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Temporal trend in socio-economic inequalities in the uptake of cancer screening programs in France between 2005 and 2010: Results from the cancer barometer surveys

Journal:	BMJ Open
Manuscript ID	bmjopen-2017-016941
Article Type:	Research
Date Submitted by the Author:	30-Mar-2017
Complete List of Authors:	Kelly, David; Institut National du Cancer, Social sciences, Epidemiology, Public Health Estaquio, Carla Leon, Christophe Arwidson, Pierre Nabi, Hermann; Institut National du Cancer, Research in Social and Human Sciences, Epidemiology and Public Health
Primary Subject Heading :	Epidemiology
Secondary Subject Heading:	Epidemiology, Public health, Health services research
Keywords:	cancer screening, Social inequalities, cancer epidemiology

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Temporal trend in socio-economic inequalities in the uptake of cancer screening programs in France between 2005 and 2010: Results from the cancer barometer surveys

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Word count: Abstract = 288; Text =3212

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ABSTRACT

Objectives: Cancer screening is a form of secondary prevention for a disease which is now the leading cause of death in France. Various socio-economic indicators have been identified as potential factors for disparities in cancer screening uptake. Our study aims to identify the socioeconomic inequalities which persist for screening uptake, and to quantify these disparities over a 5year period.

Setting: The Cancer barometer is a population-based survey carried out in 2005 and 2010 across France.

Participants: A total of 4000 randomly selected participants aged 15 to 85 years, are questioned on their participation in breast, cervical and colorectal cancer screening programs and their socioeconomic profile.

Primary and secondary outcome measures: For each type of screening program, we calculated participation rates, odds ratios (OR) and relative inequality indices (RII) for participation. derived from logistic regression of socio-economic variables. Changes in participation between 2005 and 2010 were then analyzed.

Results: Participation rates for breast and colorectal screening increased significantly along the majority of socio-economic categories, whereas for cervical screening there were no significant changes between 2005 and 2010. The magnitude of RIIs for income decreased for all 3 screening programs in 2010. The relative inequalities for education in mammography (RII=0.40, 95% CI 0.18 to 0.90) and cervical smear (RII=0.35, 95% CI 0.20 to 0.60) were significant in 2005, and increased for cervical smear (RII=0.30, 95% CI 0.16 to 0.54) in 2010.

Conclusions: There is a persistence of socio-economic inequalities in uptake of non-organized cervical cancer screening. Conversely, organized screening programs for breast and colorectal

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cancer saw a reduction in socio-economic inequalities. Deficiencies in knowledge of, access to and affordability of cancer screening programs are likely to be responsible for the socio-economic disparities in participation.

Key words: cancer screening, breast cancer, cervical cancer, social inequalities, cancer epidemiology

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Strengths and limitations of this study

- First study to examine temporal changes in inequalities for cancer screening uptake in • France using relative inequality index.
- Benefits from datasets of two identical questionnaires on cancer screening uptake, taken 5 years apart, using two comparable population samples, hence minimizing selection and information bias.
- Evolution in the format of colorectal screening program in terms of technique and age limits may have led to measured differences in uptake between 2005 and 2010.
- Residents of collective dwellings, hospitals and other institutions were excluded from the survey, limiting the generalisability of the findings.
- Rrelatively small number for certain socio-economic strata, reducing therefore the precision of some estimates.

INTRODUCTION

Screening for cancer is an important form of secondary prevention for a disease which is now a leading cause of death in France and worldwide [1]. The 2008 European report on cancer recommends that health systems focus their resources on cancer prevention and early detection rather than treatment alone, as the global disease burden of cancer threatens to become unsustainable in terms of financial costs, pressure on services, follow-up of patients and delivery of care [2].

To date, many European countries have rolled out screening programs for breast cancer, colorectal cancer, cervical cancer via mammography, faecal occult blood test (FOBT) and cervical smear, respectively [3, 4]. However, for these screening programs to have a significant effect on reducing cancer mortality, they require a minimum level of participation among the eligible population; for instance 70% for mammography, and 50% for FOBT [5]. Although the determinants of participation in screening programs are multiple, several studies have identified various indicators as potential explanatory factors for sub-optimal participation among populations.

