

BMJ Open What are common barriers and helpful solutions to colorectal cancer screening? A cross-sectional survey to develop intervention content for a planning support tool

Marie Kotzur ¹, Sara Macdonald,¹ Ronan E O'Carroll,² Rory C O'Connor,¹ Audrey Irvine,³ Robert J C Steele,⁴ Kathryn A Robb ¹

To cite: Kotzur M, Macdonald S, O'Carroll RE, *et al*. What are common barriers and helpful solutions to colorectal cancer screening? A cross-sectional survey to develop intervention content for a planning support tool. *BMJ Open* 2022;**12**:e062738. doi:10.1136/bmjopen-2022-062738

► Prepublication history and additional supplemental material for this paper are available online. To view these files, please visit the journal online (<http://dx.doi.org/10.1136/bmjopen-2022-062738>).

Received 09 March 2022
Accepted 05 August 2022



© Author(s) (or their employer(s)) 2022. Re-use permitted under CC BY-NC. No commercial re-use. See rights and permissions. Published by BMJ.

¹School of Health & Wellbeing, University of Glasgow, Glasgow, UK

²Psychology, University of Stirling, Stirling, UK

³NHS Tayside, Dundee, UK

⁴Surgery and Oncology, University of Dundee, Dundee, UK

Correspondence to

Professor Kathryn A Robb;
Katie.Robb@glasgow.ac.uk

ABSTRACT

Objective Colorectal screening using faecal immunochemical tests (FITs) can save lives if the people invited participate. In Scotland, most people intend to complete a FIT but this is not reflected in uptake rates. Planning interventions can bridge this intention-behaviour gap. To develop a tool supporting people willing to do colorectal screening with planning to complete a FIT, this study aimed to identify frequently experienced barriers and solutions to these barriers.

Design This is a cross-sectional study.

Setting Participants were recruited through the Scottish Bowel Screening Programme to complete a mailed questionnaire.

Participants The study included 2387 participants who had completed a FIT (mean age 65 years, 40% female) and 359 participants who had not completed a FIT but were inclined to do so (mean age 63 years, 39% female).

Outcome measures The questionnaire assessed frequency of endorsement of colorectal screening barriers and solutions.

Results Participants who had not completed a FIT endorsed significantly more barriers than those who had completed a FIT, when demographic, health and behavioural covariates were held constant ($F(1,2053)=13.40$, $p<0.001$, partial $\eta^2=0.01$). Participants who completed a FIT endorsed significantly more solutions than those who did not ($U=301\,585.50$, $z=-3.21$, $p<0.001$, $r=0.06$). This difference became insignificant when covariates were controlled. Participants agreed on the most common barriers and solutions regardless of screening history. Barriers included procrastination, forgetting, fear of the test result, screening anxiety, disgust and low self-efficacy. Solutions included hand-washing, doing the FIT in private, reading the FIT instructions, benefit of early detection, feelings of responsibility, high self-efficacy and seeing oneself as a person who looks after one's health.

Conclusion This survey identified six barriers and seven solutions as key content to include in the development of a planning tool for colorectal screening using the FIT. Participatory research is required to codesign an engaging and accessible planning tool.

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ Collaboration with the Scottish Bowel Screening Programme enabled targeted recruitment of a large sample evenly matched in sex and socioeconomic status across participant groups.
- ⇒ Participants who had not completed screening were significantly older and more ethnically diverse than those who had, but this did not affect outcome measures.
- ⇒ Despite efforts to recruit similar numbers of people who had and had not completed screening, the proportions of participants who had completed screening were much larger due to an error.

BACKGROUND

Colorectal cancer is the third most common cancer and second most common cause of cancer death globally.^{1,2} In the UK and in Scotland, it is the second biggest cancer killer, responsible for over 16 600 and 1700 deaths annually, respectively.^{3,4} Colorectal cancer screening can save lives and reduce healthcare spending.⁵

In November 2017, the Scottish Bowel Screening Programme replaced the Faecal Occult Blood Test (FOBT, samples collected at home over 3 days) with the Faecal Immunochemical Test (FIT). The FIT requires participants to take one faecal sample and mail it for testing. People aged 50–74 years are invited to complete a FIT every 2 years. In a survey of a convenience sample of 200 Scottish adults, 85% of people reported intending to complete a FIT and rated it easier to complete and less disgusting than FOBT used previously.⁶ While uptake rose to 63%,⁷ a gap remains between screening intentions and participation. A major reason may be that people are 'not getting round to it'⁸ which is

consistent with previous work on ‘inclined abstainers,’⁹ showing that a proportion of people intending to do screening fail to do it. This explanation seems particularly likely for colorectal screening which, unlike other screening tests, is self-completed at home¹⁰: in a recent Australian survey 64% reported intentions to do the FIT.¹¹

Systematic reviews demonstrate that interventions supporting people to plan how to enact a behaviour can change the behaviour of inclined abstainers.¹² Planning support interventions have been shown to be more effective than other approaches, such as self-monitoring,¹³ and have high adherence rates.¹⁴ Planning support promotes behaviour change using ‘if-then’ plans.¹⁵ They are often embedded in planning support tools¹⁶ encouraging people to plan better by offering a solution where a key barrier (‘if’) is linked with an appropriate solution (‘then’), for instance: “If I am tempted to eat when I am at a party”—“then I will tell myself that if I try hard enough I can keep from overeating”.¹⁶

