



Predicting stages of adoption of mammography screening in a general population

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Abstract

This study assessed predictions of the Transtheoretical Model (TTM) of behaviour change applied to mammography screening in a random sample of 909 Swiss women aged 40–80 years. We examined stages of mammography adoption, positive and negative attitudes toward screening (pros, cons and decisional balance), and additional predisposing, enabling and reinforcing characteristics. The stage of mammography adoption was defined for 827 women, of whom 46.9% reported on-schedule screening (action 10.2%, maintenance 29.7%, relapse risk 7.0%) and 53% did not (precontemplation 23.1%, contemplation 13.5%, relapse 16.4%). Independent factors associated with more advanced stages (from precontemplation to maintenance) were high pros, low cons, belief that mammography screening is recommended every 2 years, high objective risk of breast cancer, being married and higher income. Independent correlates of stage regression (from action/maintenance to relapse) were high cons, belief that mammography screening is recommended every 4 years or not at all and not being married. Perceived utility of an organised screening programme and reluctance to pay for a mammogram were independently associated with only certain transitions between stages of adoption. Our results confirm the applicability of the TTM to mammography screening in a European context. They also suggest that constructs other than pros and cons may be useful in predicting mammography use. © 2001 Elsevier Science Ltd. All rights reserved.

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1. Introduction

A key factor for the effectiveness of mammography screening programmes is the proportion of the target population which follows screening guidelines. Research aimed at identifying determinants of mammography use and assessing their relative importance has relied upon the Health Belief Model [1–4], models for health service utilisation [5,6], or closely related frameworks [7–9]. The Transtheoretical Model (TTM) was applied to mammography screening more recently [10–12]. This model states that the acquisition and maintenance of a health-protective behaviour is not an all-or-nothing phenomenon, but a gradual process. Therefore, the TTM

defines *stages of mammography adoption* derived from information on past and present screening behaviour, and intention to get mammograms in the future.

Other important components of the TTM are beliefs and attitudes either favourable (*pros*) or opposed (*cons*) to mammography screening. Women who have more positive attitudes (i.e. who have a higher level of pros and a lower level of cons) are more likely to be in an advanced stage of mammography adoption.

Several studies conducted in the United States have confirmed the postulated relationships between pros, cons and stages of mammography adoption [13–15]. Other studies also examined whether components of the Health Belief Model [16–19], women's informational environment [20], or personality factors [21] vary across stages of mammography adoption. In contrast, little is known about how pros and cons relate to stages of mammography adoption in non-US populations, and in

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areas where no official screening guidelines are in effect. Finally, previous studies surveyed highly selected populations [10,12,13,17,18], relied upon small samples [10,13,18,19], had low participation rates [13,16,17,19], or focused on only a few stages of adoption [10,15,16,18].

In this paper, we describe stages of adoption of mammography screening among randomly selected women residing in Geneva, Switzerland, 1 year before the launching of a state programme of breast cancer screening. We examine six important stages of mammography adoption and explore their relations with Rakowski's scales of pros and cons of mammography screening [11], while taking into account predisposing, enabling and reinforcing variables derived from previous work [5,6,9].

2. Patients and methods

2.1. Setting and context

The Geneva health authorities launched a state-wide programme of breast cancer screening in March 1999. The programme advocates biennial two-view mammograms with independent double reading for the 49 000 women aged 50–69 years residing in the state. The present study assessed the baseline situation, 1 year before programme initiation. At that time, only mammograms ordered for diagnostic purposes were covered by mandatory basic health insurance contracts and, as no local screening guidelines had yet been released, screening mammograms still resulted only from individual decisions made by women and their physicians.

2.2. Study population

We conducted a mail survey of 1400 women aged 40–80 years, randomly selected from the general population. The Geneva Population Bureau provided the name, address, date of birth, marital status and nationality of the prospective participants.

