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Psychosocial Variables Associated with Colorectal Cancer Screening in South Australia

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Abstract
Background Population screening reduces mortality from colorectal cancer, yet factors associated with uptake of screening are incompletely understood.
Purpose The purpose of the study was to determine demographic and psychosocial factors associated with participation in faecal occult blood test (FOBT)-based colorectal cancer (CRC) screening in an average risk community programme in Adelaide, South Australia.
Method A questionnaire consistent with the Preventive Health Model was used to determine demographic and psychosocial differences between previous FOBT-based screening participants (n=413, response rate 93.2%) and non-participants (n=481, response rate 47.9%). Results were analysed by univariate and multivariate generalised linear modelling, and factors associated with participation were identified.
Results Factor analysis of psychosocial items revealed an optimal three-factor solution (knowledge, faecal aversion, belief in the value of screening). Following multivariate analyses, two psychosocial and two demographic factors remained as predictors of FOBT screening behaviour: (1) items related to faecal aversion (Aversion), relative risk (RR)=0.61, CI=0.55–0.69, (2) perceptions about the value of screening (Value), RR=1.45, CI=1.13–1.85, (3) age band 65–69 (Age, five age bands, relative to age 50–54), RR=1.43, CI=1.16–1.76 and FOBT type (Test; three tests, Hemoccult®, FlexSure®, InSure® randomly assigned, relative to Hemoccult®: FlexSure®: RR=1.41, CI=1.17–1.71, InSure®: RR=1.76, CI=1.47–2.11.
Conclusions The psychosocial factors associated with non-participation in FOBT-based CRC screening are amenable to interventions designed to improve participation. The small relative risks values associated with each predictor, however, raise the possibility that additional factors are likely to influence screening participation.

Keywords Screening · Colorectal cancer · Faecal occult blood test · Participation · Psychosocial factors associated with screening

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Introduction

Colorectal cancer (CRC, bowel cancer) is the second most frequently diagnosed cancer in developed countries [1]. Randomised controlled trials have demonstrated that population screening using faecal occult blood tests (FOBT) is effective for reducing mortality from CRC [2–4]. Screening also reduces CRC incidence when the colonoscopy rate is high [5].

Results from FOBT-based screening trials indicate that screening is underutilised [6], with participation rates ranging from around 30% for research trials offering guaiac-based FOBT [7, 8] up to 58% in recent population

screening feasibility trials of faecal immunochemical FOBT (FIT) [9].

Various studies have sought to identify factors associated with participation in FOBT-based CRC screening. Several reports have described associations between demographic and psychosocial characteristics and intention to screen [10, 11], although there is a relatively weak correlation between *intention* and actual participation [12]. Studies comparing actual participants and non-participants have tended to be limited in scope, focusing only upon demographic differences between participants and non-participants [13] or reasons for declining or participating [14]. Limited results from population screening studies using immunochemical testing have shown that there is a greater acceptance of this testing technology which does not require dietary restrictions [7, 8, 15], involves sample collection over fewer days [16] or uses improved sampling methodology [8]. Apart from fatalism [17, 18], few psychosocial factors associated with FOBT-based screening behaviour have been identified. Vernon's 1997 review of CRC screening literature [19] concluded that being female, having a high income, engaging in other health-promoting behaviours and having knowledge of CRC were the only factors consistently identified as being associated with screening uptake.

It is becoming increasingly important to better understand the psychosocial factors that are associated with or predict population participation in FOBT screening. Potential factors include knowledge, attitudes, beliefs, experiences and behaviours related to CRC in particular and to population health practices in general. Such factors are best explored through surveys of actual participants and non-participants. However, there are very few studies that compare the psychosocial characteristics of these groups from true population-based FOBT screening trials or which use validated survey instruments based on appropriate theoretical heath behaviour models, and those available are small [13, 14, 19, 20].

Socio-cognitive models of health behaviour provide important insights into the sorts of factors that influence a person's decision to participate in a preventive activity such as CRC screening. The preventive health model (PHM) [21] provided the theoretical framework whereby themes identified in a variety of preliminary studies which were potentially associated with participation in screening were transformed into questionnaire items. The PHM represents a synthesis of elements from frequently used models of health behaviour, including the health belief model [22], the theory of planned behaviour [23] and social cognitive theory [24]. The variables within the PHM have proved valuable in predicting participation in FOBT [25] *intention* to screen by FOBT [26] and in flexible sigmoidoscopy uptake [27].

