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Factors influencing participation in colorectal cancer screening programs in Spain



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FACTORS INFLUENCING PARTICIPATION IN COLORECTAL CANCER SCREENING PROGRAMS IN SPAIN

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Abstract

To analyze the sociodemographic and organizational factors influencing participation in population-based colorectal cancer screening programs (CRCSP) in Spain, a retrospective study was conducted in a cohort of people invited to participate in the first 3 screening rounds of 6 CRCSP from 2000-2012. Mixed logistic regression models were used to analyze the relationship between sociodemographic and organizational factors, such as the type of fecal occult blood test (FOBT) used and the FOBT delivery type. The analysis was performed separately in groups (Initial Screening-first invitation, Subsequent invitation for previous never-responders, Subsequent invitation-regular, Subsequent invitation-irregular intervals). The results showed that, in the Initial screening-first invitation group, participation was higher in women than in men in all age groups (OR 1.05 in persons aged 50-59 years and OR 1.12 in those aged 60-69 years). Participation was also higher when no action was required to receive the FOBT kit, independently of the type of screening (Initial screening-first invitation [OR 2.24], Subsequent invitation for previous never-responders [OR 2.14], Subsequent invitation-regular [OR 2.03], Subsequent invitation-irregular intervals [OR 9.38]) and when quantitative rather than qualitative immunological FOBT (FIT) was offered (Initial screening-first invitation [OR 0.70], Subsequent invitation for previous never-responders [OR 0.12], Subsequent invitation-regular [OR 0.20]) or guaiac testing (Initial screening-first invitation [OR 0.81], Subsequent invitation for previous never-responders [OR 0.88], Subsequent invitation-regular [OR 0.73]). In conclusion, the results of this study show that screening participation could be enhanced by inclusion of the FOBT kit with the screening invitation and the use of the quantitative FIT.

Introduction

Colorectal cancer (CRC) is one of the most common malignancies in developed countries and the incidence of CRC in Spain is higher than that of any other cancer when both men and women are considered together. CRC is the third most common cancer in men after prostate and lung cancer, and is the second most common in women after breast cancer (Ferlay et al., 2015).

Studies performed since the 1990s have shown that the fecal occult blood test (FOBT) and flexible sigmoidoscopy contribute to the early detection of CRC and therefore to reducing associated mortality (Heresbach et al., 2006; Mandel et al., 1993; Saito et al., 1995; Atkin et al., 2010; Segnan et al., 2002; Kronborg et al., 1996; Hardcastle et al., 1996). Currently, the World Health Organization and the European Union (Wilson et al., 1968) recommend CRC screening programs (CRCSP). The expected long-term benefit of these programs is a reduction in overall and CRC-specific mortality and a decrease in the incidence of this tumor (Pan et al., 2016).

The European Commission has drawn up guidelines for quality assurance in CRC screening and diagnosis (Segnan et al., 2010). This document establishes the recommendations, criteria and standards that should be achieved by organized population-based screening programs. Because assessment of the impact of these programs requires a long time lapse since their initiation, monitoring of participation and detection rates is essential to allow prediction of their impact. If CRCSP maintain high participation rates and adhere to standards for detection, mortality can be expected to be reduced after 10 years of screening (McClements et al., 2012; Zorzi et al., 2014).

CRCSP are recent in Europe and in Spain have been implemented in the last few years. Consequently little research has been conducted on the possible influence of sociodemographic and organizational factors on participation and detection rates.

Some studies have shown that participation is higher in women than in men (Klabunde et al., 2015; Portillo et al., 2013; Molina-Barceló et al., 2016, Clarke et al., 2015), especially in those aged 50-59 years (Salas et al., 2014).

Participation has also been related to area of residence and socioeconomic status. A study performed in The Netherlands showed that high participation was related to living in a rural area and having high socioeconomic status (Hol et al., 2010), another study from United States concluded that the likelihood of adherence to CRCSP was lower in residents of rural areas (James et al., 2006). On the other hand several studies analyzed participation related to

socioeconomic status with different results (Molina-Barceló et al., 2014; Hurtado et al., 2015; Burón et al., 2015).

