (72 x 72 DPI)

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4-6
Objectives	3	State specific objectives, including any prespecified hypotheses	6
Methods			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6-8
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	7
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6-7
Bias	9	Describe any efforts to address potential sources of bias	*8-9*
Study size	10	Explain how the study size was arrived at	na
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	9
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	8-9
		(*b*) Describe any methods used to examine subgroups and interactions	na
		(*c*) Explain how missing data were addressed	na
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	8-9
		(*e*) Describe any sensitivity analyses	9-10
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	10-11- Table 2
		(b) Give reasons for non-participation at each stage	na
		(c) Consider use of a flow diagram	na
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	na
		(b) Indicate number of participants with missing data for each variable of interest	na
Outcome data	15*	Report numbers of outcome events or summary measures	10-11- Table 2
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	10-11- Table 2
		(*b*) Report category boundaries when continuous variables were categorized	na
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	10-11- Table 2
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	10
Discussion			
Key results	18	Summarise key results with reference to study objectives	11-12
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	12-13
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	14
Generalisability	21	Discuss the generalisability (external validity) of the study results	12
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	15

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

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

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Impact of a mass media campaign on participation rates in a national bowel cancer screening program: a field experiment

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Impact of a mass media campaign on participation rates in a national bowel cancer screening program: a field experiment

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ABSTRACT

Objectives and Design: This field experiment aimed to compare bowel cancer screening participation rates prior to, during and after a mass media campaign promoting screening, and the extent to which a higher intensity campaign in one state led to higher screening rates compared to another state that received lower intensity campaign exposure. **Intervention**: An eight-week television-led mass media campaign was launched in selected regions of Australia in mid-2014 to promote Australia's National Bowel Cancer Screening Program (NBCSP) that posts out immunochemical faecal occult blood test (iFOBT) kits to the homes of age-eligible people. The campaign used paid 30-second television advertising in the entire state of Queensland but not at all in Western Australia. Other supportive campaign elements had national exposure, including print, four-minute television advertorials, digital and online advertising. **Outcome measures**: Monthly kit return and invite data from NBCSP (January 2012 to December 2014). Return rates were determined as completed kits returned for analysis out of the number of people invited to do the iFOBT test in the current and past 3 months in each state. **Results**: Analyses adjusted for seasonality and the influence of other national campaigns. The number of kits returned for analysis increased in Queensland (Adjusted Return Rate=20%, 95% CI:1.06-1.35, p<.01) during the months of the campaign and up to two months after broadcast, but only showed a tendency to increase in Western Australia (Adjusted Return Rate=11%, 95% CI:0.99-1.24, p=.087). **Conclusions**: The higher intensity eight-week television-led campaign in Queensland increased the rate of kits returned for analysis in Queensland, whereas there were marginal effects for the low intensity campaign elements in Western Australia. The low levels of participation in Australia's NBCSP could be increased by national mass media campaigns, especially those led by higher intensity paid television advertising.

Article summary

Strengths and Limitations

- Objective behavioural outcome data were used from monthly iFOBT invites and returns over the previous two-and-a-half years, compared to those during and after the campaign period
- Adjustment for seasonality and the potential influence of other campaigns, as well examination of the duration of effects
- Lack of a completely unexposed comparison state, however able to compare effects of higher versus lower campaign intensity across entire state populations
- Examined overall campaign effects, rather than for demographic subgroups
- Campaign effects reported are likely to be conservative, as we examined effects only among those invited in the current or past three months, not those invited earlier, and not among those who may have accessed screening 'outside' of the program (e.g., purchasing iFOBT from pharmacy or obtaining a script from GP for non-NBCSP iFOBT or colonoscopy)

INTRODUCTION

Bowel cancer (also known as colorectal cancer) is a leading cause of morbidity and mortality in high income nations. For example, it is the second most common cancer diagnosed in both men and women, and is also the second most common cause of cancer death in Australia.(1) Despite this, 90% of bowel cancer cases can be treated successfully if detected early.(2) Screening for bowel cancer via faecal occult blood tests (FOBT) has been shown to reduce bowel cancer mortality by 15-33%.(3, 4) An Australian model suggests that with a 40% biennial participation rate, 59,000 deaths are expected to be prevented over the 2015-2040 period, and if a participation rate of 60% could be achieved, an additional 24,800 bowel cancer deaths could be prevented.(5)

