Effect of an Information Leaflet on Breast Cancer Screening Participation. A Randomized Controlled Study

Jose Maria Montero-Moraga
Institut Hospital del Mar d'Investigacions Mèdiques
Margarita Posso (mposso@parcdesalutmar.cat)
Institut Hospital del Mar d'Investigacions Mèdiques
Marta Román
Institut Hospital del Mar d'Investigacions Mèdiques
Andrea Burón
Institut Hospital del Mar d'Investigacions Mèdiques
Maria Sala
Institut Hospital del Mar d'Investigacions Mèdiques
Xavier Castells
Institut Hospital del Mar d'Investigacions Mèdiques
Francesc Macià
Institut Hospital del Mar d'Investigacions Mèdiques

Research Article

Keywords: Early Detection of Cancer, Diagnostic Screening Programs, Breast Neoplasms, Information Leaflet, Screening Participation, Screening Attendance

Posted Date: March 1st, 2021

DOI: https://doi.org/10.21203/rs.3.rs-200108/v1

Abstract

Objective: To evaluate the impact of an information leaflet about the risk-benefit balance of breast cancer screening on women's participation.

Methods: This randomized controlled study was conducted within a population-based breast cancer screening program and included women from the catchment areas of two hospitals in Barcelona, Spain. We evaluated women aged 50-69 years invited to screening between September 2019 and January 2020. One hospital attended a population with a lower socioeconomic status than the other. The intervention group received an information leaflet on the benefits and harms of mammography screening. The control group received the usual invitation letter. We compared the participation rate between groups, stratified by hospital and by per-protocol and intention-to-treat analyses.

Results: We included 11,119 women in the study: 5,416 in the intervention group and 5,703 in the control group. A total of 36.4% (1,964/5,393) of the women in the intervention group and 37.5% (2,135/5,694) of those in the control group attended screening, respectively. Overall, we found no differences in participation among groups (difference in participation -1.1%; 95% CI; -2.9% to 0.7%, p-value=0.240). In the hospital attending a population with a low socioeconomic status, attendance was lower in the intervention group (-1.4%, 95% CI: -5.7% to -0.03%, p-value=0.029). In the per-protocol analysis, participation was lower in the intervention group (-2.6%, 95% CI: -4.6% to -0.5%, p-value=0.015).

Conclusions: Overall participation in our program was unaffected by a new information leaflet on the risk-benefit balance of breast cancer screening. However, participation was lower in certain populations with lower socioeconomic status.

Highlights

- An information leaflet on the benefits and risks of breast cancer screening programs did not affect overall participation.
- The information leaflet decreased participation in an area with low socioeconomic status.
- Screening programs sending material with detailed information on the risk-benefit balance of breast cancer screening should consider that participation could decrease in certain areas.

Background

The risk-benefit balance of breast cancer screening programs has been extensively discussed (1). Several reviews have assessed this controversy, gathering and evaluating available studies (2–4). Overall, these reviews have concluded that there is evidence of the benefits of these programs, but there is still uncertainty regarding the magnitude of both the benefits and adverse effects (2–4). Thus, governments and institutions have decided to continue offering breast cancer screening, updating the recommendations on which diagnostic tests to use, the periodicity of screening, and the starting and ending ages (5, 6). A fundamental issue that has been highlighted is the need to provide evidence-based information to women invited to participate (2).

Such information must be balanced, explaining both the benefits and adverse effects of participation, as the general population tends to overestimate the benefits and underestimate the adverse effects of breast cancer screening (7–9). This information can be presented in different ways, such as interviews with healthcare workers, decision aids, or information leaflets. Few studies have assessed the effect of materials providing information on the benefits and adverse effects of screening programs on participation. Among published studies, most have measured intention to participate, and few have studied effects on screening participation (10–13).

In Catalonia, Spain, a new evidence-based leaflet was designed by an expert panel of the Oncology Master Plan of Catalonia and began to be distributed at the end of 2019. The leaflet explicitly addresses the balance between the benefits and harms of breast cancer screening. To our knowledge, it is not known whether the leaflet has had any effect on women's attendance.

Therefore, the aim of this study was to evaluate the impact on participation of this new leaflet targeting women invited to a breast cancer screening program in Barcelona, Spain.

Methods

2.1. Design

We performed a randomized controlled study, within a breast cancer screening program in Barcelona. The program targets women aged 50 to 69 years, offering them a mammogram every 2 years. The study was carried out in the technical office of Parc de Salut Mar (PSMAR) in Barcelona.