2.3. Dependent variable

The stages of adoption of mammography screening [14] were defined as follows: (1) *Precontemplation*: never had a screening mammogram and has no intention to have one in the next 6 months; (2) *Contemplation*: no screening mammogram in the past 2 years, but plans to have one in the next 6 months; (3) *Action*: no screening mammogram 2–4 years ago, has had one in the past 2 years, and intends to have mammograms in the future; (4) *Maintenance*: at least two screening mammograms in the past 4 years, one of them in the last 2 years, and plans to have mammograms in the future; (5) *Relapse risk*: one screening mammogram in the last 2 years or

two mammograms on schedule in the last 4 years, but no intention to get another one in the future; (6) *Relapse*: one or more screening mammograms in the past, none during the last 2 years, and does not plan to get one in the next 6 months.

Definitions of mammograms performed for diagnostic and screening purposes were provided. Women were asked to report screening mammograms only.

2.4. Independent variables

2.4.1. Pros, cons and decisional balance

Opinions about the positive (pros) and negative (cons) aspects of mammography screening were assessed with a translated version of the 10-item scale developed by Rakowski and colleagues [11] (Table 1). Responses were measured on a five-point Likert scale ranging from 'Totally disagree' to 'Totally agree'. Raw scores of pros and cons were obtained by averaging responses to the items corresponding to each subscale. Scores were computed whenever a woman answered more than half of the items on a scale. Raw scores were transformed into T-scores (mean = 50, Standard deviation (S.D.) = 10). The decisional balance index was obtained by subtracting the cons T-score from the pros T-score. Positive values of decisional balance reflect a globally favourable attitude toward mammography, negative values an unfavourable attitude.

2.4.2. Predisposing characteristics

Two items assessed beliefs about screening recommendations and perceived risk of breast cancer (Table 2). Gail's equation was used to estimate the objective risk of breast cancer [22]. Women who were in the highest tertile of relative risk (RR) were considered to be at high risk of breast cancer (RR = 1.88–8.3, highest value observed).

The questionnaire also asked about age, marital status, country of birth and level of education.

2.4.3. Enabling characteristics

Enabling variables were: net monthly income per person in household, reluctance to pay for a mammogram, and perceived usefulness for oneself of a mammography screening programme that would check mammogram quality and let women know when they are due (Table 3).

2.4.4. Reinforcing characteristics

Factors that reinforce a health behaviour derive from past experience with that behaviour and its consequences [9]. We considered two such factors: having had more than two screening mammograms in a lifetime, and history of surgical breast biopsy. Because these factors are irrelevant to most women in precontemplation or contemplation, analyses were limited

Table 1

Descriptive statistics and factor analysis (principal component analysis, varimax rotation) of a French version of Rakowski's scales of pros and cons of mammography screening in 909 women free of breast cancer, aged 40–80 years, and residing in Geneva, Switzerland

	Percent responding			Factor loading		
	Missing	Totally agree	Totally disagree	Mean (SD)	Factor 1	Factor 2
Pros						
I will feel better about myself if I have a mammogram	4.7	46.1	6.3	4.1 (1.2)	0.00	0.82
I am confident that I can have mammograms on a regular schedule	7.6	37.8	4.2	4.0 (1.1)	−0.08	0.56
Having a regular mammogram will give me a feeling of control over my health	2.4	50.4	4.3	4.2 (1.1)	−0.08	0.80
Mammograms are now a very routine medical test	2.0	61.2	5.0	4.3 (1.1)	0.16	0.44
My family will benefit if I have a mammogram	3.3	46.2	4.4	4.1 (1.1)	0.07	0.80
Cons						
If my doctor does not mention a mammogram, neither will I	2.2	7.6	46.9	2.2 (1.4)	0.73	−0.12
Mammograms have a high risk of leading to surgery that is not needed	2.6	0.7	55.3	1.9 (1.1)	0.69	0.17
If my doctor gives me a breast exam, then I do not need to have a mammogram	2.2	6.6	45.3	2.1 (1.3)	0.77	−0.04
I would probably not have a mammogram unless I had a problem with my breasts	3.2	9.7	53.4	2.0 (1.4)	0.80	−0.02
Once I have a couple of mammograms in a row that showed no problems, I don't need any more mammograms	2.5	12.4	44.5	2.3 (1.4)	0.72	0.09

Answer scale: 1, totally disagree, to 5, totally agree; the French version of the scales of pros and cons can be obtained from the first author upon request.

to women in action, maintenance, relapse risk and relapse.