The Australian National Health and Medical Research Council-approved clinical guidelines recommend all asymptomatic people aged of 50-74 years who are average risk should be screened for bowel cancer every two years with an FOBT. To facilitate this, the Australian Government commenced the National Bowel Cancer Screening Program (NBCSP) in 2006 where immunochemical FOBT (iFOBT) kits are sent directly to people aged 50-74 at home. A study of people diagnosed with bowel cancer between 2006 and 2008 indicated that compared to non-invitees, those invited to participate in the NBCSP (and particularly those who participated) had less advanced bowel cancers when diagnosed and a lower risk of dying from their bowel cancer.(6)

Unfortunately participation in the NBCSP among the Australian population has been disappointing, with only 40.9 % of those invited taking up the opportunity to be screened by the program(7). Lack of awareness of bowel cancer and the benefits of screening have been found to contribute to poorer screening rates, including among those invited to participate in the NBCSP.(7, 8) Of those strategies trialled in Australia and elsewhere to improve screening rates, there is strong evidence for the important role of primary care practitioners' recommendations to undergo screening in determining whether a patient is screened.(9) Using media education (postcards, letters) within primary care and enhancing primary care practice electronic medical records to include reminder systems can also improve screening rates.(10) Outside primary care, culturally-adapted group education sessions and multi-component interventions (such as education sessions, videos, and special events) have been found to increase screening rates,(11) while telephone outreach modestly increases screening.(12) Financial support and one-on-one education has been found to be less effective than group

education.(11) As the delivery of each of these interventions relies on practitioner, community or cultural group initiatives, they are likely to have limited population reach and so are limited in their capacity to drive increases in the overall population screening rate.

Increasing the population screening rate will likely require interventions delivered to the broad population through mass dissemination techniques. There is some evidence that tailoring of mail-based interventions with FOBT invitation modestly improves screening above standard FOBT mail-out,(12) while one study has shown celebrity endorsements can increase screening rates.(13) The few studies that have examined the effectiveness of mass media bowel cancer screening campaigns have shown that they can increase population screening rates,(11) but describe the effects as moderate and short lived. This is consistent with the pattern of effects found for mass media campaigns for other health behaviours,(14) such as for smoking cessation.(15)

Research into the effectiveness of mass media in changing other health behaviours has shown that success is closely tied to the extent and timing of exposure, with time-limited effects for 'one-off' campaigns and less impact if there is low message repetition and narrow population exposure.(16) Nonetheless, these studies have shown that small effects can lead to substantial impact on population behaviour change due to exposing many individuals within a population. Consistent with this, a recent study found that specialist referrals increased following a one-off seven-week television-led bowel cancer detection campaign in the UK, and that the increase lasted for three months post-campaign.(17, 18) Illustrating the importance of the extent of population exposure, another study found that as past year exposure to screening information increased from news media and the television-led 'Screen for Life' campaign, levels of screening participation rose.(19) One non-televised medical practice based campaign in the UK (leaflets, DVDs, posters, bookmarks along with practice reminder letters and health professional education materials) was found to increase health professional visits and referrals to FOBT, flexible sigmoidoscopy or colonoscopy, but not more so than the comparison group that implemented only the practice reminder letters and health professional education.(20) Another non-televised campaign in the USA relying on billboards, posters and articles sent to local newspapers, and brochures and posters in clinics produced no differences in bowel cancer screening rates among those in counties exposed to it compared with those in control counties.(21) The limited effect of these campaigns is likely due to the low population reach of these types of non-televised campaign elements.

As there had been very few widespread Australian television-led mass media campaigns to promote the NBCSP and use of FOBT kits mailed to eligible people's homes, Cancer Council Australia (CCA) launched a mass media campaign in mid-2014. The campaign included a 30-second television commercial (TVC) which aired in three Australian states: all of Queensland, metropolitan Adelaide in South Australia and regional Victoria. Other supportive elements of the campaign had national exposure, including a print, digital and online strategy (full-page print advertisement in *Prevention* magazine; internet search optimisation; native digital content advertising; digital video advertising; website sponsorship) and four-minute televised editorial segments on morning show programs. The primary campaign objective was to increase the number of people aged 50-74 who completed a NBCSP FOBT.