We identified several publications from France, UK, USA, Italy, Denmark, Korea and Argentina, which identified variables shown to have a consistently significant effect on cancer screening uptake [6-19]. For breast cancer screening, various social and economic variables were found to be significant across the different studies. No recurring variable was observed, with the exception of participation in other screening programs [7, 17]. For cervical cancer screening, the variables identified as having a significant effect on uptake were more numerous, and notably consistent for income [7, 11, 19], education level [10-12, 17, 19], employment [6, 12, 17, 18] and private health insurance [6, 7, 17]. For colorectal screening, general practitioners' (GP) consultation [6, 7, 17, 18] was consistently shown to have a significant effect on uptake of screening across the

> studies, as well as income [14, 16, 17]. However, it remains unclear whether the effect of these socio-economic variables on participation rates in screening programs persists over time.

ben6⁶first published as 10.1136/bmjopen-2017-016941 on 14 December 2017. Downloaded from http://bmjopen.bmj.com/ on June 8, 2025 at Department GEZ-LTA Erasmushogeschool generation of the state of We found only one study [6] that examined the temporal evolution in screening uptake rates along socio-economic strata in France. In this study, the authors found that inequalities for participation in breast and colorectal cancer screening persisted over the study period. Thus, we believe that there is a need to re-examine how these trends may have evolved with respect to expansion in the coverage and awareness of organized cancer screening programs. The third French National Cancer Action Plan for the 2014-2019 period has identified early detection of cancers as a primary priority [20]. Within this goal is the reduction of inequalities associated with cancer diagnosis, with the hope that it subsequently reduces incidence rates. Any widening or reduction in socio-economic inequalities in the uptake of screening programs that are identified may then be used to direct future policy of the French national cancer control plan, which specifically seeks to address this issue [20]. We aim therefore in the present study to identify the socio-economic inequalities which persist for screening uptake, and to quantify these disparities over a 5 year period in France.

MATERIALS AND METHODS

Study population

We used data from Cancer Barometer surveys, two telephone surveys on cancer-related knowledge, attitudes, beliefs and practices conducted by the French National Institute for Prevention and Health (INPES). Both two surveys were carried out on a representative random sample of the general population aged over 16 years old for the first survey and aged 15–85 years old for the second, living in France. We used a two-stage random sampling design. Residents of

collective dwellings, hospitals and other institutions were excluded from the surveys. Private households with telephones were included in the sample. The first sampling step was household selection (by phone number). Within each selected household, one French speaking person aged 15–85 was randomly selected using the "next birthday" method. The interviews were conducted using a computer-assisted telephone interview (CATI) system.

The 2005 Cancer Barometer sample [17], was comprised of 4046 participants aged over 16 years interviewed between April and June 2005. Female responded more often than men (2422 vs. 1624) and mean age of interviewees was 46.7 years. There were 226 individuals with missing observations in the 2005 Cancer Barometer sample, notably for all 3 of the dependent variables, and 7 out of 10 of the covariates and independent variables. These individuals terminated the survey prematurely, and were thus removed from the analysis as their data was non-contributive, leaving 3820 participants in the sample population. The 2010 Cancer Barometer sample was comprised of 3727 participants aged 15 to 85 interviewed during the first semester of 2010 [18]. The mean age was 44.6 years and the majority of participants were also female (2124 vs 1603).

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Measures

Socio-economic indicators (independent variables) were as follows: education level (inferior, equal to, superior to baccalauréat), employment status (employed, unemployed, inactive), occupational class (farmer, trader, manager, professional, employee, manual worker, other), monthly income (below $\in 1000$, $\in 1000-1500$, above $\in 1500$) and health insurance (complementary vs. basic insurance coverage). The outcome variables were participation in breast, cervical and colorectal cancer screening programs (dependent variables). For breast cancer screening, participants aged over 40 years were asked if they had undergone mammography within the previous 2 years. For cervical cancer screening, participants aged over 20 years were asked if they had undertaken a cervical smear within the previous 3 years. For colorectal cancer screening,

Den⁶first published as 10.1136/bmjopen-2017-016941 on 14 December 2017. Downloaded from http://bmjopen.bmj.com/ on June 8, 2025 at Department GEZ-LTA Erasmushogeschool ege Protected by copyright, including for uses related to text and data mining, Al training, and similar technologies. participants aged 50-74 years were asked if they had undertaken a faecal occult blood test (FOBT) within their lifetime. Covariates included gender, smoking status, alcohol consumption, region, living in a couple and having a close relative with cancer. For the calculation of screening participation rates, we added filters to select the target population eligible for each of the 3 different screening programs. Breast screening by mammography: female gender and 49<age<75. Cervical screening by cervical smear: female gender and 24<age<66. Colorectal screening by FOBT: both genders where 49<age<75.