The specific aim of this study was to identify the demographic and psychosocial factors associated with *actual* participation in FOBT-based colorectal cancer screening in an average risk community programme in Adelaide, South Australia. In earlier univariate analyses of programme and demographic factors associated with screening participation in the same population, we showed that participation was associated with an offer of a screening test incorporating simplified sampling and improved test technology and with invitee's age [8]. Subsequently, we surveyed all invitees for a range of psychosocial characteristics that might be associated with screening and gathered further demographic data. The combined data set was used for the multivariate analyses described in this report.

Materials and Methods

Development of the Bowel Screening Questionnaire

A purpose-designed questionnaire, the Bowel Screening Questionnaire, (BSQ), containing survey items consistent with the PHM, was developed, validated and used to explore differences in demographic, experience, knowledge and psychosocial variables between participants and non-participants in population-based FOBT screening for CRC. Areas of interest (themes) were identified through:

(a). Literature review.

A literature search of MEDLINE, PsychINFO, and Cancerlit reference databases. This identified previously documented predictors of FOBT screening behaviour [19, 28] and preexisting survey items related to CRC screening. Suitable items were included or adapted. [20, 29–32].

(b). Analysis of a previous survey of non-participants.

Content analysis was conducted on 78 questionnaires from an unpublished survey of screening non-participants (invited, but did not participate in screening). The questionnaire gathered information on invitee's reasons for non-participation (181 questionnaires administered, 43.1% response rate).

(c). Analysis of face-to-face interviews.

Five participants (three men, two women) who completed FOB testing within 12 weeks of offer), and four (two men, two women) non-participants from an earlier CRC screening trial were interviewed. Individual semi-structured interviews were conducted by one interviewer and ranged in length from 30 min to 1 h. Interviews were recorded, transcribed within 24 h and analysed by content analysis methods [33].

(d). Focus groups.

Proposed questionnaire items were presented to focus groups of professional stakeholders and screening age community members, assessed for face and content validity and further refined. Some additional items were proposed at this stage and added if there was focus group consensus.

Pilot testing with 100 previous screening participants and 200 non-participants was carried out to assess BSQ acceptability. Analysis of return rates (previous participants, 73%; previous non-participants, 22%) indicated that follow-up reminders would be required for non-participants in order to reach an adequate response rate. Subsequent questionnaires were identified by a code number to enable postal and telephone reminders.

The final version of the questionnaire comprised 33 psychosocial items as statements or questions requiring responses according to Likert scales and encompassed 14 health behaviour themes. Additional information was sought for seven demographic items. Two further sections were specific for either participants or non-participants. Results from analyses of these sections have been published elsewhere [34, 35].

Application of the Bowel Screen Questionnaire

Population Surveyed

The population consisted of people aged 50–74 residing in specific postcode areas who had earlier (in 2001, <12 months prior) been invited to a research trial of FOBT-based population screening for CRC. Invitees were randomly allocated one of three different screening kits under test. The FOBTs were: (1) Hemoccult® II Sensa® (Beckman Coulter USA), requiring diet and medication restrictions and three samples collected by spatula; (2) FlexSure® (Beckman Coulter, USA), no restrictions, three samples collected by spatula; and (3) InSure® (Enterix Australia), two samples collected by brush. At the trial conclusion, invitees were classified as Participants (returned samples for testing within 12 weeks of offer) and Non-participants (did not return samples within 12 weeks of offer). After exclusion of those who: (1) tested positive in the trial, (2) had requested no further contact, (3) were known to be deceased or not to be residing at the address given on the electoral roll, (4) were invited for interview to inform the survey content (irrespective of whether they declined or agreed to be interviewed), and (5) were invited to complete pilot testing of the questionnaire, 1,447 people remained eligible to be re-contacted. In the screening trial, test type and age were found to be associated with participation, and these results have been reported previously [8].