This study aims to identify if NBCSP FOBT completion and return rates increased during and after the CCA bowel cancer screening mass media campaign and the extent to which the higher intensity paid television advertisements led to higher screening rates. This will be achieved by comparing the rate of FOBT completion over the two-and-a-half year period prior to the campaign with rates during and after the campaign. The impact of campaign intensity will be examined by comparing return rates over time in the state with complete exposure to all of the campaign elements including paid 30-second television advertising (Queensland) with a comparison state (Western Australia (WA)) that was only exposed to the lower intensity supportive elements (see following link for interactive map of the states and territories of Australia: https://en.wikipedia.org/wiki/States_and_territories_of_Australia).

METHOD

National Bowel Cancer Screening Program Register data

The NBCSP has had a gradual introduction (Table 1), with full implementation as a two-yearly program to be complete by 2020. The test used by the NBCSP is an immunochemical faecal occult blood test (iFOBT) requiring the collection of two samples, which is a non-invasive test that can detect microscopic amounts of blood in a bowel motion, which might indicate a bowel abnormality, such as a polyp, an adenoma or cancer. Once fully implemented, eligible Australians will be sent an iFOBT screening kit and invited to screen every two years between their 50th and 74th birthdays. More information about eligibility is available at:

http://www.cancerscreening.gov.au/internet/screening/publishing.nsf/Content/bowel-campaign-home.

Table 1. Australian National Bowel Cancer Screening Program implementation

Start date	Ages invited
August 2006	55, 65
July 2008	50, 55, 65
July 2013	50, 55, 60, 65
January 2015	50, 55, 60, 65, 70, 74
January 2016	50, 55, 60, 64, 65, 70, 72, 74
January 2017	50, 54, 55, 58, 60, 64, 68, 70, 72, 74
January 2018	50, 54, 58, 60, 62, 64, 66, 68, 70, 72, 74
January 2019	50, 52, 54, 56, 58, 60, 62, 64, 66, 68, 70, 72, 74

To participate, those invited by the NBCSP need to complete the screening test and post it in the provided post-paid envelope to the NBCSP pathology laboratory for analysis within 14 days of completing the test. Results are then sent to the participant, their nominated primary health-care practitioner and to the NBCSP Register. Those with a positive screening result, indicated by blood in the stool sample, are advised to consult their primary health care practitioner to discuss further diagnostic assessment which in most cases will be a colonoscopy.(6)

De-identified NBCSP monthly data from 1 January 2012 to 31 December 2014 from Queensland and WA were obtained. The data included the number of NBCSP invitations sent out and the number of NBCSP kits returned for analysis within each month and state.

Participant involvement

At the campaign development and refinement stage (October 2013) potential NBCSP eligible members of the public were consulted through a series of focus groups (4 groups of 50-54 year old and 4 groups of 55-65 year old people across metropolitan and regional areas). These groups were shown the campaign materials and responded to these through a guided discussion. They discussed perceived salience and relevance of the message, message understanding and perceived credibility and likely impact on behaviour change. A number of additions and refinements were made to the campaign materials in response to this feedback.

Patients were not involved in the design or conduct of the study as this research involved secondary analysis of real world data collected by the NBCSP. We completed a standard data

request for the invite and kit return data for this study from the Australian Government Institute of Health and Welfare (AIHW) (https://www.aihw.gov.au/our-services/data-on-request). The AIHW follows Australian research ethics guidelines with data and considers whether the data request requires ethical approval, and they deemed that our data request did not require ethics approval. In the NBCSP information booklet that is sent to participants with the FOBT kit, it stated that "Your personal details will be used to: monitor and evaluate the effectiveness of the program and its impact on the incidence of bowel cancer. This information booklet also detailed how participants can opt out of the program if they would like to. The Data Quality Statement for the NBCSP can be found at http://meteor.aihw.gov.au/content/index.phtml/itemId/668817.