Various studies have shown that individual screening history is associated with participation in subsequent rounds, with persons attending previous rounds being more likely to attend subsequent screening (Lo et al., 2014). In addition, repeat invitations to persons not accepting previous invitations can increase uptake (Steele et al., 2010).

Participation is also influenced by the organizational features of CRCSP. Thus, uptake increased by 10% when the screening invitation was accompanied by a general practitioner's endorsement and a leaflet explaining in detail how to complete the FOBT (Hewitson et al., 2011). Another strategy to enhance participation is sending an advance notification letter (Senore et al., 2015).

An analysis of the information available on effective interventions to increase participation in CRCSP concluded that educational interventions and organizational measures are required to enhance the impact of CRCSP (Senore et al., 2015). Another European study compared distinct forms of FOBT delivery and found that participants receiving the FOBT kit with the invitation had a significantly higher likelihood of participating than persons who received a letter of invitation asking them to collect the FOBT kit in the health center (Van Roosbroeck et al.; 2012).

In Spain, the population eligible for CRCSP consists of asymptomatic men and women, with no prior history of CRC, aged between 50 to 69 years, the age group at highest risk. The target population is invited to complete an FOBT every 2 years and persons with a positive result are offered diagnostic confirmation through colonoscopy (Salas Trejo et al., 2016). There are 17 Spanish regions with autonomy in the organization of certain health services. Each region has developed and implemented a CRCSP since 2000, which has been progressively expanded. In 2012, coverage was 17%. Although the methodological foundations (ie, target population, screening intervals) are common to all programs, there are some organizational differences between regions, such as the type of invitation (affecting FOBT delivery) and the type of FOBT offered.

The first autonomous communities implementing CRCSP in Spain participated in the CRIBEA research project, whose aim is to evaluate the impact of CRCSP in Spain.

Given the scarcity of studies on this topic, the aim of this study was to estimate uptake of CRCSP in Spain and to identify and quantify the influence of certain organizational and

sociodemographic factors, such as age, sex, municipality of residence, FOBT delivery type, type of FOBT and screening history on participation rates.

Methods

The CRIBEA Project

The CRIBEA Project is a retrospective study of a cohort of men and women aged 50 to 69 years taking part in the 6 CRCSP in Spain that participate in the project: Catalonia, the Valencian Community, Murcia, Cantabria, the Canary Islands, and the Basque Country. The project aims to identify the factors that could influence the balance between predictors of benefits and harms in CRCSP. The study was approved by the Clinical Research Ethics Committee of the General Directorate of Public Health and the Public Health Research Center of the Valencian Community.

Information was gathered on invitations sent since the start of each CRCSP until December 31, 2012. All CRCSP are based on biennial FOBT (rounds), i.e., the target population are invited to undergo FOBT every 2 years and, in 2012, at least 2 rounds had been completed. All programs are population-based, ie, individual letters of invitation are sent to the entire target population a reminder is sent to non-participants. All the CRCSP use FOBT (Salas Trejo et al., 2017) and inform participants of negative and positive results and schedule a colonoscopy in persons with a positive result. The organizational features of the CRCSP included in the study are shown in Table 2.

Population

To conduct the CRIBEA project, a database common to the CRCSP was constructed (Table 3), linking all the information on each of the invitations issued during the study period. The database contained information on 1,995,719 invitations sent to 1,320,300 persons. Persons whose invitations were sent to the wrong address and those with a prior colonoscopy were excluded. The population is a dynamic cohort, with members leaving and being added over time, depending on their age.

The participation study analyzed the invitations of the first 3 screening rounds. The sample consisted of 1,748,753 invitations. Individuals without information on the first screening

invitation were excluded. Among the data analyzed, each person is linked to one of the 6 CRCSP. Because a single person can have 1 to 3 invitations, the data have a repeated measures structure.

In this study, we analyzed the sample by stratifying it in four groups by type of screening (Segnan et al., 2010): (Table 1)

Initial Screening-first invitation: persons receiving a first invitation to CRCSP, independently of the organizational round of the program.