Behavioural theories, such as the Integrated Screening Action Model (I-SAM), show that a range of individual and environmental factors may hinder or facilitate screening participation.¹⁷ We aimed to establish the most relevant content for a planning support tool to overcome barriers to colorectal screening using the FIT, by identifying frequently experienced barriers and the solutions perceived as most helpful among people invited to complete a FIT and intending to do so. As the FIT is relatively new to Scotland, little is known about people’s experience with this test which continues to rely on faecal self-sampling at home and research is required to establish what barriers remain and how people who complete colorectal screening overcome them.

This study seeks to answer five research questions in a cross-sectional survey to inform the development of planning support tool:

- i. What are the most common perceived barriers to completing a FIT among people willing to do so?
- ii. How frequently are colorectal screening barriers experienced by people who have or have not completed a FIT?
- iii. What are the most common solutions used to overcome colorectal screening barriers among people who have completed a FIT?
- iv. What are the most common solutions to overcome colorectal screening barriers suggested by people who have not completed a FIT, but are willing to do so?
- v. Are sociodemographic characteristics associated with differences in reporting colorectal screening barriers and solutions for a FIT?

METHOD

Recruitment

To recruit a well-stratified sample, we planned to invite potential participants based on colorectal screening

history (completed a FIT vs not completed a FIT), sex (female vs male), age (50–62 years vs 63–74 years), area-based socioeconomic status (SES), and location in Scotland (Greater Glasgow and Clyde health board vs other health board). Area-based SES was derived from the Scottish Index of Multiple Deprivation based on home postcodes (40% most affluent vs 40% most deprived).¹⁸

We collaborated with the Scottish Bowel Screening Centre who used the sampling frame to identify eligible potential participants (see online supplemental table S1) and send them a questionnaire.

We aimed to recruit 1000 people who had completed a FIT and 1000 people who had not completed a FIT. Based on our previous work, we anticipated low response rates from people who had not completed a FIT by oversampling this group. We therefore planned to send questionnaires to 1250 people who had completed a FIT and 5000 people who had not completed a FIT. However, due to an error, we sent 4482 people who had completed a FIT and 5000 who had not a questionnaire between January and May 2019. People who did not complete a FIT who had not returned questionnaires or declined participation in the study were sent reminder questionnaires after 3 weeks.

Materials

The questionnaire was designed with public and patient involvement (PPI) input to be easy to read. The questionnaire is available in online supplemental file 2.

Health and experience of cancer

We measured perceived general health with one item *Would you say that for someone of your age your own health in general is:* with response options: *poor, fair, good, excellent*.¹⁹ Based on questions by Miles *et al*,²⁰ we also asked participants whether they, their close family, or friends had ever had cancer, and if so, what type.

Intentions and past FIT completion

The questionnaire showed an image of the FIT kit and then assessed past screening behaviour with two items: *Have you received a new bowel screening test like the one pictured above?* (response options: *yes, no, not sure*) and *If yes, did you complete and post the new test?* (response options: *yes, no, not applicable*).

We assessed future screening intentions with one item adapted from McCaffery and coauthors²¹: *If you receive a new bowel screening test in the future, will you do the test?* with response options: *definitely not; probably not; yes, probably; yes, definitely*. Participants who selected *definitely not* or *probably not* were excluded from the study in line with eligibility criteria (see online supplemental table S1).

We also assessed self-efficacy for completing a FIT with one item: *How easy or hard do you think the new bowel screening test is to do?* with six response options:

very easy, easy, neither easy nor hard, hard, very hard, and don't know.

Barriers and solutions

Barrier and solution items were developed based on semi-structured interviews with people who had and had not completed a FIT in previous research.²²

To assess colorectal screening barriers, 33 barrier items were presented (see online supplemental file 2) with response options on a five-point Likert-scale from 1, *strongly disagree* to 5, *strongly agree*. Participants were also asked, *Is there anything else that makes bowel screening hard for you? Please can you describe:*

Similarly, 25 solution items (see online supplemental file 2) were presented with response options on a five-point Likert-scale from 1, *strongly disagree* to 5, *strongly agree*. Participants were also asked: *Can you think of any other ways that bowel screening could be made easier? Please can you describe:*

Responses to barrier and solution items were dichotomised as follows: *Strongly disagree*, *Disagree*, and *Not sure* were grouped into a *Not endorsed* category; *Strongly agree* and *Agree* were grouped into an *Endorsed* category.

Demographic characteristics

Demographic characteristics included: age; gender; marital status; ethnic group.²⁰ We assessed individual SES as an aggregate score of housing arrangement (rent from local authority/housing association, rent from private landlord, own your home/have a mortgage, other), car ownership, education level.^{23 24}

Procedure

Potential participants received a mailed invitation letter, a 10-page questionnaire, and a prepaid reply envelope. The reminder included another questionnaire and prepaid reply envelope.