The weighting was based on the data of the 1999 and 2008 employment survey of the French population [21], taking into account age, gender, region, education level and number of persons per household [17]. This allowed us to effectively calculate age-adjusted standardized rates for screening participation, in addition to later adjusting the regression models on the covariates mentioned.

Statistical analysis

We calculated age-adjusted screening rates (AAR) for each stratum using the weighting provided by the INPES. The temporal evolution in the participation rate along each stratum between 2005 and 2010 was examined using a Chi squared test. The disparity within each socio-economic variable was calculated as the absolute difference between the AAR for the highest and lowest group within an ordinal or binary variable for the given year.

Odds ratios (OR) derived from univariate logistic regression of screening participation on each socio-economic variable separately were used as a measure of participation likelihood for each stratum of the 6 socio-economic variables. The model was adjusted on the covariates: gender (colorectal screening only), region, alcohol, smoking, living in couple and close relative with cancer. For categorical variables, the higher socio-economic position was used as the reference

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group. The p-value for significance of the evolution of the odds ratios between 2005 and 2010 was calculated using an interaction term between the socio-economic variable and the time period, in order to be consistent with the methodology of previous studies on the topic [22, 23].

For ordinal variables of income and education level, we calculated the Relative Inequality Index (RII) as a measure of health inequality. Previous studies on health inequalities, including breast cancer screening uptake [4, 9], employed a similar methodology for examining temporal evolutions along ordered socio-economic strata [22, 24]. The RII takes into account the proportion of the population within each stratum of a categorical socio-economic variable, which is used to create a separate independent variable that ranges from 0 to 1. This variable is calculated as the mid-point of the proportion within each stratum, added to the proportion of the population in the preceding stratum, beginning with the most favorable stratum. The RII provides the magnitude of the inequality in screening rates by comparing the Odds ratio of the most favorable socio-economic strata with that of the least favorable. All statistical analysis was performed using SAS version 9.2.

RESULTS

Table 1 presents the demographic and socio-economic characteristics of the study populations. The screening participation rates included only the eligible populations for each program. Table 2 shows the Chi2 test for the change in participation rates along each socio-economic stratum between 2005 and 2010. For mammography, participation rates increased significantly (p<0.05) along all socio-economic strata, with the exception of farmers, managers, manual workers, unemployed, basic health insurance and education level superior to baccalauréat. For FOBT, participation rates increased significantly along all socio-economic strata between, with the exception of those unemployed or occupation classified as other. For cervical smear there were no significant changes in participation rates along any of the socio-economic strata, except for those

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without complementary health insurance, which increased significantly from 52.51% to 71.0% (p=0.017).

Table 3 shows the results of the logistic regression models for mammography participation on each socio-economic variable separately, adjusted for covariates. In 2005, farmers, self-employed, employees and manual workers showed significantly reduced participation compared to managers/executives, whereas in 2010 only the association in manual workers remained significant. For income, those earning ≤ 1000 (OR=0.49, 0.28-0.87) showed significantly reduced participation compared to those earning \geq 1500 in 2005, which became non-significant in 2010 (OR=0.75, 0.36-1.57). In 2005, those with an education inferior to baccalauréat (OR=0.55, 0.33-0.91) showed significantly reduced participation compared to those superior to baccalauréat, which became nonsignificant in 2010 (OR=0.98, 0.50-1.93).

