Effect of an organised screening program on socioeconomic inequalities in mammography practice, knowledge and attitudes

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Breast cancer stands as the leading cause of cancer related mortality in women worldwide. Mammography screening has the potential to improve prognosis by reducing stage at diagnosis. Socioeconomic inequalities in mammography cancer screening have been widely reported. The influence of organised programs on socioeconomic disparities regarding mammography screening is to date unclear. We aimed to investigate the impact of an organised regional screening program on socioeconomic inequalities in terms of the uptake, knowledge and attitudes towards mammography screening.

Reference

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Effect of an organised screening program on socioeconomic inequalities in mammography practice, knowledge and attitudes

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Abstract

Background: Breast cancer stands as the leading cause of cancer related mortality in women worldwide. Mammography screening has the potential to improve prognosis by reducing stage at diagnosis. Socioeconomic inequalities in mammography cancer screening have been widely reported. The influence of organised programs on socioeconomic disparities regarding mammography screening is to date unclear. We aimed to investigate the impact of an organised regional screening program on socioeconomic inequalities in terms of the uptake, knowledge and attitudes towards mammography screening.

Methods: Data were obtained from two cross-sectional surveys of women 50 to 69 years old conducted in 1998 and 2012, before and after the implementation of an organised breast cancer screening program in Geneva, Switzerland. Socioeconomic status was measured by monthly household income and education level. Logistic and linear regression multivariable models were used to investigate the evolution of socioeconomic gradients between 1998 and 2012 in terms of uptake, knowledge and attitudes towards mammography screening.

Results: In 1998, before the implementation of an organised screening program, 44% of women from the lowest education category reported mammography practice conforming to recommendations versus 63% of the more educated participants. This socioeconomic gradient was no longer present in 2012 where reported mammography practice at guideline-recommended frequency were 83 and 82% in the lowest and highest education level categories respectively (change in education gradient over time, \( p = 0.018 \)). The difference in mammography practice in agreement with recommendations between the lowest and the highest income category went from 27 percentage points in 1998 to 14 percentage points in 2012 (change in income gradient over time, \( p = 0.10 \)). The socioeconomic gradient in negative attitudes towards mammography screening persisted in 2012 but was reduced compared to 1998. We did not observe a reduction in the socioeconomic disparities in knowledge regarding mammography screening over this period.

Conclusions: This study suggests that mammography screening programs may lessen socioeconomic inequities in mammography practice. Such programs should feature adapted communication tools to reach women of lower socioeconomic status to attempt to further reduce socioeconomic gradients in mammography screening.

Keywords: Socioeconomic gradients, Mammography breast cancer screening, Organized screening program
Background

Breast cancer stands as the leading cause of cancer-related deaths in women worldwide. With a breast cancer crude incidence rate of 153.5 per 100,000 women [1], Switzerland ranks amongst the most affected countries worldwide. Mammography screening offers the potential benefit of earlier stage at diagnosis allowing for an improved prognosis. A reduction in breast cancer mortality by mammography screening, whilst controversial in certain age categories, has been consistently observed in women 50 to 69 years old [2, 3].

Mammography screening may be available as part of an organized program which invites the defined target group to undertake the screening test at regular intervals. Such programs should operate with standardized equipment and procedures, allowing for quality control. Mammography screening carried out outside an organized program, either due to patient preference or to lack of availability of such a program, is defined as opportunistic screening [4]. WHO recommends organized population-based mammography screening programs for women of age 50 to 69 [5]. The benefit of such programs remains nonetheless debated by some, mainly due to concerns of overdiagnosis and potential harm caused by false positive tests [6].

Socioeconomic inequalities in breast cancer survival have been documented by a number of studies [7–9]. More advanced stage at diagnosis in the unprivileged contributes to increased breast cancer mortality in lower socioeconomic status groups [10, 11]. Features of organized mammography screening programs may allow them to contribute to lessen socioeconomic inequalities in breast cancer mortality by improving access to mammography in the more deprived.