This office opened in 1996, with a target population of about 70,000 women and an observed participation rate of around 55% during the last decade.

2.2. Population

We included six of the 25 catchment areas of Barcelona covered by the PSMAR, those that sent invitations during the study period. The PSMAR consists of two hospitals: Hospital del Mar (Hospital A), which covers four of the six catchment areas included, and Hospital de l'Esperança (Hospital B), which covers the other two. The six catchment areas cover a target population of 15,825 women per screening round. The target population of Hospital A has low socioeconomic status while that of Hospital de l'Esperança has high socioeconomic status. These two populations differ from each other and from the city average regarding socioeconomic status.

We included women invited to participate between 30th September 2019 and 17th January 2020.
The screening round was defined as a cycle in which a population is invited to screening, indicating how many times screenings have already been offered. Two catchment areas were in the 11th screening round, three were in the 12th round, and the last one was in the 13th round. To identify the women to be invited to screening, the program uses the Catalan registry of persons covered by the publicly-funded health service, which has information on women's age and residence. We excluded women who had moved residence outside the PSMAR catchment area, as well as census errors.

2.3. Intervention

Following the usual screening program protocol, we sent invitations to participate in the screening program by surface mail. The invitation includes a personalized letter of invitation with a scheduled date for the mammogram. This date is scheduled three to four weeks after the invitation is sent. The intervention consisted of adding to the letter a leaflet containing information on breast cancer, mortality reduction due to mammography screening, the probability of detecting early stage cancer in participants, and explaining the mammogram (Supplemental File 1). The leaflet also provides information on the potential risks of screening, overdiagnosis and overtreatment, and false positives and false negatives. Furthermore, it provides numerical estimates on mortality reduction and overdiagnosis. The control group received the usual letter of invitation, containing information on the benefits of the breast cancer screening program, along with a scheduled date for the mammogram.

2.4. Randomization

The randomization unit was the processing day of the letter of invitation, which was set to be Tuesdays and Fridays. In the program, the letters to be sent on Monday and Tuesday of the following week are processed on Friday of the preceding week, and the letters to be sent from Wednesday to Friday are processed on Tuesday. We chose to randomize women in this way because it fitted the established workings of the technical screening office and because assignment to those days did not correspond to criteria that could bias randomization. The populations of the different processing days were comparable to each other because we did not expect differences between women on different processing days. We used the RANDOM excel function to perform blind random assignment. The randomization was performed by the research team and the subsequent

assignment to groups was done by the screening program staff. The staff also reviewed the women's residence to exclude women who moved or census errors (Fig. 1).

2.5. Data source

We retrieved the data from the database used by the PSMAR for the daily management of the breast cancer screening program. The database already registers all the information needed for the study, and consequently no informed consent was required from women invited to participate in the program.

2.6. Primary outcome

The primary outcome was participation in the program, which is automatically registered in an application at the moment of screening mammography. The follow-up period started 30 days from the date of the scheduled mammogram and ended on 29th February in Hospital A and on 8th March in Hospital B. The dates differed because there is a two-week interval in Hospital A between the processing date of the letter and the date of the scheduled mammogram, while this period is three weeks in Hospital B. This was due to the lower number of letters of invitation sent in Hospital B.

Women were considered to participate if they were screened during the follow-up period.

Other variables included in the study were place of birth and study level, because in our screening program, women have been found to differ in participation because of these variables. Another variable was initial or subsequent screening, women classified as initial screening had never participated in breast screening while women classified as subsequent screening had participated at least once.

2.7. Sample size

Assuming a participation rate of 55%, we calculated that 4,820 letters of invitation were needed for the intervention group and 4,820 for the control group to detect a statistically significant difference of 3% in participation between the groups. An alpha risk of 0.05 and a beta risk of 0.2 in a two-sided test was accepted, with an anticipated drop-out rate of 10%.

2.8. Statistical analysis

We obtained participation by dividing the number of women who had a screening mammogram by the number of women invited to participate in the program for each group.
Then, we calculated the difference in participation and its 95% confidence interval (95% CI) between the intervention and control groups. Because the socioeconomic status of the covered populations differed between hospitals, we performed a stratified analysis by hospital.