Table 4 shows the results of the regression model for cervical smear participation for each socio-economic variable. In 2005, significantly reduced participation was observed for selfemployed and manual workers, which became non-significant for both in 2010. In 2005, there was significantly reduced participation for those earning $< \in 1000$ and $\in 1000 - \in 1500$, which remained significant in 2010 for those earning <€1000. An education level inferior to baccalauréat showed significantly lower participation in both 2005 and in 2010. In 2005, being unemployed or inactive significantly reduced participation, and remained significant for both in 2010. The odds ratio for cervical smear participation changed significantly (p=0.010) for those without complementary health insurance from 0.29 (0.17-0.49) in 2005 to 0.69 (0.41-1.17) in 2010. Having only basic health insurance was significantly associated with reduced participation in both periods.

Table 5 shows the logistic regression results for FOBT participation on each socio-economic variable. In 2005, those classified as inactive showed increased participation (OR=1.56, 1.19-2.03) compared with those employed, and remained significant in 2010 (OR=1.52, 1.18-1.96). For

 occupation, manual workers (OR=0.63, 0.42-0.95) showed significantly reduced participation in 2010. Odds ratios for all other occupations showed reduced participation compared to managers, but at a non-significant level in 2005 and 2010. There were no significant temporal changes in any of the odds ratios for participation in breast or colorectal cancer screening between 2005 and 2010.

The regression of screening participation on income distribution produced RIIs which can be found in tables 3-5. The results showed significant inequalities for mammography (RII=0.36, 0.15-0.85) and cervical smear (RII=0.24, 0.13-0.46) in 2005, but not for FOBT (RII= 0.70, 0.38-1.28). The magnitude of the RIIs decreased for all 3 screening programs in 2010, meaning a reduction in income-based inequalities, and remained significant only for cervical smear (RII=0.28, 0.14-0.57). For education, mammography (RII=0.40, 0.18-0.90) and cervical smear (RII=0.35, 0.20-0.60) showed significant inequalities in 2005, whereas the RII for FOBT was non-significant (RII=0.69, 0.42-1.14). In 2010, the magnitude of the education RII decreased for mammography and became non-significant (RII=0.73, 0.23-2.24), whereas the RII for cervical smear increased and remained significant (RII=0.30, 0.16-0.54). The p-trend for the temporal change in the RIIs (adjusted model) measured by interaction term between 2005 and 2010, was found to be non-significant for all 3 screening programs for income and education level.

DISCUSSION

Our objectives were to determine along which socio-economic strata existed significant disparities in uptake for breast, cervical and colorectal screening and to examine if these disparities have changed between the 2005 and 2010 Cancer barometer surveys. In absolute terms, we found a significant increase in participation rates across all socio-economic strata for mammography and for FOBT between 2005 and 2010. Cervical cancer screening however saw no significant change in participation rates between 2005 and 2010 (except for those without complementary health

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insurance). A similar trend was observed when relative inequalities were considered. It should be noted that some of these inequalities were persistent between 2005 and 2010, even though formal statistical tests for trend were generally not significant.

Findings in the context of the literature

It is encouraging to note the globally significant increase in participation rates across all socio-economic strata for mammography between 2005 and 2010. This effect was not demonstrated by a French study by Sicsic et al. on mammography participation rates in 2006, 2008 and 2010, which showed a decrease in participation rates over time [6]. This study did however show a large increase in colorectal cancer screening rates, in line with our findings. Cervical cancer screening however saw no significant change in participation rates between 2005 and 2010 (except for those without complementary health insurance), while Sicsic et al. showed an overall decrease in participation rates from 2006 to 2010. Our study confirmed significantly reduced participation for manual workers in breast and colorectal screening and for those with only basic health insurance in breast and cervical screening in 2010. This is consistent with Sicsic et al., which showed reduced participation in all 3 screening programs for manual workers and those with only basic health insurance.

Page 12¹ Protected by copyright, including for uses related to text and data mining, Al training, and similar technologies. Breast and colorectal cancer screening programs saw the absolute differences in participation rates reduced over time for all socio-economic variables in our study, with the exception of employment and basic health insurance. Sicsic et al. [6] found that disparities in participation did not decrease for mammography or FOBT screening from 2006 to 2010. An American study by Kim et al. showed the disparity in mammography participation based on income remained unchanged, while the disparity based on education decreased from 2000 to 2005 [9]. Cervical cancer screening

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however saw a persisting disparity in participation rates for the majority of socio-economic variables in our study, consistent with the results of De Maio et al. [19] and Sicsic et al. [6].