Cancer Council Australia mass media campaign

The mass media campaign, run by CCA with Australian government funding, aimed to increase awareness of the preventability of bowel cancer when detected early and to encourage adults aged 50-74 years to participate in the NBCSP when invited. The proposed creative concepts went through extensive qualitative developmental testing to ensure that they were relevant and likely to be effective with the target audience.(22) A 30-second TVC featured real people who prematurely lost loved ones to bowel cancer reflecting on how much they missed them and how preventable bowel cancer is if detected early. The TVC informed people that "Bowel cancer kills 75 Australians every week", that "If detected early, 90% of bowel cancers are cured" and asked "Are you 50 or over? Do the test. It could save your life". The TVC closed by encouraging people to visit a campaign microsite (bowelcancer.org.au) and Cancer Council Helpline (13 11 20) to find out more.

The TVC aired from 1 June to 26 July 2014 and was estimated by media buyers to reach around three-quarters of the target audience approximately 10-11 times.(23) It was broadcast on Channel Seven, the most popular free-to-air Australian network channel, across the entire state of Queensland. It was also released nationally as a Community Service Announcement and achieved approximately AUD$40,000 in bonus airtime nationally from the Seven Network. A four-minute televised advertorial (i.e., an interview segment within a morning show TV program) was also broadcast nationally, being shown 21 times (in The Morning Show and The Daily Edition, which had high potential audience reach among 50+ year olds). A full-page advertisement and editorial coverage were included in the July edition of *Prevention Magazine*, which also had good potential audience reach among 50+ year olds. General practitioners were

also targeted with advertisements in the *Medical Journal of Australia* and *Australian Family Physician*. Finally, the campaign included online promotion using Google Adwords search, YouTube, TrueView video, Outbrain, Multi-channel network partnership, and Yahoo!7 Display/Video.

Statistical Analyses

Our outcome measure was the number of FOBT kits returned to the NBCSP for analysis per month. This outcome showed no evidence of autocorrelation, however it was overdispersed (mean=5234; variance=5,769,399) and so negative binomial regression was used in preference to Poisson regression. The pattern of the data was examined in preliminary analyses to examine if there was any seasonality. This examination revealed a lower number of kits were returned for analysis during each January to February, due to the lower number of invitations that were sent out during the summer high temperature months (i.e., from December to February). In addition, higher numbers of kits were returned for analysis around May, October, November and December each year, due to greater numbers of invitations sent out in March, April, September, October and November each year to compensate for lower numbers in the high temperature months (Figures 1 & 2).

The Jodi Lee Foundation also funded a separate television-led bowel cancer screening campaign with additional online and news supportive media in September 2014 in metropolitan and rural Queensland and metropolitan WA. An indicator variable was constructed to denote when that campaign was on air and for 2 months after it aired (September to November 2014), so it could be included in analyses as a covariate.

Insert Figures 1 and 2 about here

We constructed a bivariate variable to denote when the CCA campaign was on air plus two months after the end of the broadcast period (i.e., '0' for non-campaign months (used as the reference) and '1' for June, July, August, September 2014). Previous research has indicated the effects of behaviour change campaigns may last for up to two to three months after broadcast ends,(24-26), and so we limited the potential effect of the CCA campaign to only two months post-broadcast to avoid substantial overlap with the Jodi Lee campaign that began in mid-September 2014.

Similar to prior research examining the effects of mass media campaigns on screening rates,(27) negative binomial regression analyses were conducted to compare rates of kits returned for analysis over time and in both states each year. To enable detection of the effects prompted by the campaign on return rates among those recently sent an invitation, we used the average monthly number of people invited to do the FOBT test in the current and past 3 months as the offset term.(28, 29)

Seasonally adjusted models were run, with additional adjustment for the month associated with the Jodi Lee campaign and the two months after that campaign went off air (September-November 2014). The first set of negative binomial models examined the overall effect of the CCA campaign in Queensland and WA together (including a State indicator as a covariate). The second set of models examined whether there was an interaction between state and campaign, with subsequent models categorising the state and campaign period separately (1=WA, non-campaign months; 2=WA, campaign months; 3=QLD, non-campaign months; 4=QLD, campaign months), to examine state-specific return rates and rate ratios. Sensitivity analyses examined effects of specifying the duration of CCA campaign effect as lasting up to one month after broadcast, instead of up to two months after broadcast. Examination of the duration of effects beyond two months was not possible due to overlap with the Jodi Lee campaign.