2.5. Translation, pretest and data collection

A professional translator and two bilingual epidemiologists independently translated the items from English to French; the questionnaire was refined during a phase of pilot testing on a sample of 31 public health specialists and female volunteers.

The initial mailing took place in January 1998. A postcard reminder and three additional mailings were sent to non-respondents over the next 3 months.

2.6. Statistical analysis

2.6.1. Pros and cons scales

Percentages of missing values were computed as an indication of the acceptability of each item. Factor analysis followed by varimax rotation was performed on the items of pros and cons to identify independent dimensions of opinions toward mammography.

2.6.2. Transtheoretical model

We used Chi-square tests to compare distributions of discrete variables across stages of adoption. One-way analysis of variance was performed to assess differences in mean scores of pros, cons and decisional balance across stages of adoption.

The TTM does not specify the precise nature of the relations between scores of pros and cons, and stages of adoption. Therefore, we conducted two sets of multi-

variate analyses, each relying upon different assumptions regarding the functional relationships among covariates and stages of adoption. First, ordinal logistic regression (proportional odds regression analysis) was used to assess the contribution of independent variables in predicting stages of adoption. This analysis assumed *uniform relationships* between the covariates and stages of adoption *across* a sequence of stages. Because relapse risk and relapse do not fit in the logical flow of obligatory steps from precontemplation to maintenance, and occur only in women who have already been in action or maintenance, we fitted one model for the progression from precontemplation to maintenance, another for the backward shift from action/maintenance to relapse. The later model was stratified on the number of screening mammograms within the past 4 years, to account for the possibility that some women may pass from action to relapse risk and relapse without transiting through maintenance. Variables that predicted stages of adoption in bivariate analysis at $P < 0.20$ were included in the initial models; a backward strategy was then used to delete covariates that were not significant at $P \leq 0.05$ in either models. Ordinal logistic regression analyses were repeated with decisional balance replacing the pros and cons.

In the second analysis, logistic regression with binary outcome was used to conduct *pairwise comparisons* between stages of adoption. The goal was to determine whether any variable specifically predicted adhesion to only certain stages of adoption. We applied the same decision rules for variable inclusion as in the models above.

Table 2

Stages of adoption of mammography screening as a function of predisposing characteristics in a random sample of 827 women free of breast cancer, aged 40 to 80 years, and residing in Geneva, Switzerland^a

Characteristic	Total <i>n</i> (%)	Stage of adoption						<i>P</i> value
		Precontemplation (<i>n</i> = 191) column%	Contemplation (<i>n</i> = 112) column%	Action (<i>n</i> = 84) column%	Maintenance (<i>n</i> = 246) column%	Relapse risk (<i>n</i> = 58) column%	Relapse (<i>n</i> = 136) column%	
Is mammography screening recommended in Switzerland among women your age? Yes, once every year or two	471 (57.0)	28.8	69.6	67.9	85.4	55.2	28.7	<0.001
High objective risk of breast cancer (missing = 95), RR ≥ 1.88	230 (31.4)	25.6	30.6	30.1	40.3	32.1	24.8	0.02
Compared with other women, you consider that your risk to have breast cancer one day is... (Missing = 24, don't know = 248)								<0.001
Lower	122 (22.0)	31.4	14.3	22.8	17.3	23.5	23.7	
Similar	384 (69.2)	66.9	78.6	70.2	65.9	64.7	72.2	
Higher	49 (8.8)	1.7	7.1	7.0	16.8	11.8	4.1	
Age (years)								<0.001
40–49	274 (33.1)	57.1	31.3	33.3	15.0	19.0	39.7	
50–69	438 (53.0)	27.2	56.3	57.1	77.2	60.3	36.8	
70–80	115 (13.9)	15.7	12.5	9.5	7.7	20.7	23.5	
Married (missing = 4)	517 (62.8)	56.5	61.6	67.5	70.8	62.1	55.9	0.02
Born in Switzerland (missing = 3)	633 (76.8)	77.0	72.3	77.1	79.5	69.0	78.7	0.50
Education ≤ 10 years (missing = 49)	227 (29.2)	30.6	35.2	25.3	24.5	20.4	28.7	0.15

Chi-square tests of independence were used to compare distributions of stages of mammography adoption across categories of independent variables.