The RII for income and education decreased for breast and colorectal cancer screening in our study, consistent with De Maio et al., which showed a decrease in the RII for breast cancer screening from 2005 to 2009 [19]. Whereas in the study by Kim et al. [9], the RII for income tended to decrease slightly and the RII for education remained constant over time. The cervical screening RII decreased for income and increased for education from 2005 to 2010 in our study, remaining statistically significant for both. This is consistent with the De Maio et al.[19], where the social gradient decreased for income and increased for education between 2005 and 2010.

Interpretation of results

The screening programs for breast and colorectal cancer are organized at a national level, and have seen their absolute differences in participation rates and relative inequalities reduced over time for all socio-economic variables. For both breast and colorectal screening, the odds ratios for manual workers showed reduced participation compared to managers/executives in 2010. Education and occupation are strongly correlated, with manual workers having a higher proportion of participants with an educational level inferior to baccalauréat (85%) than any other occupational category in 2010. Thus they may have been less aware of the health marketing campaigns for colorectal cancer screening and the recommendation of FOBT.

Cervical cancer screening remains without a nationally organized program in France, where it is the duty of their doctors to organize and for the individual two pay for the cervical smear. The lack of a nationally organised screening program may impose significant financial, educational and cultural barriers to screening uptake among certain sections of the French population. The financial costs for a consultation and laboratory processing of the screening test may deter those with only

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basic health insurance, as public reimbursement covers only 70% of the cost [25]. This may account for the persistence of the observed differences in participation rates and large RIIs. Improving the awareness, affordability and access to cervical cancer screening should be prioritised in order to increase participation rates and reduce socio-economic disparities.

Limitations and strengths of the study

Our study availed of two almost identical datasets to construct a temporal analysis of participation in screening programs in France between 2005 and 2010. The use of relative inequality indices to measure the evolution of socio-economic inequalities in our study is the first to employ this methodology among a French population for cancer screening. The comparability of the study populations minimized selection bias and the conservation of the questionnaire format minimized information bias.

The study still has several limitations however. It shares the usual shortcomings of quantitative telephone surveys. There is a potential selection bias, as residents of collective dwellings, hospitals and other institutions were excluded from the survey. The study includes only those who are francophone, excluding individuals whose native language is not French. There was no available data on ethnicity or nationality of participants in the study, which may have been an important source of confounding or effect modification. Changes in screening policies concerning age limits, screening techniques and regional access left the 2005 and 2010 Cancer Barometers not directly comparable for certain programs. The question of screening participation for colorectal cancer was therefore limited to lifetime use of FOBT. Organized cervical screening was available in 13 regions in 2009, a source of regional variation not present in 2005. Some screening techniques are more memorable to patients, due to the invasiveness of the screening technique or the duration of the screening intervals, which may have led to recall bias.

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The total sample population numbered approximately 4000 participants in each Barometer enquiry. However, disparities along socio-economic strata may not have been captured in the particular sample population, leading to false observations and conclusions. Missing observations for each variable accounted for less than 5% of the total population, except for the variable income (16.3% missing in 2005 and 9.3% in 2010). After filters had been applied to select the subpopulation eligible for screening, the remaining participants were of a relatively small number for certain socio-economic strata. This limited the precision of certain estimates, producing participation rates with large standard errors and odds ratios with large confidence intervals.

Conclusion

Despite these limitations, the present study represents a unique contribution to this topic. The findings suggest that organized screening programs have the potential to reduce socio-economic disparities in participation.

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Acknowledgements

This article uses data collected from the 2005 and 2010 Barometre cancer studies, provided by the Institut national de prévention et d'éducation pour la santé (Inpes). Special thanks to the department of screening at the Institut National du Cancer (INCA).

Funding statement

This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors. The data collection was funded by the National Institute for prevention and health education (INPES) in association with the French National Cancer Institute (INCa). The authors declare no external or private sources of funding.

Competing interest statement

All authors have completed the ICMJE uniform disclosure form at <u>www.icmje.org/coi_disclosure.pdf</u> and declare: no support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous three years; no other relationships or activities that could appear to have influenced the submitted work.