Survey Administration and Follow-Up

Identity-coded BSQs were mailed to all eligible screening trial invitees in June and July 2002. If within 4 weeks a completed questionnaire had not been received or there was no other contact with the invitee, a reminder letter was sent. If no contact with the invitee had been made after a further 4 weeks, telephone contact was attempted. Finally, a request to complete the questionnaire was sent by registered mail to all who had not returned a completed questionnaire or had not been able to be contacted. Questionnaire responses were entered onto an Access 97 database (Microsoft) and audited for accuracy. The final questionnaire response rates were: Participants, 428 questionnaires returned/443 sent, 96.6% return rate; Non-participants, 481/1,004, 47.9%.

Statistical Analyses

For each questionnaire item, responses were transformed to coded data using previously defined coding criteria. Furthermore, in order to reduce the number of individual psychosocial items of the BSQ into item groups (factors), exploratory factor analysis was undertaken in MPlus v5.0 [36]. Missing values were replaced with the mode of the variable, and items not weighting significantly on any factors were not included in the computation of factor scores in the final confirmatory factor analysis.

Following this, demographic variables and identified latent factors were analysed separately for their association with screening participation using univariate generalised linear modelling (GLM, SPSS 15.0). All significant items from the univariate models were then analysed by multivariate GLM to determine joint predictors of participation. Items were retained if $p < 0.05$, the confidence interval (CI) of the risk ratio did not include 1, and the direction of the effect was plausible. Different combinations of items were examined and items were sequentially omitted if they did not fulfil the above criteria. In all multivariate models, the demographic variables were entered before the psychosocial factors.

Results

The demographic characteristics of the study population are given in Table 1. The majority of participants were aged between 50 and 69, were either married or living in a de facto relationship, and were employed or retired.

Table 1 Characteristics of the study population

	Participants (n=428)	Non-participants (n=481)
Sex (M)	205 (48%)	227 (47%)
Age		
50–54 years	67 (16%)	109 (23%)
55–59 years	140 (33%)	156 (32%)
60–64 years	103 (24%)	94 (20%)
65–69 years	100 (23%)	87 (18%)
70+ years	18 (4%)	27 (6%)
Marital status		
Married/de facto	357 (83%)	388 (81%)
Widowed	24 (6%)	21 (4%)
Never married	12 (3%)	14 (3%)
Divorced/separated	35 (8%)	52 (11%)
Education (highest level)		
Primary school	29 (7%)	37 (8%)
Lower high school	172 (40%)	196 (41%)
Upper high school	100 (23%)	102 (21%)
Tertiary diploma or degree	126 (29%)	135 (28%)
Employment status		
Employed	164 (38%)	205 (43%)
Unemployed	14 (3%)	13 (3%)
Retired	197 (46%)	197 (41%)
Home duties/carer	52 (12%)	59 (12%)
Test type		
Hemoccult®	86 (20%)	178 (37%)
FlexSure®	169 (39%)	188 (39%)
InSure®	173 (40%)	115 (24%)

Identification of Factors

In order to determine the number of factors/item groups to extract from the 33 psychosocial BSQ items, a scree plot of eigenvalues was generated. Inspection of this plot suggested that the data could define only three factors with eigenvalues of 6.55, 3.06 and 2.13, respectively. Whilst a further eight eigenvalues were ≥1, the third clearly marked the onset of the scree. Therefore, we extracted a three-factor solution and applied varimax rotation. The loadings of items across the three factors were inspected. Whilst the majority of items loaded significantly on only one of the three factors (i.e. ≥0.30), eight items did not load well on any factor. This can indicate that too few factors have been extracted. Therefore, we reanalysed the data for four- and five-factor solutions, respectively. Increasing the number of factors did not improve interpretability, and most of the items began loading weakly across all factors. Thus, the three factor solution was considered optimal.