Analysis

Analyses were carried out using IBM SPSS Statistics V.28. Data from ineligible participants who did not meet the inclusion criteria were excluded from the analysis. Less than 5% of cases had missing data for demographic and behavioural characteristics, except for individual SES with 14.99% of cases missing data. Missing data for barriers and solution items were greater with 16.24% and 10.31% of cases, respectively. Cases with missing data were excluded test wise. χ^2 tests were used to compare demographic characteristics of included participants and those who did not return a questionnaire.

Analyses comparing the demographic and behavioural characteristics of participant who completed a FIT and those who did not were performed using χ^2 and Mann-Whitney U tests. Ethnicity was dichotomised for χ^2 -testing because several categories contained fewer than five participants. Self-efficacy responses were also dichotomised for χ^2 -testing.

Frequency analyses were carried out to rank barriers and solutions by the proportion of participants who

completed a FIT and those who did not who endorsed each item. We used Mann-Whitney U tests to compare frequency of endorsed barriers and solutions between participants who completed a FIT and those who did not. To do this, the number of endorsed barriers and solutions was counted for each participant. We used analysis of covariance to assess whether significant differences in the number of endorsed barriers and solutions persisted when demographic, health, and behavioural sample characteristics (see table 1) were held constant.

Patient and public involvement

Two patient and public representatives provided feedback on the design of the study and reviewed all participant-facing documents and materials to be accessible and engaging. Participant will be sent a summary of the findings if they have requested this.

RESULTS

Sample

Of 2904 completed questionnaires, 156 responses were excluded (n=130 reported no intention to complete a FIT or had not answered this question; n=21 reported having colorectal cancer, and n=5 were aged younger than 50 years). Our study included 2387/4482 participants who had complete a FIT (response rate 53.3%) and 359/5000 participants who had not completed a FIT (response rate 7.2%).

Compared with those who did not return a questionnaire, included participants were more likely to have completed a FIT (30.7% vs 87.2%, $p<0.001$), to reside in a health board other than NHS Greater Glasgow and Clyde (48.7% vs 55.1%, $p<0.001$), and to be more affluent (39.0% vs 50.5%, $p<0.001$). Contrary to those who did not return a questionnaire, included participants were more likely to be older if they had completed a FIT than if they had not completed a FIT (59.6% vs 49.6%). There was no significant difference in sex between those who did not return a questionnaire and included participants.

Demographic and behavioural characteristics are shown in table 1. The age of the total sample ranged from 50 to 75 years with a mean age of 63.4 years (SD: 7.3 years). There were no significant differences between participants who completed a FIT and those who did not in sex, area-based SES, or having ever had cancer; however, screening participants who did not complete a FIT were significantly older than those who did. Participants who did not complete a FIT were significantly more likely to have a lower individual SES score, report poor or fair health, to be single, divorced/separated or widowed, to be unsure whether their family or friends had cancer, and to be from an ethnic background other than white than participants who completed a FIT.

Although area-based SES and individual SES had differing associations with screening history, area-based SES was significantly associated with individual SES,

Table 1 Demographic, health-related and colorectal screening characteristics

	Completed a FIT (n=2387)	Did not complete a FIT (n=359)	Significance
Age			
<i>Median*</i>	63 years	65 years	U=501 898.5, z=5.3, p<0.001, r=0.1
	n (%)	n (%)	
Sex			
Female	947, 39.7%	140, 39.0%	
Male	1437, 60.2%	219, 61.0%	$\chi^2(2)=0.5$, p=0.9
Other	3, 0.1%	0, 0.0%	
Marital status			
Single	219, 9.2%	40, 11.1%	
Married	1609, 67.4%	224, 62.4%	
Cohabiting/living with a partner	162, 6.8%	16, 4.5%	$\chi^2(4)=9.6$, p<0.05
Divorced/separated	204, 8.5%	35, 9.7%	
Widowed	161, 6.7%	35, 9.7%	
Ethnic group			
White background	2317, 97.1%	339, 94.4%	
<i>Other ethnic background</i>	46, 1.9%	14, 3.9%	$\chi^2(1)=5.8$, p<0.005
Missing	24, 1.0%	6, 1.7%	
Area-based SES			
Scottish Index of Multiple Deprivation 1 & 2 (most deprived)	1166, 48.8%	191, 53.2%	$\chi^2(1)=2.9$, p=0.1
Scottish Index of Multiple Deprivation 4 & 5 (least deprived)	1221, 51.2%	165, 46.0%	
Individual SES			
<i>0 (most deprived)</i>	97, 4.1%	24, 6.7%	
<i>1</i>	181, 7.6%	46, 12.8%	
<i>2</i>	425, 17.8%	79, 22.0%	$\chi^2(4)=31.5$, p<0.001
<i>3</i>	731, 30.6%	95, 26.5%	
<i>4 (least deprived)</i>	649, 27.2%	63, 17.5%	
Self-reported health			
<i>Poor</i>	96, 4.0%	31, 8.6%	
<i>Fair</i>	480, 20.1%	97, 27.0%	$\chi^2(3)=35.1$, p<0.001
<i>Good</i>	1356, 56.8%	190, 52.9%	
<i>Excellent</i>	422, 17.7%	34, 9.5%	
Cancer history			
Has/had cancer	233, 9.8%	37, 10.3%	
Does not have cancer	2113, 88.5%	316, 88.0%	$\chi^2(2)=0.2$, p<0.94
Unsure	16, 0.7%	2, 0.6%	
Family or friends with cancer			
Yes	1813, 76.0%	260, 72.4%	
No	461, 19.3%	79, 22.0%	$\chi^2(2)=6.7$, p<0.05
<i>Not sure</i>	52, 2.2%	15, 4.2%	
Colorectal screening experience and intention			