^a Women with a missing stage of adoption were excluded (*n* = 82).

Table 3

Stages of adoption of mammography screening as a function of enabling and reinforcing characteristics in a random sample of 827 women free of breast cancer, aged 40–80 years, and residing in Geneva, Switzerland

Characteristic	Total ^a <i>n</i> (%)	Stage of adoption						<i>P</i> value
		Precontemplation (<i>n</i> = 191) column%	Contemplation (<i>n</i> = 112) column%	Action (<i>n</i> = 84) column%	Maintenance (<i>n</i> = 246) column%	Relapse risk (<i>n</i> = 58) column%	Relapse (<i>n</i> = 136) column%	
Self-reported net income per month per person ≤ 1500 Swiss Franc ^b (Missing = 154)	153 (22.7)	34.2	27.5	16.7	14.6	27.0	19.8	<0.001
Would not get a mammogram for the only reason that incurred cost is Swiss Franc 200 ^c (missing = 109)	105 (14.6)	19.2	19.1	16.4	5.0	24.4	17.4	<0.001
Thinks that the future state programme of breast cancer screening will be useful to her personally (missing = 66)	605 (79.5)	71.5	93.9	83.6	78.4	88.7	75.2	<0.001
Had more than two screening mammograms in her lifetime ^d (missing = 3)	381 (73.1)	–	–	19.0	71.1	31.0	16.9	<0.001
Ever had a surgical breast biopsy ^d (missing = 7)	53 (10.3)	–	–	0.0	15.3	8.6	8.1	<0.001

Chi-square independence tests were used to compare distributions of stages of mammography adoption across categories of independent variables.

^a Women with a missing stage of adoption were excluded (*n* = 82).

^b In October 2000, 1 Swiss Franc was equal to US\$0.56.

^c Amount charged for a screening mammogram in Geneva.

^d Analysis limited to the 524 women who were in action, maintenance, relapse risk or relapse.

3. Results

Of 1400 women contacted, 62 were not eligible (had died, were too ill, had moved out of the state or did not speak French). Of the remaining 1338 women, 952 responded (71.2%). Participants and non-participants differed in age (mean: 56.4 years versus 58.3 years, $P = 0.005$), marital status (married: 62.1% versus 55.6%, $P = 0.005$), and nationality (Swiss: 76.8% versus 62.1%, $P < 0.001$). 43 women (4.5%) reported a history of breast cancer and were removed from further analysis, leaving a final sample size of 909.

3.1. Stages of adoption

The stage of mammography adoption was defined for 827 women (91.0%) of whom 191 were in precontemplation (23.1%), 112 in contemplation (13.5%), 84 in action (10.2%), 246 in maintenance (29.7%), 58 in relapse risk (7.0%), and 136 in relapse (16.4%).

3.2. Pros, cons and decisional balance

Scores of pros and cons of mammography screening were computed for 885 women (97.4%). Proportion of missing responses per item were low (Table 1), but increased with age (data not shown). The proportion of women who totally agreed with each item of pros and totally disagreed with each item of cons ranged from 37.8 to 61.2 and 44.5 to 55.3%, respectively.

The mean raw score was 20.72 (S.D. 4.05) for pros and 10.40 (S.D. 4.72) for cons. Factor analysis identified

the same two principal components as reported by Rakowski and colleagues 11; these accounted for 53.1% of total variance (28.1% for the cons and 25.0% for the pros). Items loadings confirmed a clean bidimensional structure (Table 1). Cronbach's alpha was 0.72 for the pros and 0.80 for the cons. The Pearson correlation coefficient between the two scales was -0.54 ($P < 0.001$).