Contributors

DK reviewed the background literature, run statistical analyses and drafted the manuscript. CE, CL, PA provided advice on methodology and statistical analyses. CL & PA directed the data collection. HN conceived the study, advised on methodology, reviewed the results of statistical analyses and supervised the final edit of the manuscript. All authors contributed to the final draft of this manuscript.

Data sharing statement

<text> All data presented in this manuscript came from 2 original datasets of the 2005 and 2010 Cancer Barometer surveys. The original files can be requested by contacting Santé Publique France (formerly INVS and INPES) via Pierre Arvidson (pierre.arwidson@santepubliquefrance.fr) or Christophe Léon (christophe.leon@santepubliquefrance.fr).

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Table 1. Standardized[†] distribution of study populations for 2005 and 2010 Cancer Barometer surveys

Variables	Barometer 20	005 (n=3820)	Barometer 2010 (n=3727)			
	n	%	n	%		
Gender						
Male	1854	48,5	1790	48,0		
Female	1966	51,5	1937	52,0		
Region						
Ile-de-France	701	18,4	696	18,7		
West Paris basin	380	10,0	348	9,3		
East Paris basin	305	8,0	290	7,8		
North	257	6,7	238	6,4		
West	508	13,3	504	13,5		
East	334	8,8	321	8,6		
South West	414	10,9	412	11,1		
South East	455	12,0	447	12,0		
	457	12,0	471	12,6		
Occupation	117	2.4	01			
Farmer	117	3,1	81	2,2		
sen-employed/cransman	220	5,8	2/0	1,2		
nrofessional	589	15,4 20.2	595 01 <i>1</i>	10,U 24 E		
employee/office worker	970	20,3	829	24,3		
manual worker	642	25,4 16.8	825	22,5		
other	506	13.3	199	5.3		
Education level						
	1946	52.0	2270	61.2		
BAC	651	17.4	635	17.1		
Superior BAC	1146	30.6	803	21.7		
Monthly Income				,		
<€1000	414	13.2	399	12.1		
€1000-1500	663	21.0	499	15.1		
>€1500	2075	65,8	2401	72,8		
Employment						
employed	2146	56.2	1851	49 7		
unemployed	177	4.6	260	7.0		
Inactive	1497	39,2	1615	43,3		
Alcohol consumption		,				
Yes	3430	89.8	3195	85.7		
No	389	10.2	532	14.3		
Smoking status		/_		,		
Voc	964	25.2	1105	32.1		
No	2856	74.8	2532	67.9		
Close Belative with cancer	2000	, 1,0	2332	01,5		
Voc	2266	62.1	2109	62.2		
No	2300	27.0	1220	82,2		
	1440	57,5	1339	57,9		
	2465	64.6	2222	(2)(
Yes	2465	64,6 25.4	2333	62,6		
	1551	55,4	1594	57,4		
	2540	02.0	2210	00.0		
res No	3518	92,6	3210	89,6		
NU Pasia Haalth Insurance	282	7,4	3/5	10,5		
	201	10.2	A 4 4	10 4		
No	361	10,2	2100	12,4 07 c		
Nommorrowhy 21	5182	8,80	3109	٥/,٥		
iviammograpny <2yrs				.		
Yes	499	43,6	325	28,0		
NO	645	56,4	836	72,0		