Continued

Table 1 Continued

	Completed a FIT (n=2387)	Did not complete a FIT (n=359)	Significance
Ever received a FIT in post (N, per cent)			
Yes	2157, 90.4%	194, 54.0%	$\chi^2(2)=334.3$, $p<0.001$
No	195, 8.2%	138, 38.4%	
Not sure	33, 1.4%	26, 7.2%	
Perceived ease of doing a FIT			
Not easy	146, 6.1%	68, 18.9%	$\chi^2(1)=122.2$, $p<0.001$
Easy	2110, 88.4%	184, 51.3%	
Intention to do a FIT			
Yes, probably	110, 4.6%	118, 32.9%	$\chi^2(1)=327.4$, $p<0.001$
Yes, <i>definitely</i>	2277, 95.4%	241, 67.1%	

*Significantly different groups are italicised.
FIT, Faecal Immunochemical Test; SES, socioeconomic status.

$\chi^2(4)=461.65$, $p<0.0001$. Therefore, subsequent analyses used area-based SES only.

Past FIT experience and colorectal screening intentions

Participants who completed a FIT (90.4%) were twice as likely to recall having received a FIT in the post as participants who did not complete a FIT (54.0%; [table 1](#)).

All participants reported intentions to do a FIT in the future as this was an eligibility criterion. Participants who completed a FIT (95.4%) were significantly more likely than those who did not (67.1%) to report they would definitely do a FIT in the future. Participants who completed a FIT were also significantly more likely to report that the FIT was easy to complete (88.4%) compared with participants who did not complete a FIT (51.3%)

Most common barriers and solutions

[Table 2](#) shows the proportion of participant who completed a FIT and participant who did not complete a FIT who endorsed each barrier. The barrier items are grouped into seven types, based on their face-value meaning, and ranked from most to least frequently endorsed by participants who did not complete a FIT. Participants most frequently endorsed practical, emotional, and self-efficacy barriers, regardless of screening history. Across barrier types, participant who had and had not completed a FIT agreed on the six most important barriers.

[Table 3](#) shows the proportion of participants who had and had not completed a FIT who endorsed each solution, ranked from most to least frequently endorsed by those who had not completed a FIT. Similar to barrier items, there were seven types of solutions, according to their face-value meaning. Solutions that improved self-image and increased the perceived efficacy of the FIT were on average most often endorsed by participants, regardless of screening history. Eight solutions were each endorsed by more than 80% of participants who had not completed a FIT. Seven of these were each also endorsed by over 90% of participants who had completed a FIT,

suggesting general agreement on the most helpful solutions to FIT barriers.

Demographic and behavioural differences in endorsed barriers and solutions

Participants who had not completed a FIT endorsed significantly more barriers (Mdn.=2) compared with participants who had (Mdn.=0, $U=410\,791.50$, $z=14.59$, $p<0.01$, $r=0.30$). This difference remained significant in ANCOVA controlling for age, sex, marital status, family history of cancer, intention to do a FIT, and perceived ease of doing a FIT ($F(1, 2053)=13.40$, $p<0.001$, partial $\eta^2=0.01$), as shown in [table 4](#). The following groups endorsed significantly more barriers in the multivariable analysis: younger participants, women, those who were single, who were unsure whether their friends or family had had cancer, with weaker intention to do a FIT, and those who thought the FIT was not easy to complete endorsed significantly more barriers (see online supplemental table S2).

Participants who had not completed a FIT endorsed significantly fewer solutions (Mdn.=18) compared with those who had (Mdn.=19), $U=301\,585.50$, $z=-3.21$, $p<0.001$, $r=0.06$). This difference was not significant in ANCOVA with demographic and behavioural characteristics ($F(1, 2143)=0.40$, $p=0.53$; $\eta^2=0.00$; see [table 4](#)). The number of solutions endorsed, however, was related to several covariates: more deprived participants, with stronger intention to complete a FIT, who thought the FIT was easy to complete, and women endorsed more solutions (see online supplemental table S2).