Subsequent invitation for previous never-responders: persons invited to previous rounds but who had not participated.

Subsequent invitation-regular intervals (adherence): previously-invited persons who had participated in the previous round.

Subsequent invitation-irregular intervals: invited persons who had not participated in the immediately previous round but who had participated in at least one prior round.

Response variable:

Participation: persons invited for screening who returned the FOBT, independently of the result (positive, negative, weak positive, technical error, and unknown).

Explanatory variables:

Age and sex groups: women aged 50-59 years and 60-69 years, men aged 50-59 years and 60-69 years. Age at the time of invitation was analyzed.

Area of residence: municipalities with less than 5,000 inhabitants were defined as rural, those with between 5,000 and 10,999 inhabitants as semi-rural, and those with more than 10,000 inhabitants as urban.

FOBT delivery type: This variable concerned how each participant obtained the FOBT kit. There were three modalities.

Active collection: a letter of invitation is sent and the FOBT is collected from a retail pharmacy or patient's health center;

Minimal action: a letter of invitation is sent and the person confirms his or her wish to participate by postcard, telephone call, etc.; the person is then sent an FOBT kit.

No action: the FOBT is sent directly with the letter of invitation.

Type of FOBT: Guaiac (gFOBT), quantitative immunological (quantitative FIT), or qualitative immunological (qualitative FIT).

Statistical analysis:

To include the experience of each patient in the CRCSP, participation was analyzed by stratifying the sample by screening type. Initial participation was studied by analyzing participation in the first invitation and in Subsequent invitation for previous never-responders. Subsequent screening participation was analyzed through study of participation in Subsequent invitation-regular intervals and Subsequent invitation-irregular intervals.

Because individuals could receive more than one invitation, each data group had a repeated measures structure, except the groups of Initial screening-first invitation and Subsequent invitation-irregular intervals (round 3 only), in which each individual had only one invitation.

A descriptive analysis was conducted of the data collected in the CRIBEA study and the data from the three rounds analyzed in this study. For each round and each stratum, the number of invitations and the percentage of participation were analyzed.

A descriptive analysis was performed of participation according to sociodemographic and organizational variables. The percentage of participation was calculated in each group, taking the number of participations as the numerator and the number of invitations sent as the denominator. The percentage of participation in Initial Screening was calculated globally, taking the number of invitations in Initial screening-first invitation as the denominator and the sum of participations, both in Initial screening-first invitation and in Subsequent invitation for previous responders, as the numerator. The chi-square test was used to study the relationship between explanatory variables and the response variable, with calculation of the corresponding p-value and 95% confidence intervals. Statistical significance was set at $p < 0.05$.

To explain participation in terms of organizational and sociodemographic factors of the CRCSP, a mixed logistic regression model was adjusted in each stratum, considering random effects of the individual when the data analyzed showed a repeated measures structure. The response

variable was participation and the explanatory variables were age and sex groups, area of residence, FOBT delivery type, and type of FOBT. The analysis was performed with the R statistical package, using the glmer function of the lme4 library.

Results

A total of 1,748,753 invitations were analyzed. Among these, there were 852,497 FOBT, and 17,506 persons were diagnosed with high- or intermediate-risk adenomas and 2,641 with CRC (Table 3).

Participation was 52.9% in Initial screening overall, 48.8% in Initial screening-first invitation, 17.7% in Subsequent invitation for previous never-responders, 85% in Subsequent invitation-regular intervals and 37.8% in Subsequent invitation-irregular intervals (Table 4).

Participation was higher in women aged 60-69 years in Initial screening-first invitation and in women aged 50-59 years in Subsequent invitation for previous never-responders. In Subsequent invitation-regular intervals, participation was higher in men and women aged 60-69 years than in other age groups (Table 4).

Uptake was higher when no action was required by the invited person to receive the FOBT. This association was maintained for all screening types, with participation being higher both in Initial Screening (no action 68.6%, minimal action 45.3%, active collection 47.4%) and in Subsequent invitation-regular intervals (no action 89.1%, active collection 77.4%) and most markedly in Subsequent invitation-irregular intervals (no action 57.9%, active collection 12.7%) (Table 4).

