A comparison of colorectal neoplasia screening tests: a multicentre community-based study of the impact of consumer choice

The Multicentre Australian Colorectal-neoplasia Screening (MACS) Group

ABSTRACT

Objective: International guidelines and local practices for colorectal cancer screening suggest an important role for several different screening tests, and for consumer choice. We aimed to determine whether choice of test improved participation in screening.

Design: A randomised comparative study offering one of six screening strategies: faecal occult blood testing (FOBT), FOBT and flexible sigmoidoscopy (FS), computed tomography colonography (CTC), colonoscopy, or one of two groups offered a choice of these strategies (one of which was sent an FOBT kit with the letter of invitation, while the other was required to request an FOBT kit by telephone if that was the test chosen).

Setting and participants: 1679 people aged 50–54 or 65–69 years, randomly selected from the electoral roll in metropolitan Perth, Adelaide and Melbourne.

Main outcome measures: Participation, yield of advanced colorectal neoplasia (CRN), acceptability and safety.

Results: 346 (20.6%) were excluded from screening, mostly for a recent examination (165), symptoms (72) or personal or family history of colorectal neoplasia or cancer (83). 278 of the 1333 eligible (20.9%; 95% CI, 18.7%–23.1%) participated in screening. Participation was similar by age and sex, but lower in Perth than Adelaide (17.1% v 24.2%; $P = 0.01$). Participation by screening group was: FOBT, 27.4%; FOBT/FS, 13.7% ($P < 0.001$ compared with FOBT); CTC, 16.3% ($P = 0.005$); colonoscopy, 17.8% ($P = 0.02$); or a choice of test 18.6% ("with FOBT kit"; $P = 0.03$) or 22.7% ("without FOBT kit"; $P = 0.3$). Yield of advanced CRN was higher in participants screened by colonoscopy than FOBT (7.9% v 0.8%; $P = 0.02$). All tests were well accepted and no serious complications arose from screening.

Conclusion: A choice of screening test did not improve participation. Participation by FOBT was higher than by other tests. Yield of advanced colorectal neoplasia on an intention-to-screen basis, determined by test sensitivity and participation, is likely to be a critical determinant of the effectiveness of screening strategies.

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Colorectal neoplasia (CRN) screening in Australia is imminent,[1,2] and is likely to be based on faecal occult blood testing (FOBT). Internationally, screening programs also use FOBT, although other screening tests are endorsed by professional bodies.[3] Endoscopic screening by flexible sigmoidoscopy (FS) or colonoscopy is widely used in North America, and there are local data to support this practice in Australia.[4-6] Computed tomography colonography (CTC) (often referred to as virtual colonoscopy) may have a future role as yet another screening tool,[6,7] but has not yet received professional endorsement for this indication.

"Choice of screening test" has implicit endorsement by some international professional bodies. However, whether providing a choice of test within programs based on FOBT, FS or colonoscopy improves participation has not been evaluated. We aimed to determine whether being offered a choice of screening test improved participation over being offered a single test, by undertaking a comparative study of screening by FOBT, FS, CTC, colonoscopy and "choice", in three Australian metropolitan regions.

METHODS

A list of enrolled voters in suburbs of Perth, Adelaide and Melbourne, selected as within reasonable proximity to participating study centres and representing a broad mixture of socioeconomic regions, was obtained from the Commonwealth Electoral Office. Socioeconomic status was assigned using an urban index of residential postcodes known as socioeconomic indices for areas (SEIFA).[8] The selected study population was also restricted to two age groups (50–54 years and 65–69 years). Screening strategy groups were then allocated to the sample by means of random number generation after stratifying by sex, age group and SEIFA.

People were allocated to one of six groups: FOBT; FOBT and FS; CTC; colonoscopy; or one of two groups offered a choice of these four screening tests. In the FOBT and FOBT/FS groups, the FOBT kit was mailed with the letter of invitation, so as to mirror the Australian FOBT pilot program. The two groups offered a choice of screening test differed in that one group had the FOBT kit mailed with the letter of invitation, and one required the participant to phone and request an FOBT kit if that was the test chosen.

The rationale for a group combining FOBT and FS was to allow for an analysis of a screening strategy recommended by the National Health and Medical Research Council in 1999. For logistic reasons, we accepted that tests were being compared by means of a "once-off" test, acknowledging that, especially for FOBT, regular repeated screening is important. The "choice with FOBT kit" group allowed us to determine whether providing a choice of screening test increased participation, while the "choice without FOBT kit" group allowed us to compare test choice with the CTC and colonoscopy screening groups, in which phone contact was required to initiate screening.

A letter of invitation (plus an FOBT kit for the FOBT, FOBT/FS, and "choice with FOBT kit" group) and an information leaflet were sent to each potential participant, between 1 February and 31 October 2004. The information leaflets were specific to the test or tests being offered, and similar to those used in previous programs;[6] potential participants were not made aware that there were other screening groups.