DISCUSSION

The results suggest that participants who had not completed a FIT perceived significantly more barriers than participants who had. Participants who had not completed a FIT also found significantly fewer solutions helpful than those who had. This difference in solutions,

Table 2 Frequency of barriers endorsed

It's hard for me to do the bowel screening test because...	Completed a FIT	Did not complete a FIT
Practical barriers	4.0%*	20.9%
... <i>I never get round to doing it.</i> †	6.2%	36.9%
... <i>I keep forgetting.</i>	6.2%	32.3%
... I don't have time.	1.8%	7.4%
... I don't have all the things I need to do it.	1.7%	6.9%
Emotional barriers	3.9%	11.9%
... <i>I'm worried about the results.</i>	6.3%	19.6%
... <i>I get anxious when I think about screening.</i>	7.3%	17.9%
... <i>I think it is messy.</i>	6.0%	16.6%
... I'm worried I might touch my poo.	3.2%	10.7%
... I find this test too embarrassing to do.	2.1%	10.1%
... I think doing it is disgusting.	4.3%	9.8%
... I didn't know I was going to be asked to do this test.	1.9%	9.3%
... I'm embarrassed to put the bowel screening kit by the toilet to remind me to do it.	2.0%	6.6%
... I don't like others telling me what to do.	1.7%	6.3%
... I'm embarrassed that somebody might see this test in my house.	1.2%	4.5%
Low self-efficacy	2.9%	11.5%
... <i>I'm not used to doing a test like this.</i>	6.6%	23.8%
... I'm unsure how to do it.	2.3%	12.8%
... I'm unsure how to take a sample of my poo.	2.8%	11.5%
... I think a bowel screening test should be done by a doctor or nurse.	1.3%	5.3%
... I find the new test difficult to use.	1.3%	4.2%
Comorbidities	3.9%	8.7%
... I have a physical disability or health condition.	4.3%	10.8%
... I'm often constipated.	3.9%	8.9%
... I often have diarrhoea.	3.5%	6.3%
Fatalism	1.8%	6.5%
... I don't want to tempt fate.	1.9%	9.0%
... I feel that no matter what I do, if I'm meant to get cancer, I will get cancer.	2.6%	8.7%
... I don't want to know if I have bowel cancer.	1.7%	5.7%
... I don't think it matters if I do it or not.	0.9%	2.4%
Low perceived screening test efficacy	1.1%	4.7%
... I get asked to do too many medical tests.	1.2%	5.7%
... I don't think it is necessary.	0.9%	3.6%
Lack of social support	1.0%	3.1%
... I don't think I can talk to anybody about how to do it.	1.8%	6.9%
... people close to me don't care if I do it or not.	0.8%	3.0%
... I think the NHS doesn't really care if I do it or not.	0.7%	2.1%
... people close to me don't want me to do it.	0.7%	1.8%
... someone important to me decided they will not do it.	0.9%	1.5%

*For groups of barriers average percentage of endorsement is presented to account for the varying number of barriers in each group.

†Italicised items denote the six most frequently endorsed barriers.

Table 3 Frequency of endorsed solutions

It would be helpful for me to...	Completed a FIT	Did not complete a FIT
Identity	91.8%*	84.9%
<i>... tell myself that I'm responsible for my health.†</i>	97.4%	94.7%
<i>... remember that I am the kind of person who looks after their health in this way.</i>	93.0%	82.0%
... make myself do this test anyway because I know I'll feel better about myself afterwards.	85.1%	78.0%
High perceived screening test efficacy	90.9%	83.7%
<i>... remember that this test can find bowel cancer early when it can often be cured.</i>	98.0%	94.7%
... tell myself that I'll feel more confident in my health if I do this test.	87.9%	79.9%
... tell myself that doing this test could make me a healthier person.	86.7%	76.4%
Self-encouragement	76.3%	75.8%
<i>... tell myself that this test will be quick and easy to do.</i>	92.7%	88.7%
... tell myself that if I try hard enough, I can do this test.	59.9%	62.9%
Practical solutions	76.8%	75.8%
<i>... wash my hands after doing this test.</i>	98.5%	95.6%
<i>... do the test when I won't be interrupted.</i>	93.2%	89.9%
<i>... read the instructions carefully.</i>	95.9%	89.6%
... put everything I need to do this test in the bathroom.	86.2%	82.6%
... think about how I would do this test.	82.5%	77.3%
... put the bowel screening kit somewhere I would see it on my way to the bathroom.	70.6%	71.0%
... use toilet paper to make sure I don't need to touch my poo.	78.5%	68.8%
... put a reminder in my diary/ calendar/ elsewhere.	59.3%	65.9%
... pick a day and a time when I can do this test.	58.1%	57.9%
... use rubber gloves to do this test.	45.2%	52.4%
Increase perceived social support	78.0%	69.8%
... think about how my not doing this test affects those people who are close to me.	84.3%	75.1%
... think about how I'll be a better role model for others if I do this test.	76.4%	69.9%
... think about people around me encouraging me to do this test.	73.3%	64.3%
Manage emotions	46.0%	34.8%
... joke about doing this test.	46.0%	34.8%
Seek advice	25.4%	22.9%
... speak to someone close to me about how to do this test.	38.7%	33.1%
... speak to my GP about doing this test.	16.4%	18.3%
... call the bowel screening helpline.	21.1%	17.4%

*For groups of solutions average percentage of endorsement is presented to account for the varying number of barriers in each group.
 †Italicised items denote the seven most frequently endorsed solutions.