In order to compute factor scores for each of the psychosocial factors, confirmatory factor analysis was performed. Only the items which loaded significantly on a given factor (see Table 2) were included in the calculation of those factors scores, and in the case of an item loading significantly on more than one factor, it was used in the calculation of scores for each of the factors it loaded significantly on. Item loadings from the confirmatory analysis along with questionnaire content are provided in Table 2. Factor 1 was termed ‘knowledge’ because it was defined by questions measuring knowledge about CRC. Factor 2 was defined by items addressing beliefs about screening for CRC and was therefore termed ‘belief in the value of screening’. The third factor was termed ‘faecal aversion’ because it was defined solely by the three items measuring this construct.

Predicting Screening Behaviour

Following factor analysis, univariate GLM was undertaken to determine the univariate predictors of screening behaviour. All of the demographic variables presented in Table 1 were analysed as well as the effect of socioeconomic status and the effect of different test types on screening behaviour. Only two variables emerged from the univariate analyses as significant predictors of behaviour. First, age group distinguished the screening participants from the non-participants

Table 2 Item loadings from the factor analysis and questionnaire item content

Factor and loading			Questionnaire item
F1	F2	F3	
0.34			About how many people do you think will get bowel cancer at some time in their lives?
0.79			Can you name any symptoms of bowel cancer?
0.72			Can you name any treatment/s for bowel cancer?
0.56			Have you known someone who has had bowel cancer?
−0.35			I think that most people who get bowel cancer usually die within a year
0.55			I think that what you eat can affect your chance of getting bowel cancer
−0.55			There is nothing I can do to stop myself getting bowel cancer
0.37			I think that the main thing that affects my health are my own habits and lifestyle
0.28	0.30		Compared to the other cancers how common is bowel cancer
0.29	0.28		I think that if bowel cancer is in your family it increases your risk of getting it too
0.37	0.35		If detected early, I think there is a good chance bowel cancer can be cured
	0.43		I am worried about getting bowel cancer
	−0.25		I think it is extremely unlikely that I will get bowel cancer
	0.83		I believe that I should have a screening test for bowel cancer
	0.23		I usually worry about my chance of getting sick in general
	0.81		I think the general public over 50 should have regular bowel checkups even when they don't have symptoms
	0.66		Screening tests provide a valuable way of detecting bowel cancer in the early stages
	0.85		How important is it to participate in bowel cancer screening in the future?
	0.79		I would have bowel cancer screening if my GP advised
	0.75		I would have bowel cancer screening if encouraged by my family and/or friends
	0.73		I intend to have a bowel screening test in the next 2 years
	−0.45		People over 50 years old really do not need a medical checkup every year
		0.76	Testing faeces for the purpose of bowel cancer screening is distasteful
		0.77	It is inconvenient to test 2 or 3 bowel motions for the purpose of bowel screening
		0.81	Testing faeces for the purpose of bowel cancer screening is unhygienic

F1=*knowledge*; F2=*value of screening*; F3=*faecal aversion*

(Wald χ^2=10.9, p<0.05). Compared with people in the lowest age group (50–54 years old), the relative risk (RR) of participating increased for each 5-year age band up to 69 years. The RR approached significance for 'Age group 55 to 59 years' (RR=1.24, CI=0.99–1.55) and was significant for 'Age group 60 to 64' (RR=1.37, CI=1.09–1.73) and 'Age group 65 to 69' (RR=1.41, CI=1.12–1.77). Membership in the oldest age group (70–74 years) was unrelated to participation (RR=1.05, CI=0.7–1.6), but the sample size for this group is small (see Table 1). Second, test type emerged as a significant predictor (Wald χ^2= 38.90, p<0.001). Compared to Hemoccult®, participants receiving FlexSure® (RR=1.45, CI=1.18–1.78) and InSure® (RR=1.84, CI=1.51–2.24) were significantly more likely to participate.

Of the identified psychosocial factors, univariate GLM identified only two that were significantly associated with actual participation (Table 2): factor 2 *belief in the value of screening* (RR=2.82, CI=2.34–3.40) and factor 3 *faecal aversion* (RR=0.54, CI=0.50–0.59). Factor 1 *knowledge* was not a significant predictor of participation (RR=0.86, CI=0.67–1.12, Wald χ^2=1.3, p=0.26).