A floor effect was observed only for the score of cons (19.0% of respondents), a ceiling effect only for the scores of pros (23.5%) and decisional balance (9.9%).

3.3. Bivariate correlates of stages of adoption

Both pros and cons were significantly associated with the stages of adoption in bivariate analysis. Mean T-scores of pros increased from precontemplation to maintenance, then decreased to relapse ($P < 0.001$); cons followed an opposite pattern ($P < 0.001$; Fig. 1). The mean scores of decisional balance were -14.4 in precontemplation (S.D. 18.4), 3.0 in contemplation (S.D. 12.9), 7.2 in action (S.D. 12.5), 11.0 in maintenance (S.D. 10.0), -3.8 in relapse risk (S.D. 16.7), and -5.9 in relapse (S.D., 16.5; $P < 0.001$).

Among predisposing variables, belief about screening recommendations, objective and subjective risk of breast cancer, age and marital status were significantly associated with stage of adoption (Table 2). Women in maintenance were the most likely—and women in precontemplation/relapse the least likely—to believe that mammography screening was recommended in Switzerland at least once every 2 years among women of their age. The proportion of women at high objective risk of breast

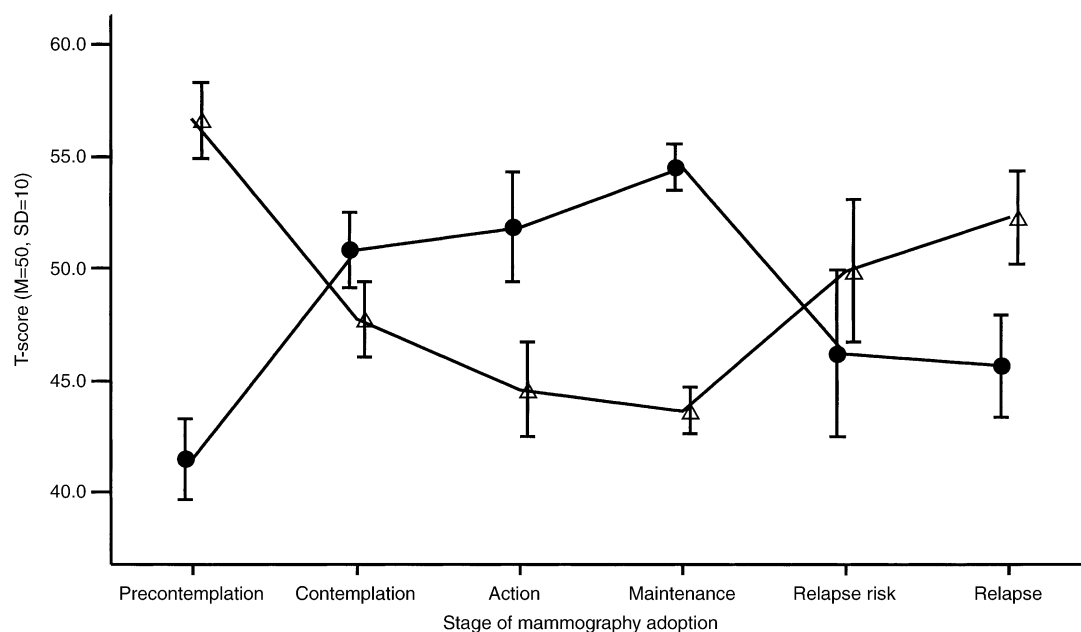


Fig. 1. Mean T-scores (95% confidence intervals) of pros (dots) and cons (triangles) by stage of adoption of mammography screening in women aged 40–80 years residing in Geneva, Switzerland. Pros, $P < 0.001$; cons, $P < 0.001$.

cancer was the highest among women in maintenance and the lowest among women in precontemplation/relapse. As for perceived risk, women in precontemplation were the most likely to consider that their risk of having breast cancer one day was lower than for other women; women in maintenance held opposite beliefs. The proportion of women eligible for regular screening (i.e. aged 50–69 years) increased from precontemplation to maintenance and decreased from maintenance to relapse. Married women were more likely to be in action/maintenance and less likely to be in precontemplation/relapse.