We performed an intention-to-treat and a per-protocol analysis. In the per-protocol analysis, we excluded women who reported undergoing mammography in the previous six months, as well as those who reported being followed up by another provider. The reason for excluding these women was that they were not considered to be suitable to participate in the screening program, but they could only be identified after we performed the randomization. Since these women were taken from the denominator in the calculation of participation, participation rates were expected to be higher in the per-protocol analyses. Furthermore, there was a higher proportion of women who were followed up by another provider in Hospital B, so excluded women in the per-protocol analyses were mostly from Hospital B.

Finally, we compared non-participant and participant characteristics, as well as excluded and included women's characteristics in the per-protocol analysis.

Results

A total of 11,119 women were included in the study, 5,416 were assigned to the intervention group and 5,703 to the control group. The baseline characteristics of the two groups were similar, except that there was a larger number of women from

Hospital A than Hospital B in the intervention group. There was also a slightly higher percentage of women born in Asia and Oceania in the intervention group in Hospital A (Table 1).

Table 1
Characteristics of the women included in the study. Intention-to-treat analysis.

	Hospital A				**Hospital B**				**Total**			
	Intervention Group		**Control Group**		**Intervention Group**		**Control Group**		**Intervention Group**		**Control Group**	
	n	%	n	%	n	%	n	%	n	%	n	%
Age (median and IQR)	57	53–62	57	53–62	58	54–63	58	54–63	58	53–63	58	54–63
Place of birth												
Spain	1,460	56.8%	1,418	56.2%	1,956	69.3%	2,203	69.5%	3,416	63.3%	3,621	63.6%
Europe or North America	143	5.6%	174	6.9%	108	3.8%	107	3.4%	251	4.7%	281	4.9%
Center or South America	301	11.7%	292	11.6%	220	7.8%	261	8.2%	521	9.7%	553	9.7%
Asia or Oceania	515	20.0%	448	17.8%	33	1.2%	42	1.3%	548	10.2%	490	8.6%
Africa	96	3.7%	150	5.9%	12	0.4%	14	0.4%	108	2.0%	164	2.9%
Missing	55	2.1%	40	1.6%	494	17.5%	545	17.2%	549	10.2%	585	10.3%
Study level												
Primary or less	633	24.6%	667	26.4%	118	4.2%	144	4.5%	751	13.9%	811	14.2%
High-school or PT	1,098	42.7%	1,046	41.5%	1,543	54.7%	1,767	55.7%	2,641	49.0%	2,813	49.4%
Higher level	398	15.5%	419	16.6%	997	35.3%	1,066	33.6%	1,395	25.9%	1,485	26.1%
Missing	441	17.2%	390	15.5%	165	5.8%	195	6.1%	606	11.2%	585	10.3%
Initial or subsequent screening												
Initial screening	1,188	46.2%	1,151	45.6%	2,101	74.4%	2,306	72.7%	3,289	61.0%	3,457	60.7%
Subsequent screening	1,381	53.7%	1,371	54.4%	722	25.6%	866	27.3%	2,103	39.0%	2,237	39.3%
Missing	1	0.0%	0	0.0%	0	0.0%	0	0.0%	1	0.0%	0	0.0%
Total	2,570	100%	2,522	100%	2,823	100%	3,172	100%	5,393	100%	5,694	100%

PT: Professional Training

Overall, there were no differences in participation between the intervention and the control groups. A total of 36.4% (1,964/5,393) of the women in the intervention group participated in the breast cancer screening program versus 37.5% in the control group (2.135/5.694). The difference in participation of - 1.1% was not statistically significant (95% CI: -2.9% to 0.7%, p-

value= 0.240). However, in the analysis stratified by hospital, participation was lower in Hospital A in the intervention group (49.9%, 1,283/2,570) than in the control group (53%, 1,336/2,522) with a statistically significant difference of -1.4% (95% CI: -5.7% to -0.03%, p-value=0.029). In Hospital B, participation was 24.1% in the intervention group (681/2,823) and 25.2% in the control group (799/3,172), with no differences between groups in this hospital (p-value=0.339) (Figure 2).

Non-participants were mostly from Hospital B (64.6%) and 85.3% of them had never participated in our screening program (Supplementary Table 2).

In the per-protocol analysis, participation was lower in the intervention group than in the control group (-2.6%, 95% CI: -4.6% to -0.5%, p-value = 0.015).
In the stratified analysis, participation was lower in both hospitals, and was almost four percentual points lower in Hospital A (-3.9%, 95% CI: -6.7% to -1.1%, p-value = 0.007), but the difference was not statistically significant in Hospital B (p-value = 0.099) (Fig.
3). In the per-protocol analysis, excluded women were mostly from Hospital B (the 82.6%) and 89.8% had never participated in our screening program (Supplementary Table 3).