All significant univariate predictors were subsequently entered into a multivariate GLM. Thus, the final model included age group, test type, belief in screening and faecal aversion. The results of this analysis are presented in Table 3. As can be seen, faecal aversion was the best predictor of participation in screening with higher levels of aversion predicting non-participation. Following this, test type appeared to be the next best predictor, with both FlexSure® and InSure® tests resulting in better participation. Belief in the value of screening remained a significant predictor with higher levels of belief in screening predicting screening participation. The RR was smaller than in the univariate analysis, and this might be explained by the significant negative correlation between belief in screening and faecal aversion (r=−0.61, p<0.001). More specifically, people with high faecal aversion tend to have lower belief in screening, and thus, these factors explained common variance in screening behaviour. Age group — the only

Table 3 Significant factors jointly associated with participation in FOBT screening for CRC

Variable		RR	CI (95%)	Wald χ^2	*p*
Faecal aversion		0.61	0.55–0.69	66.34	<0.001
Belief in screening		1.45	1.13–1.85	9.05	0.003
Test type	Hemoccult®	–	–	–	–
	FlexSure®	1.41	1.17–1.71	13.06	<0.001
	InSure®	1.76	1.47–2.11	37.60	<0.001
Age group	50–54[a]	–	–	–	–
	55–59	1.19	0.98–1.45	3.15	0.07
	60–64	1.20	0.97–1.48	3.10	0.07
	65–69	1.43	1.16–1.76	11.15	0.001
	>69	1.18	0.81–1.70	0.78	0.37

RR relative risk, *CI* confidence interval

[a] Reference category

demographic variable in this model—remained a significant predictor of participation, with the likelihood of participating being significantly higher in the 'Age group 65 to 69 years' compared with the youngest age group.

Discussion

This is the first study to survey a large population of previous invitees to FOBT-based CRC screening. Using a comprehensive questionnaire exploring psychosocial variables consistent with an established health behaviour model, the analyses have shown that psychosocial variables significantly influence a person's decision to participate in screening. This study moves forward from previous work by including a more extensive focus upon attitudinal variables associated with *actual* participants and non-participants in FOBT-based CRC screening and explains participation using a multivariate health behaviour model that comprises both demographic and psychosocial factors.

Of the 33 psychosocial items included in the BSQ, 25 defined three clearly interpretable psychosocial factors. Of these, two — faecal aversion and belief in the value of screening — emerged as significant univariate and multivariate predictors of FIT-based CRC screening behaviour. Faecal aversion was defined by items related to the requirement for faecal sampling, whilst belief in the value of screening was defined by items related to perceptions about the value of screening. Overall, this finding agrees with the results of previous smaller studies examining differences between participants and non-participants in FOBT screening [13, 14, 19, 20].

The finding that non-participants were more likely to rate the FOBT as 'unhygienic' and 'distasteful' has been found previously [37], although this study better defines the magnitude of the effect. Perceptions of the unpleasantness, inconvenience or embarrassment in handling faecal material have been commonly cited reasons for not completing the FOBT in studies surveying non-participants [14, 25, 27, 38]. The dislike of faecal sampling may prove to be a difficult barrier to overcome because of social norms, and the strong association with non-participation seen in this study supports efforts to further develop alternative sampling methodologies. Nonetheless, population-based randomised controlled trials of new technology FIT with simplified sampling show that such approaches go some way to overcoming this aversion [7, 8].

A second theme discriminating participants from non-participants emerged in relation to perceptions about the value and importance of screening and the belief that one should screen in the future. Perceptions of the social and personal value of screening may act more distally and are less likely to exert as strong an influence upon actual behaviour than factors such as aversion for sampling. This hypothesis is supported by the multivariate model in which there was a marked reduction in the predictive strength of belief in screening but not for faecal aversion, which increased slightly. Nevertheless, belief in screening remained a significant predictor, and the belief that testing is valuable and an important health maintenance activity form part of what Myers and colleagues have called the 'salience and coherence' of testing, or the way in which screening might be understood as an important and useful part of an individual's life [19, 25]. Both themes may be important targets in future interventions to increase levels of FOBT uptake within the community.