An organized mammography screening program was implemented in the Geneva canton in Switzerland in 1999. Under this program, women aged 50 to 74 years old are systematically invited every 2 years to undertake a mammography screening test in a certified radiology unit. Mammography carried out as part of this program is not subject to the deductible of the health insurance and is covered free of charge for individuals receiving a subsidy for their health insurance. This limitation in ‘out of pocket’ payments may provide an incentive for mammography screening in the more deprived. This program also features mass media breast awareness campaigns addressing lack of knowledge and negative attitudes towards mammography practice, which are important barriers to screening attendance in lower socioeconomic groups [12, 13].

Our aim was to investigate whether the running of an organized screening program limiting ‘out of pocket’ payments and featuring breast cancer awareness campaigns was accompanied by a change in socioeconomic gradients in terms of uptake, knowledge of and negative attitudes towards mammography screening.

Methods

In 1998, prior to the introduction of the regional organized program, self-completed questionnaires were sent to 1400 district households by an independent office with access to an exhaustive registry of residents of the Geneva canton of Switzerland. Households where women aged 40 to 79 were registered were selected and assigned a random number. The mailing list for the questionnaire was issued by selection of the first 1400 individuals from this list sorted by the randomly assigned number. This questionnaire was designed to investigate mammography practice and attitudes towards mammography screening in the Geneva population. A similar cross-sectional survey study was repeated in 2012 so as to evaluate the evolution in the previously mentioned outcomes in the 14 years since the launch of the screening program. The 2012 questionnaire was sent to 2000 women whose addresses were selected (using the same randomized selection process as outlined above for the 1998 questionnaire) this time from the list used by the program for their screening invitations [14, 15]. This is also an exhaustive list of legal residents of the canton from which all women in the age group targeted by the screening program can be identified. Only women 50 to 69 years old were included in this study. The questionnaires were structured in a similar fashion, collecting information on sociodemographic factors, past mammography practice, intention to screen and assessing attitudes towards mammography screening.

Mammography screening uptake was assessed by the proportion of participants who reported having had mammograms at the recommended frequency in the past 4 years. The questionnaires included 8 statements that tested knowledge of mammography screening. These items were scored on a 5-point Likert scale ranging from “I totally agree” to “I totally disagree”. To facilitate interpretation, the sum of correct answers was transformed into a mammography screening knowledge scale from 0 to 100. Negative attitudes towards mammography screening were measured by Rakowski’s 5-item scale of cons [14, 16], which has been used and validated in this setting [17]. Summary scores of cons were also repotted on a scale ranging from 0 to 100.

Reported household income and education level were used as measures of socioeconomic status (SES), both being validated SES proxies. Women were asked to report their monthly household income within five predefined income categories. Information regarding education level was collected as the total years of education, including primary and secondary school, university and apprenticeship years. For statistical analysis, education level was then converted...
to a categorical variable (≤ 10 years of education, 11–
13 years, 14–16 years, and ≥ 17 years). A copy of the or-
iginal questionnaires is available (in their original French
language form) upon request by contacting the last author.

Socioeconomic gradients in mammography practice
were assessed separately for 1998 and 2012 using
cross-tabulation and multivariable logistic regression
models. In these models, adherence to mammography
screening recommendations was set as the dependent
variable and the socioeconomic marker as an independ-
ent variable, adjusting for age and marital status. Separ-
ate models for household income and education level as
SES markers were used. The analysis was then com-
pleted by multivariable models setting as independent
variables the socioeconomic position marker (household
income or education level), the survey year (coding the
year 1998 as "0" and year 2012 as "1") and the inter-
action term of these two variables. The p value of this
interaction term assessed the statistical significance
of the change in the effect of the SES on mammogra-
phy uptake over the running time of the program.