For people mailed an FOBT kit with their invitation, enclosed instructions on use allowed for immediate participation without further contact with screening program staff;

these people were contacted by screening staff after the result of the FOBT returned, to assess their eligibility for screening. Those in the CTC, colonoscopy, and "choice without FOBT kit" groups who wished to participate in screening needed to make telephone contact, and a structured questionnaire was then administered to determine eligibility for screening.

To be eligible for screening, participants needed to be asymptomatic and at average risk for CRN. Those with symptoms or a strong family history of colorectal cancer were excluded. Those who were ineligible (ie, those with a single first-degree relative aged under 55 years or two relatives of any age with bowel cancer, reported altered bowel habit, rectal bleeding or had unexplained weight loss within the last 12 months) were advised to have clinical review and, if necessary, colonoscopy. Potential participants were also excluded if they had undergone colonoscopy, FS or barium enema within the preceding 5 years, FOBT in the last 12 months, had a personal history of CRN, other serious comorbidities, or could not speak English. Non-responders to the initial invitation were sent a second letter of invitation after a month. Failure to respond after a further month led to the person being classed as a non-participant.

Written informed consent was obtained before FS, CTC or colonoscopy, and was received with the completed test for those who underwent FOBT.

Procedures

FOBT: Participants were provided with a faecal haemoglobin immunochemical test kit (!nform, Enterix, Sydney, NSW). A positive screening test result led to colonoscopy being recommended.

FOBT/FS: Participants were provided with the same FOBT kit, and a positive FOBT result led to colonoscopy being recommended. A negative FOBT result led to an appointment for unsedated FS performed by a gastroenterologist after enema preparation. Polyps were biopsied and screening test results were considered positive if any adenoma was present; positive results led to colonoscopy being recommended.

CTC: Participants were provided with a standardised bowel preparation and provisionally booked for same-day colonoscopy in the event of a positive screening CTC result. CTC was performed at each of the three state centres based on a protocol described previously.[6] Total radiation dose for CTC was less than 5 mSv per person screened. CTCs were performed by experienced radiologists who had previously performed more than 50 CTC examinations. A positive screening test was defined according to previously reported criteria (any polyp > 5 mm, or two or more polyps of any size);[9] a positive result led to colonoscopy being recommended.

Colonoscopy: Participants were provided with the same preparation as for CTC, and attended for day-case colonoscopy. All colonoscopies were done by a gastroenterologist.

Outcome measures

Participation: The participation rate was calculated as the number of participants divided by the total number eligible for screening. For the comparisons of participation between groups, participation in screening by FOBT/FS was defined as completion of the screening strategy.

Polyp detection: The yield of advanced CRN was calculated as the number of participants with one or more such lesions per 100 participants screened. Advanced CRN was defined as any adenoma greater than 10 mm, presence of villous histology, high-grade dysplasia or carcinoma.

Acceptability and safety: Following FS, CTC and colonoscopy, and before preliminary results were given, participants completed a questionnaire that evaluated five variables (perception of pain, tolerance, satisfaction, embarrassment and readiness to have a repeat test) by a 100-point visual analogue scale (0, most favourable, to 100, least favourable). This questionnaire was modelled on previous similar analyses.[6,9] Following FOBT, two variables (embarrassment and readiness to have a repeat test) were analysed by questionnaire. The variables were evaluated by means of the following questions: "How painful was the examination?", "How did you tolerate the examination; in other words, how did you feel you coped with the examination?", "How satisfied with the examination are you?", "How embarrassed with the examination were you?", and "Would you have the examination under the same conditions again if needed?". Participants were also asked if the test was less unpleasant, as unpleasant, or more unpleasant than expected. Complications of procedures were assessed by study centre staff by means of telephone contact with participants in the 4 weeks after a procedure.

Statistical analysis

We tested the hypothesis that providing a choice of screening test would significantly increase participation. We assumed that the highest participation in any screening group would be 40% in the FOBT group. On the premise that a clinically significant increase in participation would be 15% (from 40% to 55%), and that there would be an exclusion rate from screening of 35%, we determined that each screening group required a minimum of 277 potential participants to be invited, or a total of 1662, with a power of 0.8 and $\alpha = 0.05$.

Proportions of participants by screening group, screening centre, sex, age and socioeconomic region were compared using contingency tables and the χ^2 statistic or Fisher's exact test where appropriate.

Ethical approval

The study was approved by the ethics committees of Royal Perth Hospital, Flinders Medical Centre and The Royal Melbourne Hospital.