Previous research suggests that lack of knowledge of CRC predicts participation in screening [18, 39] and that higher levels of CRC knowledge is associated with use of FOBT-based CRC screening tests [40]. Further evidence for the importance of knowledge comes from studies of prevention programmes for other types of cancer where it is a predictor of participation in mammography [41] and cervical cancer screening [42]. In the present study, a latent knowledge factor was defined by the BSQ items, but it did not predict participation in screening. The knowledge factor presented herein generally reflects factual aspects of CRC such as risk, symptoms and treatments. As such, five of the

items loading on this factor were scored dichotomously; that is, survey respondents either did know about CRC symptoms or did not. Categorical data such as these are not always well suited to factor analysis because of a lack of variance in scoring the items. Future work may look at scoring factual knowledge items in varying levels of correctness to overcome this issue.

The response rate for the BSQ was over 96% for people who had previously participated in screening. The return rate for non-participants was 48%, not taking into account people subsequently known not to reside at the address given. Close inspection of our records indicated that at least 88 people were known not to have received their questionnaire because they had moved or, for a variety of reasons, could not complete it, bringing the adjusted response rate in non-participants to over 53%. Although this adjusted rate still does not match that for participants, the two groups were demographically similar (see Table 1), and responses should be representative of both groups as a whole.

A variety of contact procedures (invitation letter, written reminder, telephone reminder, registered letter reminder) were sequentially used to maximise response rates. Apart from sending advance notification of the invitation to complete the questionnaire [43], it is difficult to conceive of additional methods that would not be considered harassment. Indeed, the unadjusted questionnaire response rate for screening non-participants is relatively high for a group that had already declined one health programme opportunity and is also high by comparison with return rates for similar studies, which ranged from 17% [20] to 43% [13]. Nevertheless, it is still possible that there may be important psychosocial differences between questionnaire respondents and non-respondents in the group of screening non-participants. Future attempts to investigate differences between participants and non-participants might wish to administer the questionnaire via telephone [44], although this poses difficulties when an unbiased population sample is initially derived from the electoral roll.

The use of a retrospective study design was desirable in the present study in order to avoid the potential influence of previous questionnaire completion upon screening behaviour. A retrospective design, however, does raise questions about the origins of the differences in attitudes between participants and non-participants. Specifically, it is not possible to determine whether differences in attitudes between participants and non-participants are the result of preexistent cognitive and/or emotional dispositions or the actual experience of testing. For example, "Williamson and Wardle [45] reported that participants who had undergone flexible sigmoidoscopy reported feeling far less embarrassed than they had anticipated.

Despite finding significant associations between psychosocial factors and screening behaviour, the magnitude of the relative risk ratios suggest that additional factors may also influence screening participation. This implies that the health behaviour models that underpin the BSQ items may be too simplistic or that other variables that were not measured are important in determining CRC screening behaviour. Further investigation should consider using additional questionnaire constructs derived from other health behaviour models, particularly those based on stage of readiness theories such as the Transtheoretical Model (TTM) [46]. This is supported by studies where CRC screening behaviour [47] and preventive behaviour for other cancers [48] were both predicted by TTM stage of readiness.