Participation was higher when the FIT type was quantitative compared with qualitative and gFOBT in Initial Screening but not in successive screening-regular intervals, in which participation rates were similar between quantitative FIT and gFOBT.

Uptake was higher with quantitative FIT than with qualitative FIT and gFOBT in Initial Screening but not in subsequent screening-regular intervals, in which participation rates were similar between quantitative FIT and gFOBT. According to the chi-square test all explanatory variables were statistically significantly.

Initial participation

In the Initial screening-first invitation model, participation was higher in women aged 50-59 years (OR 1.05; 95% CI 1.05 to 1.06) and in those aged 60-69 years (OR 1.12; 95% CI 1.11 to 1.14) than in men aged 60-69 years. Uptake was higher in rural and semi-rural populations than in urban populations and was higher when no action was required to receive the FOBT (OR 2.24; 95% CI 2.21 to 2.26) and lower when minimal action was required (OR 0.74 95% CI 0.73 to 0.75) than when active collection was required. Participation was also statistically significantly higher with the quantitative FIT (Table 5).

In the model for Subsequent invitation for previous never-responders, participation was higher in women aged 50-59 years (OR 1.09; 95% CI 1.06 to 1.16) and 60-69 years (OR 1.08; 95% CI 1.05 to 1.11) than in men aged 60-69 years. Participation was also higher in rural populations, and when minimal action (OR 1.57; 95% CI 1.53 to 1.62) or no action (OR 2.14; 95% CI 2.08 to 2.21) was required than when active collection was required to receive the FOBT. Participation was statistically significantly higher when the quantitative FIT was used (Table 5).

Subsequent participation

Participation in Subsequent invitation-regular intervals or adherence to screening was statistically significantly higher in men and women aged 60-69 years than in younger men and women and in rural and semi-rural areas, participation was higher when no action was required to receive the FOBT kit (OR 2.03; 95% CI 1.96 to 2.11) than when active collection was required. Adherence was statistically significantly greater when the quantitative FIT was used (Table 6).

In the Subsequent invitation-irregular intervals model, participation did not statistically significantly by age and sex but was statistically significantly higher in rural areas. Uptake was higher when no action was required to receive the FOBT kit (OR 9.38; 95% CI 8.06 to 10.91) (Table 6).

Discussion

Together with other indicators, participation is an indicator that measures the impact of CRCSP. Consequently, guidelines establish acceptable standards that guarantee the quality of these programs (Segnan et al., 2010). In Spain, the CRCSP have shown that indicators of the detection rate are within the ranges recommended by guidelines (Portillo et al., 2017). If these indicators are adequate, improving participation will enhance the impact of the programs. Our study shows the influence on participation of organizational factors such as the type of FOBT delivery and the type of FOBT (guaiac and qualitative or quantitative immunological) offered by CRCSP.

This study demonstrates that initial and successive participation in screening was increased by the inclusion of the FOBT kit in the letter of invitation. This factor was especially important in persons with the greatest difficulty in participating, such as those in the groups of Subsequent invitation for previous never-responders and Subsequent invitation-irregular intervals, with participation being up to 9.4 times higher in this latter group if the FOBT kit was mailed with the invitation. These results are in line with a study conducted in Belgium reporting that the probability of participation was twice as high in persons who received the FOBT kit together with a letter of invitation than in those receiving a letter of invitation with an indication to collect the kit from the general practitioner (Van Roosbroeck et al.; 2012).

The disadvantage of including the FOBT kit with the letter of invitation is that unused tests are wasted. Consequently, cost-effectiveness studies are needed that analyze participation rates in each program.

Uptake seems to be strongly influenced by the type of test employed, and rates are highest when the FIT is used, as shown by Chambers et al. (2016), although no differences have previously been demonstrated between quantitative and qualitative FIT. The results of the present study show higher participation rates with the quantitative FIT. The FIT is the easiest to use by the population and, in the context of the organization of screening programs, is also preferred because of its homogenous and automatic classification of the population.