The socioeconomic gradients in knowledge and nega-
tive attitudes towards mammography in 1998 and 2012
were analysed using the same methodology, this time
using linear regression models for these two continuous
variables. Mammography screening knowledge scores
and negative attitudes towards mammography scores
were set as the dependent variables of the models and
the independent variables used were the same as those
described above for the “adherence to mammography
screening recommendations” models. We used statistical
software Stata 13.0 for all the analyses. P values of less
than 0.05 were considered as statistically significant.

Results
The survey response rate was 71.8% in 1998 which
responds to 958 returned questionnaires out of the 1334
that were mailed. After further exclusion of 431 partici-
pants younger than age 50 or older than age 70, 521 sur-
veys from 1998 remained for analysis. Of 1916 eligible
women in 2012, 1083 responded (56.5%) and were in-
cluded in the analysis. Education level was reported by
91.1% of participants and monthly household income by
85.9%. Age distribution was similar in both surveys.

The proportion of women who reported a high house-
hold income (>8000CHF/month) was significantly higher
in 2012 than in 1998 and so was the proportion of
women who reported a high level of education.

Participant characteristics by survey year are shown in
Table 1. Nearly all women (97.3%) indicated ever having
had a screening mammogram in 2012 compared to
86.3% in 1998 (P < 0.001). Similarly, 82.2% of women
contacted in 2012 reported having had 2 screening
mammograms or more over the past 4 years compared
to 52.6% of women contacted in 1998 (P < 0.001). Mean
knowledge score was 6.1 points higher (P < 0.001), and
mean score of negative attitude towards mammography
10.2 points lower (P < 0.001) in 2012 than in 1998.

Socioeconomic gradients in the proportion of women
who had 2 mammograms or more in the past 4 years in
1998 and 2012 are reported in Table 2 and illustrated
graphically in Figs. 1 and 2. The strong
positive linear association between education level and
adherence to recommendation in mammography prac-
tice in 1998 was absent in 2012 (Fig. 1). The association
between mammography screening practice and reported
monthly household income was also stronger in 1998
than in 2012 (Fig. 2). In logistic regression (Table 3), the
odds ratio for the increase in adherence to mammog-
raphy practice recommendations from one “education
level” category to the next went from 1.25 (P = 0.012) in
1998 to 1.03 (P = 0.74) in 2012. The reduction in the in-
fluence of education level on mammography uptake over
the 14 years of running of the screening program was
statistically significant (P = 0.018). Using household in-
come as the independent variable, the odds ratio went
from 1.36 (P < 0.001) in 1998 to 1.17 (P = 0.024) in 2012.
The change in the effect of income on mammography
uptake between 1998 and 2012 was not statistically sig-
nificant (p value for interaction term = 0.10).

Mammography screening knowledge was positively as-
associated with household income and education level in
both 1998 and 2012 (Table 2). The change in socioeco-

Discussion
This repeated cross-sectional study suggests some im-
provement in socioeconomic inequities regarding
mammography uptake over the running time of an
organised screening program in the Geneva canton. The
strong socioeconomic gradient in mammography
screening adherence observed in 1998 was no longer
present in 2012 if one considered education level as
### Table 1 Participants characteristics, practice, knowledge and attitude towards screening mammography, according to survey year