RESULTS

Invitations for screening were sent to 1679 people. There was an equal distribution, both overall and by screening centre, according to sex and age group. Across the 5 SEIFA codes, there was a similar representation of low (code 1) and high (code 5) socioeconomic status, with a predominant representation of middle socioeconomic status (codes 2–4; Box 1).

The number excluded from screening was 346 (20.6%). The most common reasons for exclusion were colonoscopy in the preceding 5 years (120), recent or current symptoms (72), strong family history of colorectal cancer (46), or personal history of colorectal neoplasia (37). Mail was undelivered for a further 86 people.

Participation

Overall, 278 of 1333 eligible people were screened, giving a participation rate of 20.9% (95% CI, 18.7%–23.1%); 68% of these responded to the first, and 32% to the second, invitation to screening. Participation according to screening site, sex, age group and socioeconomic area are shown in Box 1. Participation was lower in Perth than in Adelaide, and lowest among those from the middle SEIFA class (code 3) compared with the two extremes of SEIFA class (codes 1 and 5).

1 Study population demographic characteristics and participation rate according to fixed demographic variables

		Total	Exclusions	Participation rate
Screening centre	Adelaide	563	137	24.2%
	Melbourne	558	85 ($P < 0.001$†)	21.4% ($P = 0.01$†)
	Perth	558	124 ($P < 0.001$‡)	17.1% ($P = 0.01$‡)
Sex	Men	846	177	21.1%
	Women	833	169 (NS)	20.6% (NS)
Age group	50–54 years	831	150	21.7%
	65–69 years	848	196 ($P = 0.01$)	20.2% (NS)
SEIFA code*	1	190	31 ($P = 0.2$§)	25.8% ($P = 0.02$§)
	2	283	67 ($P = 0.3$§)	22.7% ($P = 0.1$§)
	3	604	123	17.5%
	4	371	77 ($P = 0.9$§)	20.6% ($P = 0.3$§)
	5	227	46 ($P = 1.0$§)	23.2% ($P = 0.09$§)
Total		1679	346	20.9%

SEIFA = Socioeconomic index for areas (code 1, low socioeconomic status to code 5, high socioeconomic status). NS = Non-significant.
* SEIFA codes were not available for four participants. † Comparing Melbourne with Perth.
‡ Comparing Adelaide with Perth. § Comparing this SEIFA code with SEIFA code 3. ◆

Being offered a choice of screening test did not increase participation. Participation was highest in screening by FOBT (64/234 potential participants; 27.4%). Participation in screening in the other groups was as follows: FOBT/FS, 31/224 (13.7%, $P < 0.001$ compared with FOBT); CTC, 35/215 (16.3%, $P = 0.005$); colonoscopy, 38/214 (17.8%, $P = 0.02$); "choice with FOBT kit", 42/226 (18.6%, $P = 0.03$) and "choice without FOBT kit", 50/220 (22.7%, $P = 0.3$). When a choice of screening test was provided, most chose FOBT (61/92; 66%) or colonoscopy (25/92; 27%); the preference for FOBT was less marked in the "choice without FOBT kit" group (FOBT chosen by 29/50 [58%] and colonoscopy by 18/50 [36%]).

Outcome of screening

All participants with a positive screening test result had colonoscopy, with the exception of three of 11 participants with a positive CTC finding; one declined colonoscopy, one had flexible sigmoidoscopy to assess a sigmoid lesion seen at CTC, and one with two small lesions (< 5 mm diameter) was not referred for colonoscopy.

The number of participants with adenoma and advanced CRN and the yield of advanced CRN detected by each screening test are shown in Box 2. The highest yield for advanced CRN was in those having colonoscopy (7.9%). By contrast, the yield in those having FOBT was 0.8%. The *P* value for this difference was 0.02, although overall numbers were small.

Eighty-two individuals had been excluded from screening after they made initial contact by virtue of symptoms, strong family history of colorectal cancer, or both. We attempted to follow these patients by clinical review and, where appropriate, arrange for colonoscopy. Twenty-five did not have clinical review because they declined or were lost to follow-up. Of the remaining 57 who did have clinical review, 32 underwent colonoscopy and one had advanced CRN.

Acceptability and safety of screening

Visual analogue scale scores for pain, tolerance, satisfaction, embarrassment and readiness to repeat the test showed that all tests were well accepted (Box 3). Most participants found the primary screening procedures less unpleasant than expected, although this view was less consistent among participants who underwent CTC.

There were no episodes of bleeding, perforation or other serious complications arising from screening in this study. Of 112 participants undergoing colonoscopy as either a primary screening or follow-up procedure, caecal intubation (one quality assurance measure of competency of colonoscopy) was achieved in 110 (98%).