All enabling characteristics were significantly related to stages of adoption (Table 3). Low income women were less likely to be in action/maintenance and more likely to be in precontemplation. Women at risk of relapse were the most likely not to get a mammogram due to the cost, and women in maintenance the least likely. The proportion of women who considered that the future breast cancer screening programme would be useful to them personally was the highest among women in contemplation and relapse risk, and the lowest among women in precontemplation and relapse.

Approximately one-third of women at relapse risk, and one-fifth of women in action and relapse had had more than two screening mammograms in the past. The proportion of women who reported a history of breast biopsy was the highest among women in maintenance and zero among women in action.

3.4. Multivariable analyses

3.4.1. Ordinal logistic regression

Seven variables were significantly and independently associated with progression from precontemplation to maintenance, backward shift from action/maintenance to relapse, or both: pros, cons, belief about screening recommendations, objective risk of breast cancer, marital status, income (Table 4) and age (data not shown).

Women who had had three or more screening mammograms during their lifetime were also significantly less likely to be in relapse risk or relapse (adjusted OR: 0.59; 95% CI: 0.37–0.93; $P=0.03$). Nevertheless, this variable being irrelevant to precontemplators and most contemplators was excluded from the final models to facilitate comparisons of predictors of progression and regression across stages of adoption.

In general, covariates positively associated with progression from precontemplation to maintenance were negatively associated with regression from action/maintenance to relapse, and vice versa. However, pros scores were positively associated with transitions from precontemplation to maintenance, but not with regression toward relapse. Similarly, although high objective risk of breast cancer was positively associated, and low income negatively associated, with progression from precontemplation to maintenance, neither variable significantly predicted transitions from action/maintenance to relapse.

Table 4

Results of proportional odds regression models describing characteristics associated with stages of adoption of mammography screening in a random sample of 827 women aged 40–80 years residing in Geneva, Switzerland, after controlling also for age (not shown)

	From precontemplation to maintenance			From action/maintenance to relapse ^a		
	OR ^b	95% CI	<i>P</i> value	OR ^b	95% CI	<i>P</i> value
Pros (T-score), 10-unit increment	1.7	1.3–2.2	<0.001	0.80	0.62–1.0	0.10
Cons (T-score), 10-unit decrement	0.37	1.7–4.3	<0.001	1.9	1.4–2.6	<0.001
Believes mammography screening is recommended for women of her age category						
No, 'Don't know', or 'yes once every 4 years' ^c	1.0			1.0		
Yes, at least once every 2 years	2.7	0.29–0.49	<0.001	0.31	0.19–0.52	<0.001
High objective risk of breast cancer						
No ^c	1.0			1.0		
Yes	1.5	1.0–2.4	0.05	0.82	0.54–1.2	0.35
Married						
No ^c	1.0			1.0		
Yes	1.8	1.2–2.7	0.007	0.60	0.39–0.93	0.02
Income per month per person ≤1500 Swiss Franc ^d						
No ^c	1.0			1.0		
Yes	0.57	0.36–0.91	0.02	0.81	0.49–1.4	0.43

^a Model stratified on having had at least two screening mammograms within the past 4 years, to account for the possibility of direct transitions from action to relapse risk or relapse, without passing through maintenance.

^b OR, odds ratio; 95% CI, 95% confidence interval.

^c Reference category.

^d In October 2000, 1 Swiss Franc was equal to US\$0.56.

Proportional odds regression analyses were repeated after replacement of pros and cons scores with the corresponding scores of decisional balance. The substitution had virtually no effect on other variables (variation $\leq 10\%$ both for point estimates and confidence intervals). In the new models, for each 10-unit increment of decisional balance score, women were 2.1 (95% CI: 1.8–2.5) times more likely to be in a more advanced stage (between precontemplation and maintenance) and 1.5 (95% CI: 1.3–1.8) less likely to regress from action/maintenance to relapse.