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References

1. Parkin DM, Whelan SL, Ferlay J, Teppo L, Thomas DB. Cancer incidence in five continents. IARC Scientific Publication no.155. Lyon: International Association of Cancer Registries; 2002.
2. Mandel JS, Bond JH, Church TR, Snover DC, Bradley GM, Schuman LM, et al. Reducing mortality from colorectal cancer by screening for fecal occult blood. N Engl J Med. 1993;328:1367–71.
3. Hardcastle JD, Chamberlain JO, Robinson MHE, Moss SM, Amar SS, Balfour TW, et al. Randomised controlled trial of faecal-occult-blood screening for colorectal cancer. Lancet. 1996;348:472–7.
4. Kronborg O, Fenger C, Olsen J, Jorgensen OD, Sondergaard O. Randomised study of screening for colorectal cancer with faecal-occult-blood test. Lancet. 1996;348:467–71.
5. Mandel JS, Church TR, Bond JH, Ederer F, Geisser MS, Mongin SJ, et al. The effect of fecal occult-blood screening on the incidence of colorectal cancer. N Engl J Med. 2000;343:1603–7.
6. Subramanian S, Klosterman M, Amonkar MM, Hunt TL. Adherence with colorectal cancer screening guidelines: a review. Prev Med. 2004;38:536–50.
7. Cole SR, Young GP. Effect of dietary restriction on participation in faecal occult blood test screening for colorectal cancer. Med J Aust. 2001;175:195–8.
8. Cole SR, Young GP, Esterman A, Cadd B, Morcom J. A randomised trial of the impact of new faecal haemoglobin test technologies on population participation in screening for colorectal cancer. J Med Screen. 2003;10:117–23.
9. Australian Institute of Health and Welfare. Screening Monograph No5/2005. The Australian Bowel Cancer Screening Pilot Program: analysis of routinely collected data. Commonwealth of Australia; 2005.
10. Janda M, Stanton WR, Hughes K, Del Mar C, Clavarino A, Aitken JF, et al. Knowledge, attitudes and intentions related to colorectal cancer screening using faecal occult blood tests in a rural Australian population. Asia-Pac J Public Health. 2003;15:50–6.
11. Weller DP, Owen N, Hiller JE, Willson K, Wilson D. Colorectal cancer and its prevention: prevalence of beliefs, attitudes, intentions and behaviour. Aust J Public Health. 1995;19:19–23.