Discussion

4.1 Main findings

In our study, an information leaflet on the risk-benefit balance of breast screening did not appear to influence overall participation in the program. However, in one hospital attending a population with lower socioeconomic status the leaflet reduced participation (-1.4% in the intervention group in Hospital A). Furthermore, the per-protocol analysis showed an overall lower participation in the intervention group (-2.6%) in both hospitals (-3.9% in Hospital A and -2.4% in Hospital B), although this difference was not statistically significant in Hospital B.

4.2 Comparison with previous studies

We found that providing explicit information about the risk-benefit balance of screening for the first time to women may not dramatically affect participation in the program. However, this intervention reduced participation in areas with a low socioeconomic status. Similar to our overall results, a randomized controlled study in Italy found no differences in participation among women who received extensive information material (14). That study evaluated the impact of a comprehensive leaflet with additional information, which explained the balance in greater depth than our leaflet. Our results are also consistent with those of a German study reporting that providing more information about screening did not seem to affect women's intention to participate in breast cancer screening (15). Conversely, several other studies have suggested that providing information on the benefits and adverse effects of breast cancer screening decreases women's intention to be screened (10,11,13,16). In agreement with these studies, the participation rate decreased in one of our hospitals. Overall, we did not find that providing information increased attendance in any group, or in the published literature.

A systematic review found that the use of decision aids made younger women (those around the age at which women begin to receive screening invitations) reluctant to participate in breast cancer screening programs (12). In our study, we found no differences in age between the intervention and control groups. Moreover, another study found an inverse relationship between age and reading information on breast cancer screening, a finding that contradicts the possible explanation of a lower participation of young women in Hospital A due to the leaflet (17). On the other hand, another study argued that it was unlikely that women who have never participated in screening read screening information (17). In Hospital B, most women had never participated in our screening program and therefore a lower willingness to read screening information in this group could explain the absence of an effect of the leaflet in Hospital B.

Women who have never participated in screening have been found to assign more weight to adverse effects than women who have participated at some point in the screening program (9,18). In our study, there was a similar proportion of these women in the intervention and control groups, and therefore this tendency seems unlikely to have influenced our results. However,

another factor that has been related to a higher perceived importance of screening harms and lower perceived benefits is awareness of recent breast screening recommendations (9). This hypothesis is supported by our results: women in Hospital B were less willing to read the leaflet than those in Hospital A; in the intervention groups, attendance was unaffected in Hospital B but was reduced in Hospital A.

In a study focusing solely on non-participant women in Scotland, 55.5% of them had a history of non-attendance at screening (19). In our study, around 85% of non-participant women had never attended our screening program. A possible explanation for our results could be that the areas included in our study have a high proportion of women who are disengaged from our screening program, and thus are not influenced by the information that we provide.

The participation rate in this study was lower than the observed participation rate of the whole screening program in the last decade of around 55%. This could be explained by several factors. The COVID-19 pandemic started at the beginning of March 2020, thus our follow up could not been extended beyond of 29th February in Hospital A and 8th March in Hospital B. Furthermore, we estimate that the COVID-19 pandemic negatively affected the expected participation. In addition, the low participation rate in Hospital B is probably explained by the high uptake of private breast screening in the area covered by this hospital.

Strengths And Limitations

The main strength of our study is the randomized controlled design, with information about women's actual participation in the breast cancer screening program. This allowed us to assess whether providing information on the benefits and adverse effects of screening along with the invitation to the program affects participation.

Our study also has several limitations. One of them is that we randomized letter processing days rather than individual women. However, processing days are similar to natural homogeneous grouping of the population, and within each day the population is heterogeneous, so we do not consider that this influenced the internal validity of the study. Another limitation is that the catchment areas included may not be representative of the general population, and thus the results may not be extrapolable, as they include areas with high socioeconomic status and others with low socioeconomic status. For that reason, we conducted an analysis stratified by hospital. Consequently, the stratified analysis may not have sufficient statistical power to detect statistically significant differences in Hospital B.

The follow-up was initially established at 90 days after the scheduled date of the mammogram, but this period overlapped with the SARS-CoV-2 pandemic, during which time mammogram appointments were canceled. Thus, once the study had started, we were forced to limit the follow-up to 30 days. However, around 90% of the women who were actually screened did so before that period, so we believe that shortening the follow-up probably did not alter the results of the study.