For programs to be effective, the European guideline for CRC screening recommends target participation rates higher than 65% and considers an acceptable rate to be 45% (Segnan N et al., 2010). In our study, the participation rate in Initial Screening was 53%, which, according to the guideline, is acceptable but is lower than recommended rates (Segnan N et al., 2010). Strategies to increase participation rates in this group, as well as in the Subsequent invitation-

irregular intervals group, which had below the recommended percentage of participation, are direct delivery of the FOBT kit and the use of quantitative FIT. A study comparing CRCSP internationally concluded that comparisons between CRCSP should take into account organizational differences, target populations, and the interpretation of indicators (Klabunde et al., 2015).

Our study found higher initial participation and adherence to screening in rural or semi-rural areas. This finding concurs with a study conducted in The Netherlands (Hol et al., 2010), but there is no consensus in the literature on the influence of geographical region on participation in CRCSP in the United States, where one study demonstrated lower participation rates in rural areas, due to reduced access to health service coverage in these locations (Wools et al., 2016). In Spain, as in most European programs but unlike those in the US, FOBT is only offered in population-based screening programs. Moreover, in Spain, where health service coverage is similar in all geographical areas, this factor seems to be positive due to the possible closeness of health services. A Spanish study analyzed the influence of being informed of CRCSP and participation, as well as the role of primary care physicians on being informed (Molina-Barceló et al., 2016). The present study could not examine the influence of primary care physician recommendation on participation as this information was not available, but rural populations seem to have a more direct physician-patient relationship.

As observed in other studies, participation in CRCSP is influenced by age and sex, with participation in Initial screening-first invitation being higher in women (Portillo et al., 2013; Clarke et al., 2015; Molina-Barceló et al., 2014) and in persons aged 60-69 years than in persons aged 50-59 years (Salas et al., 2014). In contrast, adherence to screening among persons with previous participation showed differences by age but not by sex, with lower participation among young men and women, as reported in other studies (Ricardo-Rodrigues et al., 2015; Steele et al., 2010). The disappearance of differences by sex could be due to a selection effect, since participation in successive screening depends on previous participation. Efforts to increase participation in men should therefore focus on initial invitations.

This study has some limitations. First, the qualitative FIT was used in only one regional CRCSP, which also requires active collection of the FOBT kit, which could have influenced the results regarding this test. Second, the programs were implanted over a long period and, during the study period, not all programs had completed the first 3 rounds.

Among the strengths of this study are that it analyzes population-based data, drawn from routine clinical practice, with a large sample, consisting of 1,748,753 invitations in distinct

screening rounds (the first 3 rounds). A further strength is that this study analyzed the effects of distinct organizational types in a population that was similar in terms of age and sex.

The results of our study indicate that organizational strategies that enhance participation are the use of FIT rather than gFOBT and reducing the effort required to receive the FOBT. These results have important implications for CRCSP using the FOBT and could be applicable to other CRCSP. Moreover, our results identify certain factors such as age, sex, and geographical area of residence, for which specific invitation strategies could be designed to boost participation or increase levels to those found for other groups. Obviously, these strategies should be carried out within the framework of participation based on an informed decision on the benefits and harms of screening.

It is important to know each individual's screening history when sending an invitation as well as to monitor and analyze participation in CRCSP and search for strategies that could improve results to allow long-term evaluation of reductions in CRC-related mortality and the incidence of this tumor.

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Table 1. Number of invitations analyzed by round and screening type

	Initial Screening First invitation	Subsequent invitation previous NR	Subsequent invitation regular	Subsequent invitation irregular intervals
	N (% participation)	N (% participation)	N (% participation)	N (% participation)
1 st round	1 044 847 (50.3%)			
2 nd round	126 350 (42.1%)	182 834 (20.6%)	186 987 (85.2%)	
3 rd round	44 618 (33.7%)	101908 (12.53%)	56 093 (84.55%)	5 116 (37.8%)
Total	1 215 815 (48.8%)	284 742 (17.7%)	243 080 (85.0%)	5 116 (37.8%)

^aCRCSP from Catalonia, Valencian Community, Murcia, Cantabria, the Canary Islands, and the Basque Country

^bCRCSP from Catalonia, Valencian Community, Murcia and Cantabria

Table 2. Characteristics of the 6 Colorectal Cancer Screening Programs in the CRIBEA project, until 2012.