| Participant’s characteristics | 1998 (N = 521) | 2012 (N = 1083) | p value |
|------------------------------|----------------|----------------|---------|
| Age group (years)            |                |                |         |
| 50–54                        | 165 (32.9)     | 310 (29.2)     | p = 0.1 |
| 55–59                        | 131 (26.1)     | 253 (23.8)     |         |
| 60–64                        | 94 (18.8)      | 245 (23.1)     |         |
| 65–69                        | 111 (22.2)     | 254 (23.9)     |         |
| Monthly household income (CHF) |                |                |         |
| < 2000                       | 38 (9.2)       | 67 (7.0)       | p = 0.006 |
| 2000–3999                    | 93 (22.4)      | 188 (19.5)     |         |
| 4000–5999                    | 109 (26.3)     | 203 (21.1)     |         |
| 6000–7999                    | 79 (19.0)      | 196 (20.4)     |         |
| ≥ 8000                       | 96 (23.1)      | 309 (32.1)     |         |
| Education (years)            |                |                |         |
| 0–10                         | 150 (31.3)     | 195 (19.8)     | p < 0.001 |
| 11–13                        | 142 (29.6)     | 259 (26.3)     |         |
| 14–16                        | 107 (22.3)     | 263 (26.8)     |         |
| ≥ 17                         | 80 (16.7)      | 266 (27.1)     |         |
| Smoker                       | 82 (16.0)      | 200 (19.3)     | p < 0.001 |
| In a relationship            | 336 (66.4)     | 695 (66.7)     | p = 0.2  |
| Study outcomes               |                |                |         |
| ever had a screening mammogram | 449 (86.3)   | 1041 (97.3)    | p < 0.001 |
| At least 2 screening mammograms over the past 4 years | 254 (52.6) | 860 (82.2) | p < 0.001 |
| Mean score /100 (SD)         | 67.7 (17.3)    | 73.8 (14.6)    | p < 0.0001 |
| Rakowski’s scale of cons     | 240 (23.0)     | 13.8 (17.7)    | p < 0.0001 |

### Table 2 Knowledge and negative attitudes towards mammography screening according to household income and education level in 1998 and 2012

| Education (years) | Mammography practice according to guidelines (%) | Mammography screening knowledge (mean score/100) | Negative attitudes towards mammography screening (mean score/100) |
|------------------|-----------------------------------------------|-----------------------------------------------|---------------------------------------------------------------|
| 1998             | 2012                                          | 1998                                          | 2012                                                          |
| < 10             | 43.7                                          | 82.8                                          | 65.1                                                          | 71.6                                                          | 30.0 | 17.2 |
| 11–13            | 54.8                                          | 82.5                                          | 70.2                                                          | 74.6                                                          | 22.4 | 13.1 |
| 14–16            | 56.0                                          | 83.7                                          | 66.8                                                          | 74.5                                                          | 21.6 | 11.6 |
| ≥ 17             | 62.8                                          | 81.7                                          | 70.8                                                          | 76.2                                                          | 17.8 | 12.3 |
| p value for trend| p = 0.012                                     | p = 0.74                                      | p = 0.028                                                     | p = 0.001                                                     | p = 0.002 | p = 0.004 |

| Monthly household income (CHF) | Mammography practice according to guidelines (%) | Mammography screening knowledge (mean score/100) | Negative attitudes towards mammography screening (mean score/100) |
|--------------------------------|------------------------------------------------|-----------------------------------------------|---------------------------------------------------------------|
| < 2000                         | 37.5                                          | 70.8                                          | 64.8                                                          | 70.7                                                          | 32.3 | 21.1 |
| 2000–3999                      | 39.0                                          | 79.8                                          | 63.2                                                          | 69.7                                                          | 32.6 | 20.1 |
| 4000–5999                      | 51.0                                          | 85.6                                          | 68.3                                                          | 72.6                                                          | 22.1 | 12.5 |
| 6000–7999                      | 61.3                                          | 82.7                                          | 72.5                                                          | 75.1                                                          | 16.4 | 11.1 |
| ≥ 8000                         | 64.9                                          | 85.3                                          | 70.3                                                          | 78.1                                                          | 16.9 | 9.9  |
| p value for trend              | p < 0.001                                     | p = 0.024                                     | p = 0.009                                                     | p < 0.001                                                     | p < 0.001 | p < 0.001 |
the socioeconomic marker. Although a similar pattern was observed with reported household income as a socioeconomic marker, the change in gradient was in this case only partial and was not statistically significant; inequities in mammography uptake according to household income persisted in 2012.