Conclusions

Although the new Catalan information leaflet on the risk-benefit balance of mammography screening did not appear to significantly affect screening attendance, participation was lower in the area with low socioeconomic status. Screening programs sending material with detailed information on the benefits and adverse effects of breast cancer screening should closely monitor participation, particularly in areas with low socioeconomic status. There is a need for further research to assess the factors associated with non-attendance and their association with information leaflets.

Declarations

Ethics approval: The study was approved by the Clinical Research Ethics Committee of the PSMAR (registration number: 2019/8898/I) and waived the requirement of informed consent for the study. All methods were carried out in accordance with the Declaration of Helsinki and national and international regulations.

Consent for publication: NA.

Availability of data and materials: The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests: The authors declare that they have no competing interests.

Funding: This work was supported by a grant from Instituto de Salud Carlos III (grant number: PI19/00007), and by the Research Network on Health Services in Chronic Diseases (RD12/0001/0015). The funder did not have any role in the design, analysis, writing or the decision to submit the manuscript.

Author's contributions: All authors conceptualized and designed the study. Data was collected by JMMM, MP, and FM. JMMM, and MR performed the statistical analyses. JMMM, MP, AB, MS, XC, and FM collaborated in the interpretation of the results. JMMM drafted the manuscript. JMMM, MP, and FM wrote the final version of the manuscript and revised it critically for important intellectual content. All authors read and approved the final manuscript.

Acknowledgments: we would like to thank Isabel Amatriain, Mercè Esturi and Cristina Hernández in particular for their work and assistance in the performance of this study and the rest of the team of the PSMAR screening technical office: Gloria Lagarriga, Maria Ángeles Mercader, Marina Reyes, Judit Silvilla and Eva Fernández.