RESULTS

Over both Queensland and WA, the CCA campaign was associated with an increase in the number of returned kits among those invited in the current and past 3 months (IRR=1.15, 95% CI: 1.05-1.27, p<.01). The seasonally-adjusted average number of monthly kits returned and analysed during non-CCA campaign months were 6631 in QLD and 3805 in WA and during CCA campaign months were 7945 in QLD and 4213 in WA. As Table 2 shows, the number of kits returned for analysis increased by 20% in Queensland during the months of the national CCA campaign and up to two months after broadcast, but only showed a tendency to increase in WA (11%, p=.087). Given the similar direction of movement (albeit non-significant in WA), there was no indication of an interaction between State and the CCA campaign (X^2 = 1.07, p=.300) and there was no significant difference between the Queensland and WA increase in rate of change (RR-difference=1.08, 95% CI: 0.93-1.26, p=.300). The sensitivity analyses

examining the length of campaign effects indicated that the overall campaign effect was non-significant when configured to last for only 1 month after broadcast (IRR=1.10, 95% CI: 0.99-1.22, p=.062), however the effect for Queensland was significant by then (IRR=1.15, 95% CI: 1.00-1.33, p=.046).

Table 2. Unadjusted and Adjusted estimates of average monthly FOBT kits returned for analysis, Rate Ratios associated with the CCA Bowel Cancer Screening campaign, in Queensland and WA from January 2012 to December 2014.

	Monthly Return Rate % Average Monthly Kit Returns[a] (Invitations[b])		Seasonally Adjusted[c] Return Rate % (95% CI) Seasonally Adjusted[c] Kit Returns (95% CI) Adjusted[c] Rate Ratio associated with the CCA campaign (95% CI)	
	QLD	**WA**	**QLD**	**WA**
Non-campaign months	34.8% 6,243 (17,919)	39.1% 3,595 (9,203)	34.3% (31.3%-37.7%) 6,631 (6,372-6,890) 1	38.6% (35.3%-42.2%) 3,805 (3,638-3,973) 1
CCA campaign months[d]	38.1% 11,057 (29,000)	39.5% 5,883 (14,894)	41.2% (35.5%-47.7%) 7,945 (7,035-8,855) 1.20 (1.06-1.35)**	42.7% (37.2%-49.2%) 4,213 (3,773-4,652) 1.11 (0.99-1.24)^

^p<.10, **p<.01
a. Average monthly FOBT kits returned and analysed.
b. Average monthly number of people invited to screen over the current and past 3 months.
c. Adjusted for seasonality and Jodi Lee Campaign (September to November 2014).
d. Campaigns months=June, July, August, September 2014 (months the CCA campaign was on air plus two additional months after campaign end).

DISCUSSION

Compared to non-campaign months, the television-led CCA campaign was found to increase the numbers of age-eligible people returning their NBCSP kits for analysis by 15% across these two Australian states, and by 20% in Queensland where the paid television advertisements were broadcast. This increase occurred during the months of the campaign and for two months following the end of the campaign. The findings of this study build on previous research that has indicated bowel cancer screening campaigns can increase bowel cancer screening rates.(11) The higher intensity campaign that included the paid television advertisement in Queensland that reached around 75% of the target audience approximately 10-11 times, plus the supportive media (i.e., 21 four-minute advertorials, plus online and digital media) generated a substantial

increase in the rate of kits returned for analysis. However, within WA where only the supportive media was used there was a smaller and non-significant increase. The interaction analysis indicated that the increased rate of return in Queensland was not significantly different from that in WA, suggesting that this lower intensity media mix in WA led to an increase in return rates that was less reliable and smaller in magnitude.

Among the 7.0% who tested positive on the FOBT in 2014 and who had a follow-up diagnostic assessment,(30) 0.7% were ultimately confirmed cancers, 2.4% were suspected cancers, 6.9% were advanced adenomas and 7.1% were non-advanced adenomas and 23.2% were polyps awaiting histopathology. Our results suggest that the Queensland CCA campaign mix that included the paid television advertising component was associated with an extra 1,314 (95% CI: 663-1,965) kits being returned per month, meaning that 5,256 (95% CI: 2,652-7,860) extra kits were returned in Queensland over the 2 campaign months and 2 months post campaign. Extrapolating these figures, the CCA campaign is estimated to have led directly to an extra 368 (range 186-550) people who tested positive on the FOBT. With around 73.4% of these having follow-up diagnostic assessment (n=270, range 137-404),(30) the CCA campaign in Queensland may therefore have led directly to the detection of around an extra 2 (range 1-3) people with confirmed cancer, an extra 6 (range 3-10) with suspected cancer, an extra 19 (range 9-28) people with advanced adenomas, an extra 19 (range 10-29) people with non-advanced adenomas, and an extra 63 (32-94) people with polyps awaiting histopathology, in that state alone.