	Year program started	Age group (years)	FOBT	Interval (years)	Number of samples	FOBT delivery type		Nº of screening rounds hasta 2012
						Initial screening first invitation	Subsequent invitation	
Catalonia	2000	50-69	gFOBT (until 2009) FIT QT (since 2009)	2	1	Active collection Minimal action	Active collection Minimal action No action	6
Valencian Community	2005	50-69 ^a	gFOBT (until 2010) FIT QT (since 2010)	2	1	Minimal action	Minimal action No action	4
Murcia	2006	50-69	FIT QT	2	2	Active collection	Active collection	4
Cantabria	2008	50-69	FIT QL	2	2	Active collection	Active collection	3
Canary Islands	2009	50-69	FIT QT	2	1	Active collection	Active collection	2
Basque Country	2009	50-69	FIT QT	2	1	No action	No action	2

FOBT, Fecal Occult Blood Test; FIT, Fecal Immunochemical Test; QT, Quantitative; QL, Qualitative

^a The Valencian Community CRCSP started the program with a cohort of persons aged 50-74 years in the first screening round in some areas of its region.

Table 3. Sample size of the main indicators of the CRIBEA project and the present study.

	CRIBEA Project population	Study population
Number of invitations	1,995,719	1,748,753
Number of participations	931,919	852,497
Number of FOBT analyzed	54,918	51,687
Number of colonoscopies	48,730	45,786
People with low-risk adenomas	9,219	8,721
People with intermediate- or high-risk adenomas	18,415	17,506
People with colorectal cancer.	2,813	2,641

FOBT, Fecal Occult Blood Test;

Number of people with low-risk adenomas were defined as those with one or two adenomas and both less than 10mm containing neoplasia in low-grade mucosa and tubular component

Number of people with high or intermediate risk adenomas: Number of people with an adenoma at least equal to or greater than 10 mm or when there were 3 or more adenomas of any size or growth on the high-grade mucosa villous component (Carcinoma "in situ" was included in this category)

Number of people with adenocarcinoma, i.e. an invasion of neoplastic cells through the muscularis mucosae into the submucosa

Table 4. Percentages of participation by invited/screened individuals and sociodemographic and organizational variables of the PCCCR, percentage of participation (%) and denominator (N)

	Initial participation			Subsequent participation	
	Initial screening ^a	Initial screening-first invitation	Subsequent invitation for previous never-responders	Subsequent invitation-regular	Subsequent invitation-irregular intervals
	%	% (N)	% (N)	% (N)	% (N)
Total participation	52.9	48.8 (1215815)	17.7 (284742)	85.0 (243080)	37.8 (5116)
Age and sex groups					
Men 60-69 years	54.2	49.1 (242572)	17.2 (71540)	86.1 (59770)	42.9 (1507)
Men 50-59 years	48.0	44.6 (345730)	16.8 (70352)	83.1 (48773)	28.7 (942)
Women 60-69 years	56.8	51.7 (266999)	18.2 (74517)	85.9 (74268)	43.1 (1732)
Women 50-59 years	54.1	50.5 (360514) ^d	18.8 (68333) ^d	84.4 (60269) ^d	28.8 (935) ^d
Area of residence					
Rural	54.0	50.4 (105482)	17.0 (22482)	84.8 (20103)	47.2 (638)
Semi-rural	59.1	56.3 (90150)	16.0 (15870)	86.0 (19540)	30.0 (646)
Urban	52.3	48.0 (1019984) ^d	17.9 (246358) ^d	85.0 (203435) ^d	37.5 (3832) ^d
FOBT delivery type					
Active collection	47.4	44.7 (480372)	13.3 (98188)	77.4 (84311)	12.7 (2276)
Minimal action ^b	45.3	38.1 (378815)	17.8 (153432)		
No action	68.6	65.8 (356377) ^d	30.0 (32989) ^d	89.1 (158769) ^d	57.9 (2840) ^d
FOBT type					
quantitative FIT ^c	56.1	52.3 (908572)	18.9 (184357)	86.4 (198903)	37.8 (5116)
gFOBT	46.9	39.1 (197366)	17.6 (86993)	87.4 (34418)	
qualitative FIT	38.9	38.6 (105992) ^d	2.3 (13265) ^d	48.8 (9759) ^d	