DISCUSSION

This is the first study to provide both a comparison of currently available CRN screening tests and a determination of whether consumer choice positively influences participation in screening by these tests. We found that the opportunity to choose a screening test did not increase participation in screening. In fact, in the group offered a choice of test, where the letter of invitation included the FOBT kit, fewer subjects participated. It may be that being provided with a choice of test creates confusion and thereby reluctance to participate, although our findings do not exclude the possibility that "guided choice" following formal clinical review might improve participation.

Although we found a higher rate of participation in screening by FOBT, this was at a lower level than in the recently conducted Australian Government FOBT pilot

2 Outcome of screening according to tests used

	No. of participants	Positive screening test	Negative screening test	No. complying with follow-up colonoscopy	No. with adenoma	No. with advanced CRN (yield)
FOBT	125	4	121	4	2	1 (0.8%)
FOBT/FS	52	6	46	6	6*	0
CTC	38	11	27	8 (1 had FS)	4	1 (2.6%)
Colonoscopy	63				13	5 (7.9%)†
Excluded patients‡	82			32	7	1

CRN = Colorectal neoplasia. FOBT = Faecal occult blood test. FS = Flexible sigmoidoscopy. CTC = Computed tomography colonography.
*Yield at FS + colonoscopy. † $P = 0.02$ compared with FOBT. ‡ Excluded from screening after initial contact because of family history or symptoms. ◆

3 Acceptability of screening tests

	FOBT	FS	CTC	Colonoscopy
No. of reponders/total no. screened	144/177	35/39	37/38	62/63
Median visual analogue scale score*				
Pain		18	20	4.5
Tolerance		10	20	4
Satisfaction		6	10	4
Embarrassment	5	10	6	4
Readiness to repeat test	4	5	10	4
Experience compared with expectation				
Less unpleasant	118 (82%)	26 (74.3%)	15 (40.5%)	52 (83.9%)
As unpleasant	24 (16.7%)	8 (22.9%)	10 (27.0%)	8 (12.9%)
More unpleasant	2 (1.4%)	1 (2.9%)	12 (32.4%)	2 (3.2%)

FOBT = Faecal occult blood test. FS = Flexible sigmoidoscopy. CTC = Computed tomography colonography.
* 100-point visual analogue scale: 0 (most favourable) to 100 (least favourable). ◆

projects,[2] and lower than in other international programs.[10-12] There were important differences in the delivery of these two Australian programs. Firstly, in the federal government project, there was a significant engagement of local general practitioners that could not be achieved in our study. Secondly, the invitations delivered to potential participants differed — our study was required to be presented as a clinical research project with due informed consent, rather than a feasibility study. This may have influenced the way people viewed the invitation to be screened. These factors may have contributed to a lower participation in screening by colonoscopy in our study compared with another recent Australian program.[5] Furthermore, in the federal government FOBT pilot program, although overall participation in screening by FOBT was 45.4%, up to 45% of those with a positive FOBT result did not go on to completion of screening by colonoscopy.

Other factors may also have contributed to lower rates of participation than we had anticipated when we designed our study. Firstly, we found an unexpected lower rate of participation in the middle socioeconomic group, which represented a disproportionately high fraction of our population. Previous studies have reported lower participation in lower socioeconomic groups.[13] Secondly, the time of year people are invited to have screening may influence participation. Recent local data suggest higher participation in summer;[14] our study was largely completed outside these months. Thirdly, the requirement to attend a major hospital rather than a peripheral screening centre might have been a disincentive for some potential participants. Finally, lower participation in Perth may have been related to a relative lack of public exposure to CRN screening compared with Adelaide and Melbourne, both of which were sites for the federal government FOBT pilot program.

The overall effectiveness of a screening program is dependent on a variety of factors of which participation is one. The yield of significant abnormalities from a screening method is also critical; whether the aim of a screening program should be to detect colorectal cancer or advanced CRN is very important, but largely undetermined. Our sample size was small, but like other studies, we found a higher prevalence of advanced CRN in participants screened by colonoscopy than by FOBT (8.7%–10.5% v 1.8%–2.9%, respectively).[6,10-12,15] Overall effectiveness of screening based on participation and yield alone would suggest that, on an "intention-to-screen" basis, community screening by colonoscopy may be more likely to detect and prevent colorectal cancer than community screening by FOBT.

We found a very high level of acceptability for all screening tests among participants, and no significant complications arose from this program. However, screening was run from three expert centres where only consultant staff performed the procedures; such technical success and such a safety record might not be applicable to the broader workforce.

In summary, we did not find that providing consumer choice increased participation in screening. Although participation in screening — about one in four — was greatest with FOBT, other screening strategies tested had participation rates of at least one in six. This suggests that other screening tests have an important adjunctive role to a nationwide FOBT program, but how alternative screening tests can be practically integrated with an FOBT program remains to be determined. Yields of advanced CRN from differing screening strategies, evaluated on an intention-to-screen basis, deserve further evaluation.

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COMPETING INTERESTS

None identified.

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