It is important to note that this clinically significant result is due to a single two-month campaign burst in one state and would be magnified if the campaign was rolled out nationally and repeated several times each year. Similar campaigns could lead to five-fold increases in these population effects, given Queensland only accounts for 20% of the Australian population. There is also a cumulative benefit given monitoring records show that 76.9% of these people will do the test again when next invited.(31) These findings highlight the importance of widespread population exposure, which is mostly reliably facilitated through paid television advertisement broadcasts combined with other supportive media channels, especially for this older demographic which still consumes many hours of television content.(32) It is possible those studies which found little impact of non-televised campaigns(21) may have suffered from inadequate population penetration.

Study limitations and strengths

There are several study limitations. First, we did not have an unexposed comparison state, given the presence of other public relations and lower level campaign activity in other Australian states. In addition, our analyses were limited to examining overall effects of campaign presence and was unable to examine the impact of the campaign by age, gender, location or socio-economic status (SES) as some previous work on the effects of mass media cancer screening campaigns has done.(27, 33) Future research should aim to examine effects by SES and location, gender and age-group, given the evidence that lower SES and remote people, males and younger age groups (50-59 year olds) are less likely to participate in the NBCSP.(30)

In addition, this study only examined the effect this campaign had on the NBCSP kit returns and among those who were invited in the current or past three months (our offset term). A minority retain the uncompleted test at home for longer than this time period, so kit returns due to the campaign could have been higher. Our offset term was therefore cautious. In Australia there is a significant proportion of people aged 50-74 who access screening 'outside' of the program, either by purchasing an FOBT from a pharmacy, obtaining a script from their GP for a non-NBCSP FOBT, or by colonoscopy.(23) Thus, while this campaign may have had a broader effect on bowel cancer screening, the present results are limited to effects only on those recently invited to complete an FOBT through the NBCSP. Finally, the estimated proportions that tested positive and undertook follow up assessment are based on information reported back by pathology providers to the NBCSP Register. As reporting back to the NBCSP Register is not mandatory, the data is incomplete and may be an underrepresentation.(30) The level of under-reporting is unknown. Therefore, it is possible the number of people who tested positive on the FOBT and who completed follow up assessment may be higher than the extrapolated numbers described above, meaning the outcomes for those assessed (i.e. proportion of confirmed cancers, suspected cancers, adenomas) likely represent an underestimate.

The strengths of this research include the use of an objective behavioural outcome to examine the impact of the campaign and statistical adjustment for the number of people who were invited to complete the FOBT kit within the current and past 3 months. Confidence in these findings is also strengthened by adjusting for seasonality and the potential influence of the presence of the other campaigns, as well as testing for the length of effects in the sensitivity analyses.

Conclusions

Overall this study suggests that the low levels of participation in the NBCSP may be increased by future national mass media campaigns, especially those led by paid television advertising. Regularly repeated broadcasting of wide-reaching mass media bowel cancer screening campaigns could educate new cohorts about the NBCSP as they age into eligibility, and remind those already eligible about the risks of bowel cancer and the benefits of screening, helping to maximise participation and ultimately prevent many thousands of bowel cancer deaths.

Acknowledgments

We thank the Australian National Bowel Cancer Screening Program for providing access to FOBT data by state to enable the analysis in this paper and for reviewing the results of this analyses.

Funding

This study was funded by Cancer Council Victoria.

Competing interest statement

SD, KB and MW are employed as researchers by Cancer Council Victoria, a state-based organisation affiliated with Cancer Council Australia which developed and ran the mass media campaign. MJS and all other authors have no other competing interests.