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Figures

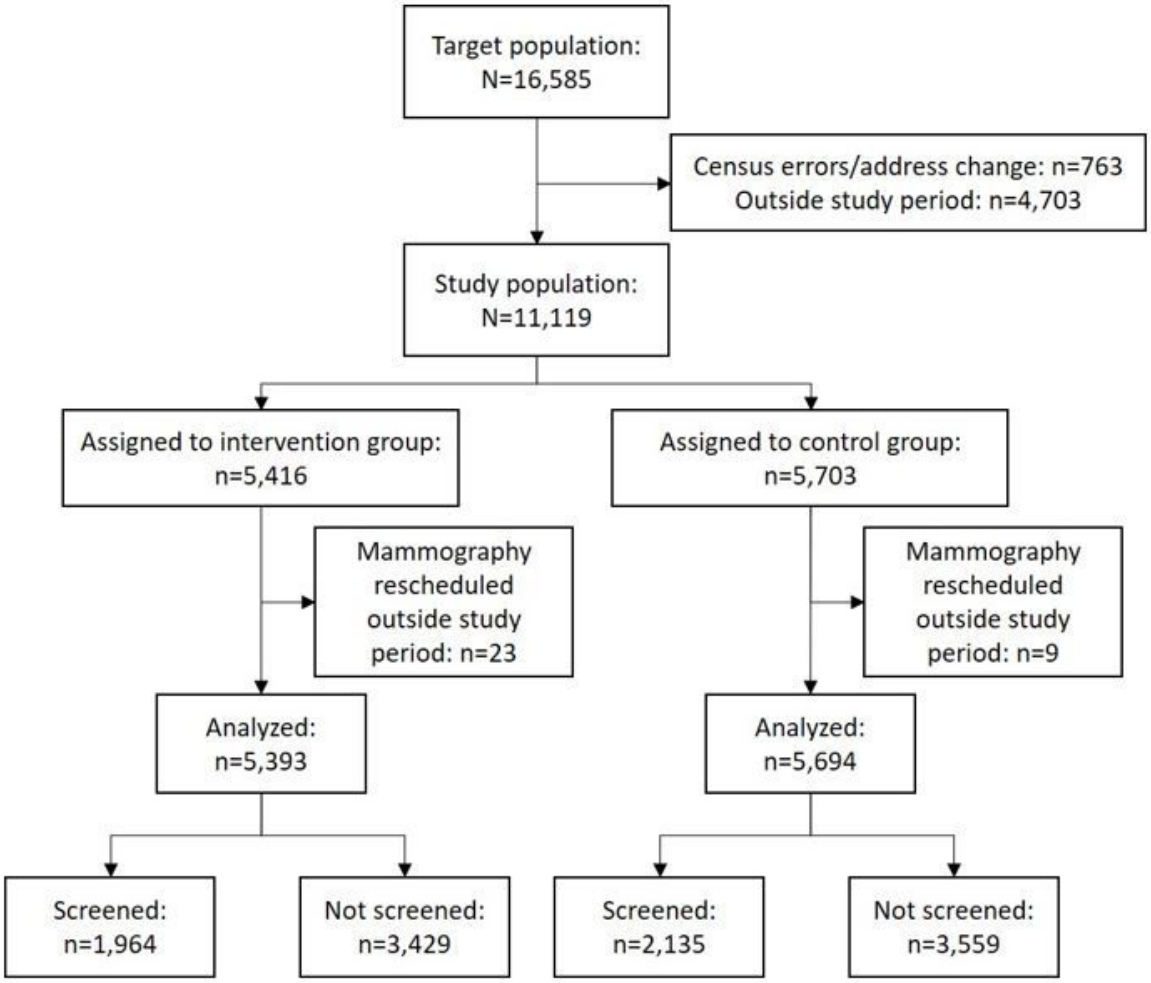


Figure 1

Flow diagram of the study

	Intervention Group		Control Group	
	n	%	n	%
Hospital A				
Participants	1,283	49.9%	1,336	53.0%
Non-participants	1,287	50.1%	1,186	47.0%
Hospital B				
Participants	681	24.1%	799	25.2%
Non-participants	2,142	75.9%	2,373	74.8%
Total				
Participants	1,964	36,4%	2,135	37.5%
Non-participants	3,429	63,6%	3,559	62.5%

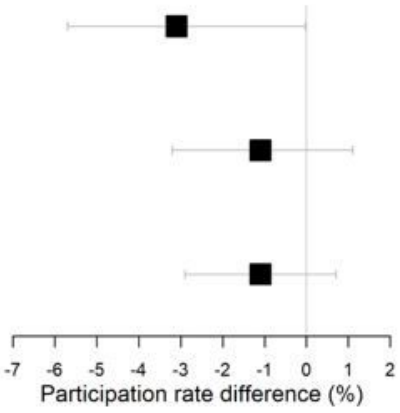
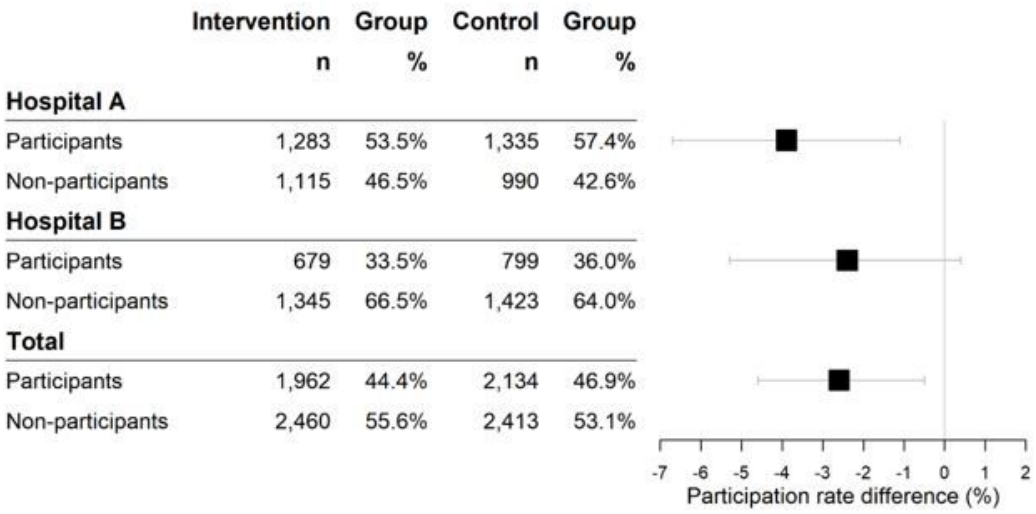


Figure 2

Participation in the breast cancer screening program. Intention-to-treat analysis.



	Intervention Group		Control Group	
	n	%	n	%
Hospital A				
Participants	1,283	53.5%	1,335	57.4%
Non-participants	1,115	46.5%	990	42.6%
Hospital B				
Participants	679	33.5%	799	36.0%
Non-participants	1,345	66.5%	1,423	64.0%
Total				
Participants	1,962	44.4%	2,134	46.9%
Non-participants	2,460	55.6%	2,413	53.1%

Figure 3

Participation in the breast cancer screening program. Per-protocol analysis

Supplementary Files

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