FOBT, fecal occult blood test; FIT immunological FOBT; gFOBT guaiac FOBT.

^a Denominator=initial screening-first invitation, numerator = initial participation-first invitation + subsequent participations in never-responders.

^b The invitation type of minimal action was not used in subsequent invitation-regular intervals and subsequent invitation-irregular intervals.

^c In subsequent screening-irregular intervals, the FOBT used in round 3 in all programs was quantitative immunological

Table 5. Multivariate models for initial participation by sociodemographic and organizational factors of the CRCSP.

	Initial screening-first invitation ^a		Subsequent invitation for previous never responders ^a	
	OR	95% CI	OR	95% CI
Age and sex groups				
Men 60-69 years	1		1	
Men 50-59 years	0.82	0.81 to 0.82	0.93	0.91 to 0.96
Women 60-69 years	1.12	1.11 to 1.14	1.08	1.05 to 1.11
Women 50-59 years	1.05	1.04 to 1.06	1.09	1.06 to 1.16
Area of residence				
Rural	1		1	
Semi-rural	1.09	1.07 to 1.11	0.86	0.82 to 0.91
Urban	0.82	0.81 to 0.83	0.95	0.92 to 0.99
FOBT delivery type				
Active collection	1		1	
Minimal action	0.74	0.73 to 0.75	1.57	1.53 to 1.62
No action	2.24	2.21 to 2.26	2.14	2.08 to 2.21
FOBT type				
quantitative FIT	1		1	
gFOBT	0.81	0.80 to 0.82	0.88	0.86 to 0.90
qualitative FIT	0.70	0.69 to 0.71	0.12	0.11 to 0.14
Random effects				
Variation (standard error)			individual 0.026 (0.162)	

OR, odds ratio; CI, confidence interval; FOBT, fecal occult blood test; FIT immunological FOBT; gFOBT guaiac FOBT.

^aThe models in each stratum were adjusted by screening round.

Table 6. Multivariate models for successive participation by sociodemographic and organizational factors of the CRCSP.

	Subsequent invitation-regular		Subsequent invitation-irregular intervals	
	OR	95% CI	OR	95% CI
Age and sex groups				
Men 60-69 years	1		1	
Men 50-59 years	0.75	0.72 to 0.77	1.04	0.85 to 1.27
Women 60-69 years	0.99	0.96 to 1.02	1.01	0.87 to 1.18
Women 50-59 years	0.84	0.82 to 0.87	1.11	0.91 to 1.36
Area of residence				
Rural	1		1	
Semi-rural	1.12	1.06 to 1.19	0.74	0.57 to 0.96
Urban	0.93	0.89 to 0.98	0.77	0.964 to 0.93
FOBT delivery type				
Active collection	1		1	
No action	2.03	1.96 to 2.11	9.38	8.06 to 10.91
FOBT type				
quantitative FIT	1			
gFOBT	0.73	0.70 to 0.76		
qualitative FIT	0.20	0.19 to 0.21		
Random effects				
Variation (standard error)	individual 0.108(0.328)			

OR, odds ratio; CI, confidence interval; FOBT, fecal occult blood test; FIT immunological FOBT; gFOBT guaiac FOBT.

^aThe models in each stratum were adjusted by screening round.

Highlights:

- Organizational features of CRCSP can enhance participation rates.
- Participation was analyzed by FOBT delivery type and the type of FOBT offered.
- Sociodemographic factors were included in the study of CRCSP participation.

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