Author contributions

SD and MW contributed to the conception and design of the study. KB contributed to the acquisition of data and interpretation of the work. SD, MS and MW contributed to data analysis and interpretation. SD drafted and revised the paper, while MW, KB, and MS revised the paper. All authors provided approval for the final version of the paper to be published.

Data Sharing Statement

The iFOBT invite and kit return data used in this study was secondary and originally obtained via a standard data request from the Australian Government Institute of Health and Welfare (AIHW) (https://www.aihw.gov.au/our-services/data-on-request). The data can be obtained directly from the Australian Government Institute of Health and Welfare (AIHW) on request (https://www.aihw.gov.au/our-services/data-on-request).

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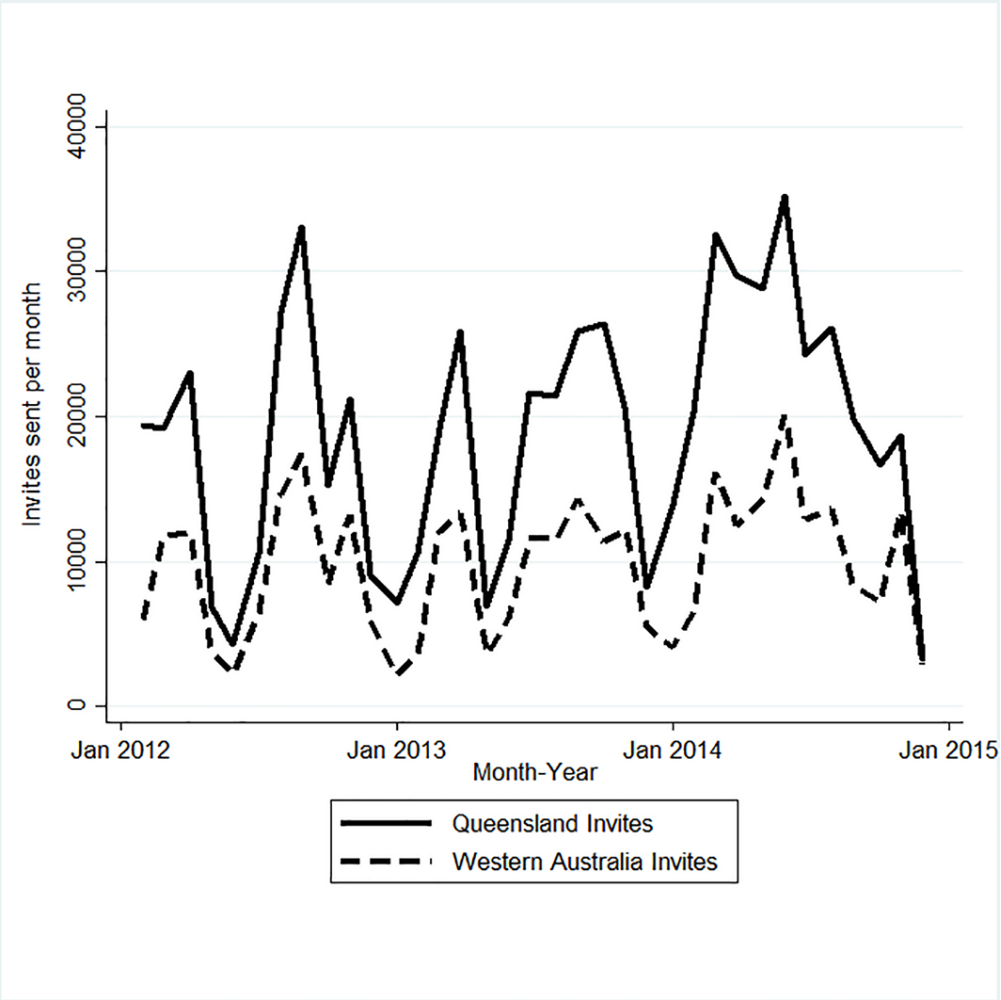
Figure 1. Monthly number of invitations sent, January 2012 to December 2014, by State.

Figure 2. Monthly number of kits returned and analysed, January 2012 to December 2014, by State.