Table 4 Analysis of covariance of number of endorsed barriers and solutions

	Number of endorsed barriers*		Number of endorsed solutions†	
	Mean (95% CI)	P value	Mean (95% CI)	P value
Screening history				
Completed a FIT	33.9 (33.75, 33.98)	F(1, 2053)=13.4, p<0.001	43.2 (42.97, 43.35)	F(1, 2143)=0.4, p=0.53,
Did not complete a FIT	34.6 (34.25, 35.04)	partial $\eta^2=0.01$	42.9 (42.32, 43.57)	partial $\eta^2=0.0$

*Means are adjusted for significant covariates: age, sex, marital status, family history of cancer, intention to do a FIT, and perceived ease of doing the FIT.

†Means are adjusted for significant covariates: area-based SES, sex, intention to do a FIT, and perceived ease of doing the FIT.

however, was not significant when demographic, health and behavioural characteristics were held constant.

The I-SAM identifies six categories of influences that hinder or facilitate cancer screening across individual and environmental contexts: automatic motivation, reflective motivation, psychological capability, physical capability, social opportunity and physical opportunity.¹⁷ Our findings show that people who intended to do colorectal screening experienced similar types of barriers regardless of their screening history, and they also agreed on the most important specific barriers. These included practical barriers (capability): not 'getting around' to completing a FIT and forgetting to do a FIT; emotional barriers (automatic motivation): feeling worried about the result of the FIT, anxiety in response to thinking about screening, and disgust; and also low self-efficacy (psychological capability) in not being used to doing a test like the FIT.

Similarly, participants, regardless of screening history, agreed that solutions related to identity (social opportunity) and increased perceived efficacy of the FIT (reflective motivation) were most helpful. Seven solutions were considered helpful by almost all participants regardless of screening history. These related to handwashing, finding bowel cancer early, feeling responsible for one's health, seeking privacy when doing a FIT, reading the FIT instructions, emphasising how easy the FIT is to do, and seeing oneself as a person who looks after one's health. Although the I-SAM categories of the most endorsed barriers appear to differ from those of endorsed solutions, [figure 1](#) demonstrates that these solutions can address the most commonly experienced barriers. The figure shows that four of the six included barriers can be addressed by more than one solution; and that five of the seven included solutions may address more than one barrier. This is crucial to the development of a planning support tool for colorectal screening using the FIT, as multiple possible combinations will allow users of the tool to create their own plans which are acceptable to them.¹⁶ Recent research indicates that suggesting specific action plans to those invited to complete a FIT was less acceptable to

screening eligible participants than other interventions.²⁵ Supporting people with planning rather than providing plans directly may be more engaging.

Akin to existing evidence, younger and single participants and those with low self-efficacy experienced more screening barriers.^{8 26} Previous research shows that people with family or friends with cancer are more likely to complete screening.^{27 28} Our findings suggest that they may experience fewer barriers to screening than people who are unsure whether their family or friends have had cancer. Women reported more barriers, which is not reflected in the UK literature,^{26 29} but matches lower uptake rates among women of FOBt and colonoscopy.³⁰ Yet, women endorsed significantly more solutions than men. Together with higher FIT uptake, these findings suggest that women may more successfully overcome FIT barriers. While reported intention to complete colorectal screening is frequently not translated into screening uptake,⁹ it is unsurprising that people with stronger intentions reported fewer barriers and found more solutions helpful. Similarly, people who perceive the FIT as easy to complete may think this way because they have more solutions to overcoming FIT barriers. The greater number of solutions endorsed among people living in deprived areas is contrary to consistently lower colorectal screening uptake in this group.^{26 30} This finding may suggest that people living in deprived areas who complete the FIT engage in more problem-solving than people living in affluent areas. Consequently, people living in deprived areas who do not complete the FIT may need more support with this same problem-solving.

Strengths and limitations

Collaborating with the Scottish Bowel Screening Centre on participant recruitment allowed us to recruit a sample evenly matched in sex and SES across people who had and had not completed a FIT. Participants who had not completed a FIT in our study were significantly more ethnically diverse and older than those who had. This difference is contrary to international evidence that screening uptake is lower among younger people, yet the difference in age appeared to be insufficiently large to mask the established association of younger age and greater perceived barriers.^{8 26} Ethnicity was not associated with the number of barriers or solutions endorsed by either group, but future research should confirm this lack of association in a more ethnically diverse sample. Despite our efforts to recruit similar numbers of participants who had and had not completed a FIT, our sample contains a much larger proportion of those who had completed a FIT. This is partly due to the erroneous invitation of additional participants who had completed a FIT, but also to the much larger difference in response rates among them (53%) and those who had not completed a FIT (7%) than anticipated. G*Power³¹ calculations, however, found the total sample size to be large enough for sufficient statistical power of our analyses.

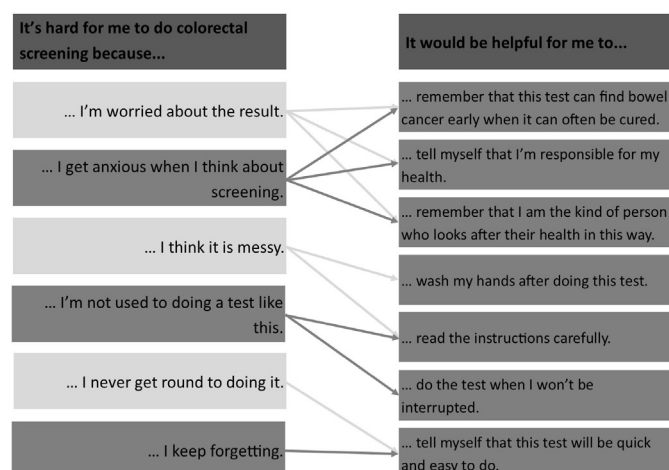


Figure 1 Common barriers and solutions matched.