3.4.2. Logistic regression for binary outcome

Pairwise comparisons between stages of adoption qualified the global results of ordinal analysis, suggesting that pros, cons, and belief about screening recommendations may independently contribute more to some transitions between stages of adoption than others (Table 5). Moreover, because the sample size was reduced and the percentage of women who were at high risk of breast cancer, married or had a low income varied only slightly between any two consecutive stages of adoption, none of these variables significantly contributed to any multivariate model of pairwise comparisons. In contrast, perceived utility for oneself of an organised programme of breast cancer screening was positively associated with contemplation versus precontemplation, and negatively associated with action versus contemplation and relapse versus relapse risk. Women who would not have a mammogram because of the incurred cost were significantly more likely to be in contemplation than precontemplation and less likely to be in maintenance than action. After adjustment, women with higher scores of pros and lower scores of cons were significantly more likely to be in relapse than precontemplation (Table 5). In contrast, scores of pros and cons did not independently predict whether a woman was in relapse risk or contemplation (data not shown).

4. Discussion

This study provides support for the validity of central elements of the TTM of behaviour change applied to mammography screening outside North America, in a context where no official guidelines or screening programme had been established. The model appears sufficiently robust to withstand translation into a different cultural context, which supports its general value for understanding human health-related behaviour.

Although it remains unclear whether a common set of pros and cons are relevant to most women, our results suggest that transculturally salient pros and cons exist. The observed pattern of relationships among pros, cons, decisional balance and stages of mammography adoption matched the theoretical predictions. The psychometric properties of Rakowski's shortest instrument of

pros and cons were remarkably similar in the Swiss and American contexts [11], and we were able to replicate the main findings of studies that relied upon longer and newer scales of pros and cons [12–14]. In ordinal logistic regression models that assumed uniform associations between covariates and logically ordered stages of adoption (Table 4), the scores of pros were significantly and independently associated with the transitions from precontemplation to maintenance only, whereas cons and decisional balance were consistently associated with all stages of adoption. These results are in agreement with previous studies [15], including some in which scores of pros and cons were replaced by estimates of benefits and barriers—two related constructs of the Health Belief Model [18,19]. Ordinal logistic regression analyses also showed that decisional balance can conveniently replace the pros and cons to adjust for attitudes toward mammography in multivariate models aimed at identifying predictors of stages of mammography adoption, but that this practice may lead to loss of information.

In further analyses (Table 5), pairwise comparisons between adjacent stages of adoption indicated that the pattern of relationships between pros, cons and stages of adoption may be more complex. For instance, pros and cons apparently play little independent role in explaining the regression from relapse risk to relapse.

We also examined the relationships between stages of adoption and several predisposing, enabling, and reinforcing variables relevant to the planning phase of an organised programme of mammography screening. Although these variables were measured by single items, associations were in the expected direction, most of them highly statistically significant. Four predisposing variables (belief about mammography recommendations, objective risk of breast cancer, marital status, and age), all enabling variables, and one reinforcing variable (having had three or more screening mammograms), also predicted some or all transitions between stages of adoption, beyond the pros and cons (Tables 4 and 5).

Four practical messages follow from our data. First, low-income women were more likely to be in the least favourable stages of mammography adoption and women in contemplation and action were most concerned about mammogram cost; therefore, the issue of adequate insurance coverage will probably be an important determinant of the ultimate success of the new state programme of mammography screening.

Second, unmarried women were less likely to be in action or maintenance; this result suggests that an organised screening programme may be useful to women living independently. Because positive attitudes toward such a programme prevailed among women in contemplation and relapse risk (Table 5), it may be particularly helpful in promoting transitions between contemplation and action and in preventing relapse among women who currently undergo active screening.