12. Herbert C, Launoy G, Gignoux M. Factors affecting compliance with colorectal cancer screening in France: differences between intention to participate and actual participation. Eur J Cancer Prev. 1997;6:44–52.
13. Neilson AR, Whynes DK. Determinants of persistent compliance with screening for colorectal cancer. Soc Sci Med. 1995;41:365–74.
14. Arveaux P, Durand G, Milan C, Bedenne L, Levy D, Doan BD, et al. Views of the general population on mass screening for colorectal cancer: the Burgundy Study. Prev Med. 1992;21:574–81.
15. Robinson MHE, Pye G, Thomas WM, Hardcastle JD, Mangham CM. Haemoccult screening for colorectal cancer: the effect of dietary restriction on compliance. Eur J Surg Oncol. 1994;20:545–8.
16. Thomas WM, Pye G, Hardcastle JD. Faecal occult blood screening for colorectal neoplasia: a randomized trial of three or six days of tests. Br J Surg. 1990;77:277–9.
17. Gorin SS. Correlates of colorectal cancer screening compliance among urban Hispanics. J Behav Med. 2005;28:125–37.
18. Powe B. Perceptions of cancer fatalism among African Americans: the influence of education, income, and cancer knowledge. J Natl Black Nurses' Assoc. 1995;7:41–8.
19. Vernon SW. Participation in colorectal cancer screening: a review. J Natl Cancer Inst. 1997;89:1406–22.
20. Hunter W, Farmer A, Mant D, Verne J, Northover J, Fitzpatrick R. The effect of self-administered faecal occult blood tests on compliance with screening for colorectal cancer: results of a survey of those invited. Fam Pract. 1991;8:367–72.
21. Myers RE, Ross EA, Jepson C, Wolf TA, Balshem A, Millner L. Modeling adherence to colorectal cancer screening. Prev Med. 1994;23:142–51.
22. Sherran P, Abraham C. The health belief model. In: Conner M, Norman P, editors. Predicting health behavior: research and practice with social cognition models. Buckingham: Open University Press; 1995.
23. Conner M, Sparks P. The theory of planned behavior and health behaviors. In: Conner M, Norman P, editors. Predicting health behavior: research and practice with social cognition models. Buckingham: Open University Press; 1999.
24. Bandura A. The explanatory and predictive scope of self-efficacy theory. J Soc Clin Psychol. 1986;4:359–73.
25. Myers RE, Trock BJ, Lerman C, Wolf T, Ross E, Engstrom PF. Adherence to colorectal cancer screening in an HMO population. Prev Med. 1990;19:502–14.
26. Myers RE, Vernon SW, Tilley BC, Lu M, Watts BG. Intention to screen for colorectal cancer among white male employees. Prev Med. 1998;27:279–87.
27. Wardle J, Sutton S, Williamson S, Taylor T, McCaffery K, Cuzick J, et al. Psychosocial influences on older adults' interest in participating in bowel cancer screening. Prev Med. 2000;31:323–34.
28. Dent OF, Bartrob R, Goulson KJ, Chapuis PH. Participation in faecal occult blood screening for colorectal cancer. Soc Sci Med. 1983;17:17–23.
29. Stanton WR, Balanda KP, Gillespie AM, Lowe JB, Baade PD. Measurement of community beliefs about colorectal cancer. Soc Sci Med. 2000;50:1655–63.
30. Thomas RJS, Clarke VA. Colorectal cancer: a survey of community beliefs and behaviours in Victoria. Med J Aust. 1998;169:37–40.
31. Macrae FA, Hill JD, St John DJ, Ambikapathy A, Garner JF. Predicting colon cancer screening behavior from health beliefs. Prev Med. 1984;13:115–26.
32. Spector MH, Appelgate WB, Olmstead SJ, DiVasto PV, Skipper B. Assessment of attitudes towards mass screening for colorectal cancer and polyps. Prev Med. 1981;10:105–9.
33. Bowling A. Research methods in health: investigating health and health services. Buckingham: Open University Press; 1997.
34. Worthley DL, Cole SR, Esterman A, Mehaffey S, Roosa NM, Smith A, et al. Participation in faecal occult blood test screening for colorectal cancer: why people choose to refuse. Intern Med J. 2006;36:607–10.
35. Worthley DL, Cole SR, Mehaffey S, Roosa NM, Smith A, Turnbull D, et al. Participant satisfaction with fecal occult blood test screening for colorectal cancer. J Gastroenterol Hepatol. 2007;22:142–3.
36. Muthen LK, Muthen BO. Mplus. The comprehensive modelling program for applied research. User's guide. Los Angeles: Muthen and Muthen; 1998.
37. Hoogewerf PE, Hislop TG, Morrison BJ, Burns SD, Sizto R. Health belief and compliance with screening for fecal occult blood. Soc Sci Med. 1990;30:721–6.
38. Myers RE, Ross EA, Wolf TA, Balshem A, Jepson C, Millner L. Behavioral interventions to increase adherence in colorectal cancer screening. Med Care. 1991;29:1039–50.
39. Polednak AP. Knowledge of colorectal cancer and use of screening tests in persons 40–74 years of age. Prev Med. 1990;19:213–26.
40. Seeff LC, Nadel MR, Klabunde CN, Thompson T, Shapiro JA, Vernon SW, et al. Patterns and predictors of colorectal cancer test use in the adult U.S. population. Cancer. 2004;100:2093–103.
41. Lagerlund M, Hedin A, Sparen P, Thurfjell E, Lambe M. Attitudes, beliefs, and knowledge as predictors of nonattendance in a Swedish population-based mammography screening program. Prev Med. 2000;31:417–28.
42. White G. Older women's attitudes to cervical screening and cervical cancer: a NZ experience. J Adv Nurs. 1995;21:659–66.
43. Edwards P, Roberts I, Clarke M, DiGuiseppi C, Pratap S, Wentz R, et al. Increasing response rates to postal questionnaires: systematic review. Br Med J. 2002;324:1183–91.
44. Ronckers C, Land C, Hayes R, Verduijn P, van Leeuwen F. Factors impacting questionnaire response in a Dutch retrospective cohort study. Ann Epidemiol. 2004;14:66–72.
45. Williamson S, Wardle J. Increasing participation with colorectal cancer screening: the development of a psycho-educational intervention. In: Rutter D, Quine L, editors. Changing health behaviour: intervention and research with social cognition models. Buckingham: Open University Press; 2002. p. 105–22.
46. Prochaska JO, DiClemente CC. Self change processes, self efficacy and decisional balance across five stages of smoking cessation. Prog Clin Biol Res. 1984;156:131–40.
47. Trauth JM, Ling BS, Weissfeld JL, Schoen RE, Hayran M. Using the transtheoretical model to stage screening behavior for colorectal cancer. Health Educ Behav. 2003;30:322–36.
48. Spencer L, Pagell F, Adams T. Applying the transtheoretical model to cancer screening behavior. Am J Health Behav. 2005;29:36–56.