The large number of barriers (33 items) and solutions (25 items) in the questionnaire, may have produced order effects and fatigue in participants. Although PPI feedback did not critique the length of the questionnaire, fatigue may explain the larger number of missing data in these sections.

Implications

Among people who are willing to participate in colorectal screening using the FIT, those who complete a FIT and those who do not, appear to experience the same screening barriers, providing an opportunity to learn from people who complete a FIT about how to overcome these barriers. Our findings suggest that those who complete a FIT and those who do not, agree on the most helpful solutions to overcoming these barriers. Nevertheless, people who do not complete a FIT, despite being willing to do so, may benefit from additional support in enacting the solutions identified in our survey. Planning interventions may provide this support. The present study has informed the development of a brief planning support tool which we will evaluate in a large-scale trial within the Scottish Bowel Screening Programme.³²

CONCLUSIONS

This study has identified six barriers and seven solutions as key content for a planning support tool for colorectal screening using the FIT. While there is strong evidence for screening barriers and facilitators, little previous research has linked barriers to facilitators, or solutions, that can overcome them. Our findings provide the basis for the development of a planning support tool for colorectal screening which we will evaluate in the next phase of our research.

Acknowledgements We wish to thank Mary Cameron and Lucy Robertson for their support of our work as patient and public representatives contributing to the development of the research and reviewing all participant-facing materials.

Contributors All authors were involved in the conception of the study and development of the study protocol. AI facilitated participant recruitment. MK carried out the data collection and analysis under supervision of KR. The findings were discussed with all of the author team. MK drafted the manuscript and all authors contributed revisions. KR is guarantor.

Funding This work was supported by the Scottish Government, Chief Scientist Office grant number HIPS/17/23.

Competing interests None declared.

Patient and public involvement Patients and/or the public were involved in the design, or conduct, or reporting, or dissemination plans of this research. Refer to the Methods section for further details.

Patient consent for publication Not applicable.

Ethics approval This study received ethical approval from the NHS Research Ethics Committee York and Humber – South Yorkshire, reference 17/YH/0439. Return of a completed questionnaire indicated consent to participate in the study.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request.

Supplemental material This content has been supplied by the author(s). It has not been vetted by BMJ Publishing Group Limited (BMJ) and may not have been peer-reviewed. Any opinions or recommendations discussed are solely those of the author(s) and are not endorsed by BMJ. BMJ disclaims all liability and

responsibility arising from any reliance placed on the content. Where the content includes any translated material, BMJ does not warrant the accuracy and reliability of the translations (including but not limited to local regulations, clinical guidelines, terminology, drug names and drug dosages), and is not responsible for any error and/or omissions arising from translation and adaptation or otherwise.

Open access This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>.