Table 5
 Results of logistic regression analysis of characteristics associated with stages of adoption of mammography screening in a random sample of 827 women aged 40–80 years residing in Geneva, Switzerland

	Contemplation versus precontemplation OR (95% CI) ^a	Action versus contemplation OR (95% CI) ^a	Maintenance versus action OR (95% CI) ^a	Relapse risk versus maintenance/action OR (95% CI) ^a	Relapse versus relapse risk OR (95% CI) ^a	Relapse versus precontemplation OR (95% CI) ^a
Pros (T-score), 10-unit increment	1.8 (1.1, 2.8)**	1.0 (0.60, 1.7)	1.3 (0.83, 1.9)	0.70 (0.45, 1.1)	1.2 (.77, 2.0)	1.4 (1.0, 1.9)*
Cons (T-score), 10-unit decrement	0.46 (0.29, 0.72)***	0.55 (0.32, 0.95)*	0.76 (0.47, 1.2)	2.5 (1.5, 4.2)***	1.0 (.57, 1.7)	0.69 (0.51, 0.92)**
Believes mammography screening is recommended for women of her age category						
No, 'Don't know', or 'yes once every 4 years' ^b	1.0	1.0	1.0	1.0	1.0	1.0
Yes, at least once every 2 years	3.4 (1.6, 7.0)***	0.70 (0.31, 1.6)	2.0 (0.97, 4.2)	0.73 (0.31, 1.7)	0.29 (0.11, 0.76)**	0.74 (0.40, 1.3)
Perceived utility for oneself of a state programme of breast cancer screening by mammography						
Useless ^b	1.0	1.0	1.0	1.0	1.0	1.0
Useful	3.5 (1.1, 10.8)*	0.29 (0.09, 0.91)*	0.76 (0.36, 1.6)	2.2 (0.72, 6.8)	0.24 (0.07, 0.88)*	0.94 (0.49, 1.8)
Would not get a mammogram for the only reason that it costs Swiss Franc 200 ^b						
No ^b	1.0	1.0	1.0	1.0	1.0	1.0
Yes	2.8 (1.1, 7.3)*	0.82 (0.32, 2.1)	0.34 (0.13, 0.90)*	1.4 (0.49, 3.7)	0.51 (0.18, 1.5)	1.4 (0.69, 2.8)

All results were also adjusted for age (data not shown); the models 'relapse risk versus maintenance/action' and 'relapse versus relapse risk' were stratified on the number of screening mammograms within the past 4 years. * $P=0.05$; ** $P=0.01$; *** $P=0.001$.

^a OR, odds ratio; 95% CI, 95% confidence interval.

^b Reference category.

Third, our results indicate that lack of information about who may benefit from regular screening is both prevalent and related to the stage of adoption. Women in precontemplation and relapse were the least likely to believe that regular mammography screening was recommended to women their age. Programme managers should not assume that women know who is eligible, but provide extensive information in this regard.

Finally, having undergone a surgical breast biopsy does not appear to prevent further participation in screening, since history of breast biopsy was not associated with being in relapse risk or relapse.

A strength of this study is its reliance both upon analyses that contrasted several stages of adoption and pairwise analyses comparing adjacent stages. Each strategy identified sets of predictors of mammography adoption that overlapped only partially and enlightened unique aspects of the relationships between predictors and stages of adoption. Nevertheless, our work has several limitations. Respondents and non-respondents differed in their demographic characteristics. Extrapolation of findings seen among respondents suggested that non-respondents were probably less likely to have favourable attitudes towards mammography and to actively engage in screening. Hence, our descriptive data may be overly optimistic. In addition, because our study was cross-sectional, we cannot establish whether the observed associations were causal. We relied upon the shortest available scale of pros and cons [11]; but additional items reflecting low perceived risk of breast cancer and reluctance to pay have been included in newer scales [12–14]. Finally, to keep our questionnaire reasonably short, we did not assess the processes-of-change for mammography, a complementary construct of the TTM which attempts to describe the cognitive and behavioural strategies women use to move toward maintenance [12].

In summary, this study confirmed the applicability of key components of the TTM of behaviour change to mammography screening in a non-US context, and showed that simple questions assessing stages of adoption, brief scales of pros and cons, and single items describing additional relevant variables could be used to depict mammography behaviour in a general population. These results should help develop parsimonious evaluation tools to monitor mammography coverage in the target population of organised screening programmes, and to compare programme performances across populations.

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