Previously published studies tend to support the hypothesis that organised screening programs have a corrective effect on socioeconomic gradients in screening mammography practice observed in the opportunistic setting. Palència et al. [18] reported an absence of socioeconomic inequalities in breast and cervical cancer screening in European countries running organised national screening programs whereas disparities persisted in countries without such programs. The more pronounced socioeconomic inequities in PAP smear screening practice as compared to mammography screening in settings where an organized screening program was running for breast cancer but not for cervical cancer also supports the capacity of organized programs to reduce socioeconomic gradients [19]. Socioeconomic inequalities in terms of breast cancer survival were also reduced after the implantation of an organised screening program in Florence, Italy [20]. However, others found no reduction in the socioeconomic

![Fig. 1](image1.png) **Fig. 1** Reported screening mammography practice according to education category in 1998 and 2012. This figure shows a gradient in mammography uptake according to education category in 1998, which is no longer observed in 2012.

![Fig. 2](image2.png) **Fig. 2** Reported screening mammography practice according to reported monthly household income category in 1998 and 2012. This figure shows a strong gradient in mammography uptake according to monthly income in 1998. This gradient is comparatively lessened in 2012.
gradient in mammography uptake before and 3 years after the implementation of an organised breast screening program in Belgium [21]. It has been argued that new public health measures take time to reduce health inequities and can even lead to a temporary widening of socioeconomic gaps [22] and the short time interval between the two evaluations in this study may account for these negative results.

This study suggests that knowledge regarding mammography screening has on the whole increased and negative attitudes lessened since the introduction of the organised program. Mass media breast screening awareness campaigns and the mailing of information leaflets regarding breast cancer screening to all women invited to have a mammogram may have contributed to this result. Our results however show that the substantial inequities in mammography screening knowledge observed in 1998 persisted in 2012. This was also the case for negative attitudes towards mammography, although the change in the effect of the SES on negative attitudes regarding mammography significantly declined over the 14 years of running of the program. This suggests that the features of the organized screening program addressing mammography screening knowledge and negative attitudes towards mammography described above have a limited reach and impact on women of lower SES. This leaves an opportunity for improvement and should stress the importance of adapting the program’s communication strategy in this regard. Communication campaigns focused on primary care physicians may be an important aspect of organised programs in this regard, knowing the impact physician recommendations have on mammography practice [14, 23, 24].

This study had several limitations. Our study was conducted in a defined area of Switzerland. We cannot ascertain that our findings can be extrapolated to other settings running organised screening programs with different features. The survey response rate was lower in 2012 than in 1998. Since information regarding non-responders was not available, we could not quantify the extent to which selection bias affected study results. Another limitation is the repeated cross-sectional study design. This implies that other factors than the introduction of the screening programme may have influenced the observed change in women’s behavior between 1998 and 2012. Also, even though we believe that the population has remained stable, unobserved confounders may have contributed to the observed changes. Monthly income and education level were also self-reported with no external validation. Finally, we also acknowledge that mammography screening uptake was assessed based on self-reporting. Whilst self reporting in survey data has been shown to overestimate cancer screening utilization, socioeconomic disparities tend to be masked by self-report [25]. This bias would be conservative in our study findings.

### Conclusions

This study suggests that mammography screening programs may lessen socioeconomic inequities in mammography practice. Such programs should feature adapted communication tools to reach women of lower socioeconomic status to in an attempt to further reduce socioeconomic gradients in mammography screening.
Abbreviations
SES: socioeconomic status

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Availability of data and materials
The datasets used for the current study are available from the corresponding author on reasonable request.

Authors’ contributions
All analysed and interpreted the data from the questionnaires and was the main contributor in the writing of the manuscript. BA and TP developed the questionnaires from which the data for the present study were obtained. TP supervised the statistical analysis of the study data. Both BA and TP provided proofreading and corrections to the manuscript before submission. All authors read and approved the final manuscript.

Ethics approval and consent to participate
The study protocols for the 1998 and the 2012 questionnaires were both submitted to the Geneva University Hospital’s Ethics Research Committee and were exempted from a full review by the latter due to the absence of risk they implied for the study populations. The present study is solely based on data extracted from these questionnaires.

Consent for publication
Not applicable

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

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