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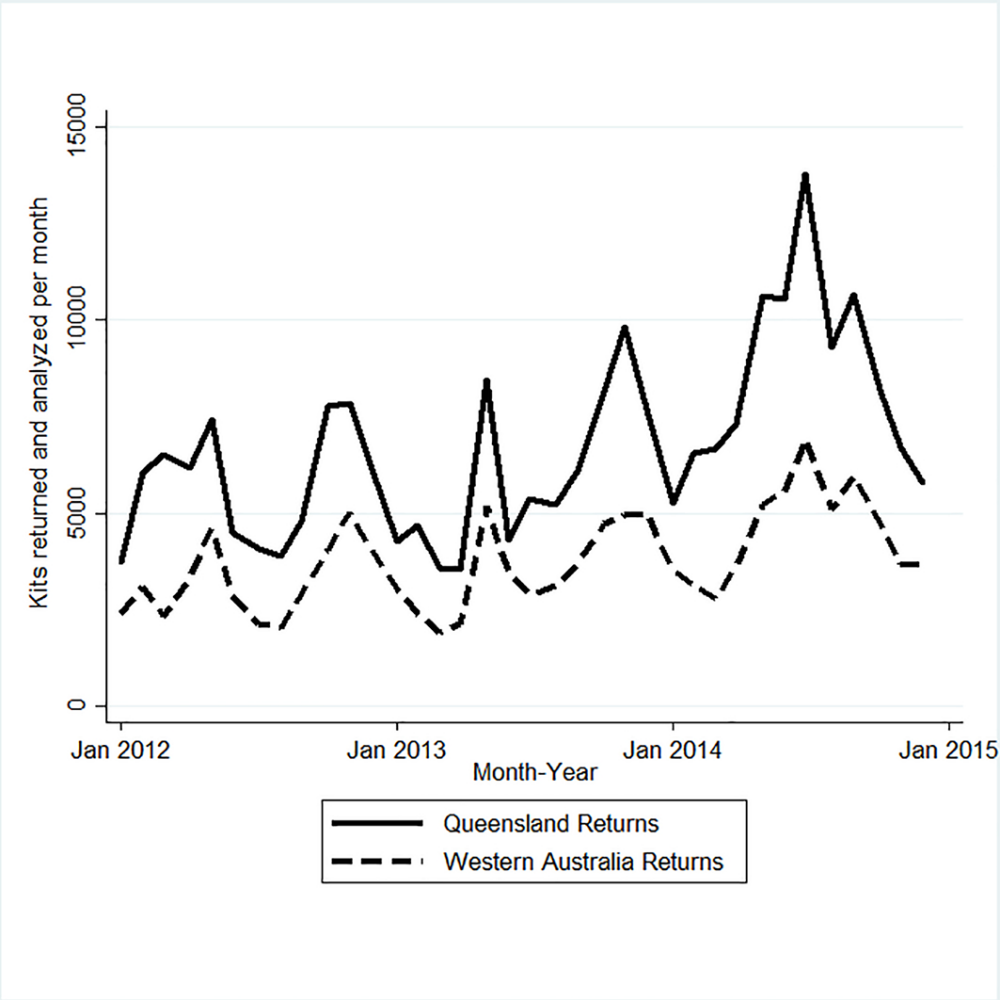

Figure 2. Monthly number of kits returned and analysed, January 2012 to December 2014, by State.

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4-6
Objectives	3	State specific objectives, including any prespecified hypotheses	6
Methods			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6-8
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	7
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6-7
Bias	9	Describe any efforts to address potential sources of bias	*8-9*
Study size	10	Explain how the study size was arrived at	na
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	9
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	8-9
		(*b*) Describe any methods used to examine subgroups and interactions	na
		(*c*) Explain how missing data were addressed	na
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	8-9
		(*e*) Describe any sensitivity analyses	9-10
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	10-11- Table 2
		(b) Give reasons for non-participation at each stage	na
		(c) Consider use of a flow diagram	na
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	na
		(b) Indicate number of participants with missing data for each variable of interest	na
Outcome data	15*	Report numbers of outcome events or summary measures	10-11- Table 2
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	10-11- Table 2
		(*b*) Report category boundaries when continuous variables were categorized	na
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	10-11- Table 2
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	10
Discussion			
Key results	18	Summarise key results with reference to study objectives	11-12
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	12-13
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	14
Generalisability	21	Discuss the generalisability (external validity) of the study results	12
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	15

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

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