ORCID iDs

Marie Kotzur <http://orcid.org/0000-0001-6921-5075>

Kathryn A Robb <http://orcid.org/0000-0002-1672-0411>

REFERENCES

- 1 Sung H, Ferlay J, Siegel RL, *et al*. GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. *CA Cancer J Clin* 2020;2021:209–49.
- 2 World Health Organisation. Cancer [Internet], 2021. Available: <https://www.who.int/news-room/fact-sheets/detail/cancer> [Accessed cited 2022 Feb 15].
- 3 Cancer Research UK. Bowel cancer mortality by sex and UK country [Internet], 2021. Available: <https://www.cancerresearchuk.org/health-professional/cancer-statistics/statistics-by-cancer-type/bowel-cancer/mortality#heading-Zero> [Accessed cited 2022 Feb 15].
- 4 Public Health Scotland. Cancer statistics: Colorectal cancer [Internet]., 2020. Available: <https://www.isdscotland.org/Health-Topics/Cancer/Cancer-Statistics/Colorectal/#summary> [Accessed cited 2022 Feb 15].
- 5 Cancer Research UK, Incisive Health. Saving lives, averting costs: An analysis of the financial implications of achieving earlier diagnosis of colorectal, lung and ovarian cancer [Internet].; 2014. <https://incisivehealth.com/publications/> [Accessed cited 2022 Feb 15].
- 6 Chambers JA, Callander AS, Grangeret R, *et al*. Attitudes towards the faecal occult blood test (FOBT) versus the faecal immunochemical test (fit) for colorectal cancer screening: perceived ease of completion and disgust. *BMC Cancer* 2016;16:96–102.
- 7 Public Health Scotland. Scottish Bowel Screening Programme Statistics: For the period of invitations from May 2018 to March 2020 [Internet], 2021. Available: <https://publichealthscotland.scot/media/3452/2021-02-02-bowel-screening-publication-summary.pdf> [Accessed cited 2022 Feb 15].
- 8 Lo SH, Waller J, Wardle J, *et al*. Comparing barriers to colorectal cancer screening with barriers to breast and cervical screening: a population-based survey of screening-age women in Great Britain. *J Med Screen* 2013;20:73–9.
- 9 Orbell S, Sheeran P. 'Inclined abstainers': A problem for predicting health-related behaviour. *Br J Soc Psychol* 1998;37:151–65.
- 10 Goodwin BC, Myers L, Ireland MJ, *et al*. Barriers to home bowel cancer screening. *Psychooncology* 2021;30:1756–64.
- 11 Myers L, Goodwin BC, Ireland M, *et al*. Mail-out bowel cancer screening: identifying the behavioural stumbling blocks. *Psychooncology* 2022;31:816–23.
- 12 Kwasnicka D, Plesseau J, White M, *et al*. Does planning how to cope with anticipated barriers facilitate health-related behaviour change? A systematic review. *Health Psychol Rev* 2013;7:129–45.
- 13 Dombrowski SU, Sniehotta FF, Avenell A, *et al*. Identifying active ingredients in complex behavioural interventions for obese adults with obesity-related co-morbidities or additional risk factors for co-morbidities: a systematic review. *Health Psychol Rev* 2012;6:7–32.
- 14 O'Connor RC, Ferguson E, Scott F, *et al*. A randomised controlled trial of a brief psychological intervention to reduce repetition of self-harm in patients admitted to hospital following a suicide attempt. *Lancet Psychiatry* 2017;4:451–60.
- 15 Gollwitzer PM, Sheeran P. Implementation intentions and goal achievement: A meta-analysis of effects and processes. In: *Advances in experimental social psychology*. San Diego: Elsevier Academic Press Inc., 2006: Vol. 38. 69–119.
- 16 Armitage CJ, Norman P, Noor M, *et al*. Evidence that a very brief psychological intervention boosts weight loss in a weight loss program. *Behav Ther* 2014;45:700–7.
- 17 Robb KA. The integrated screening action model (I-SAM): a theory-based approach to inform intervention development. *Prev Med Rep* 2021;23:101427.



- 18 Scottish Government. Scottish index of multiple deprivation, 2020. Available: <https://www.gov.scot/collections/scottish-index-of-multiple-deprivation-2020/> [Accessed cited 2022 Feb 15].
- 19 Wardle J, Sutton S, Williamson S, *et al.* Psychosocial influences on older adults' interest in participating in bowel cancer screening. *Prev Med* 2000;31:323–34.
- 20 Miles A, Voorwinden S, Chapman S, *et al.* Psychologic predictors of cancer information avoidance among older adults: the role of cancer fear and fatalism. *Cancer Epidemiol Biomarkers Prev* 2008;17:1872–9.
- 21 McCaffery K, Wardle J, Waller J. Knowledge, attitudes, and behavioral intentions in relation to the early detection of colorectal cancer in the United Kingdom. *Prev Med* 2003;36:525–35.
- 22 Kotzur M, Macdonald S, O'Carroll R, *et al.* How do people overcome barriers to colorectal cancer screening? A qualitative study. *In preparation*.
- 23 Wardle J, McCaffery K, Nadel M, *et al.* Socioeconomic differences in cancer screening participation: comparing cognitive and psychosocial explanations. *Soc Sci Med* 2004;59:249–61.
- 24 Robb KA, Simon AE, Wardle J. Socioeconomic disparities in optimism and pessimism. *Int J Behav Med* 2009;16:331–8.
- 25 Myers L, Goodwin B, Ralph N, *et al.* A health action process approach for developing invitee endorsed interventions to increase mail-out bowel cancer screening. *Appl Psychol Health Well-Being* 2022;1–19.
- 26 Young B, Robb KA. Understanding patient factors to increase uptake of cancer screening: a review. *Future Oncol* 2021;17:3757–75.
- 27 Palmer RC, Emmons KM, Fletcher RH, *et al.* Familial risk and colorectal cancer screening health beliefs and attitudes in an insured population. *Prev Med* 2007;45:336–41.
- 28 Gordon NP, Green BB. Factors associated with use and non-use of the fecal immunochemical test (fit) kit for colorectal cancer screening in response to a 2012 outreach screening program: a survey study. *BMC Public Health* 2015;15:546.
- 29 Digby J, McDonald PJ, Strachan JA, *et al.* Use of a faecal immunochemical test narrows current gaps in uptake for sex, age and deprivation in a bowel cancer screening programme. *J Med Screen* 2013;20:80–5.
- 30 Wools A, Dapper EA, de Leeuw JRJ. Colorectal cancer screening participation: a systematic review. *Eur J Public Health* 2016;26:158–68.
- 31 Faul F, Erdfelder E, Buchner A, *et al.* Statistical power analyses using G*Power 3.1: tests for correlation and regression analyses. *Behav Res Methods* 2009;41:1149–60.
- 32 Young B, Kotzur M, Robb KA. Testing ways to increase participation in bowel cancer screening (TEMPO study) [Internet], 2020. Available: https://www.gla.ac.uk/media/Media_762753_smxx.pdf [Accessed cited 2022 Feb 15].