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es	694	24.8	650	22.0
	1282	65.2	1266	66 1
	1202	0.5,2	1200	00,1
OBTever	764	67.4	647	10.2
es	/64	67,1	61/	48,3
IU Weighted by age, gender, region and educational	evel according to standard population of the	32,9 1999 and 2008 enquête en	DOU	51,/
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	N	Aammography		C	ervical smear			FOBT	
Socio-economic	nar	ticipation rate (%)	+ SF	particir	pation rate $(\%)$ + SI	F	partici	pation rate (%) + 9	F
variable	2005	2010	Chi2	2005	2010	Chi2	2005	2010	Chi2
	(n=742)	(n=804)	p-value	(n=1571)	(n=1514)	p-value	(n=1222)	(n=1425)	p-value
Occupation									
farmer	62.49 ±8.24	87.64 ±8.81	0.148	75.61 ±7.28	80.39 ±11.63	0.739	26.97 ±6.69	56.50 ±10.82	0.006
self-employed	63.70 ±9.46	85.96 ±5.37	0.027	71.02 ±7.00	77.92 ±6.89	0.438	33.47 ±5.61	52.30 ±5.75	0.009
manager	85.50 ±4.04	91.45 ±2.50	0.262	85.15 ±2.51	83.88 ±3.05	0.740	39.33 ±3.89	57.33 ±3.31	0.0003
professional	74.87 ±3.74	87.82 ±2.95	0.004	84.31 ±1.95	88.17 ±1.68	0.153	35.04 ±3.21	53.32 ±2.79	<0,0001
employee	68.76 ±3.00	90.58 ±1.98	<0.0001	78.05 ±1.81	81.52 ±2.06	0.170	29.92 ±2.63	51.07 ±3.54	<0,0001
manual worker	64.52 ±6.01	76.02 ±5.29	0.161	74.70 ±3.96	75.00 ±4.22	0.956	30.29 ±3.74	46.95 ±4,23	0.001
other	69.37 ±6.19	83.70 ±5.28	0.097	81.14 ±4.21	62.94 ±6.53	0.010	32.87 ±6.20	43.84 ±6.92	0.204
Education level									
Inferior BAC	67.80 ±2.29	86.26 ±1.79	<0.0001	75.20 ±1.77	76.88 ±1.97	0.484	31.55 ±1.82	51.06 ±2.06	0
BAC	71.86 ±5.71	93.63 ±2.15	0.0003	83.59 ±2.47	86.42 ±2.03	0.385	32.07 ±4.46	56.06 ±3.58	<0,0001
Superior BAC	80.17 ±3.49	87.34 ±2.56	0.153	84.27 ±1.65	86.81 ±1.67	0.318	37.39 ±3.27	51.23 ±2.92	0.002
difference*	12.37	1.08		9.07	9.93		5.84	0.17	
Income									
<€1000	58.45 ±4.48	82.62 ±3.92	0.001	64.78 ±4.01	64.81 ±4.70	1	27.02 ±3.55	49.40 ±4.79	0.0001
€1000-1500	68.62 ±4.19	84.95 ±3.57	0.006	72.43 ±2.96	78.81 ±3.49	0.161	33.29 ±3.35	50.61 ±4.33	0.001
>€1500	76.21 ±2.65	89.57 ±1.59	<0.0001	85.21 ±1.25	84.96 ±1.36	0.885	37.07 ±2.23	52.29 ±1.96	<0,0001
difference	17.76	6.95		20.43	20.15		10.05	2.89	
Complementary he	alth insurance								
yes	72.09 ±1.84	88.08 ±1.38	<0.0001	81.77 ±1.08	81.83 ±1.29	0.964	33.63 ±1.53	52.31 ± 1.64	<0,0001
No	48.35 ±9.53	78.06 ±7.49	0.013	52.51 ±6.04	71.00 ±5.67	0.017	20.10 ±5.58	41.51 ±7.71	0.011
difference	23.76	10.02		29.26	10.83		13.53	10.80	
Basic health insura	nce								
yes	66.12 ±7.38	69.98 ±8.60	0.694	67.20 ±4.70	67.22 ±5.47	1	26.23 ±4.56	52.75 ±6.93	0.0001
No	70.99 ±1.93	88.72 ±1.28	<0.0001	81.52 ±1.12	82.87 ±1.24	0.399	33.83 ±1.60	52.06 ±1.64	<0,0001
difference	4.87	18.74		14.32	15.65		7.60	0.69	
Employment									
employed	76.23 ±3.07	89.0 ±2.21	0.001	83.75 ±1.21	86.56 ±1.34	0.097	28.37 ±2.42	45.11 ±2.56	<0,0001
unemployed	66.26 ±9.44	84.1 ±8.73	0.176	66.00 ±5.25	72.88 ±5.23	0.304	25.48 ±6.60	35.91 ± 9.21	0.308
inactive	68.58 ±2.32	86.79 ±1.75	<0.0001	72.72 ±2.51	71.15 ±2.73	0.665	36.51 ±1.93	56.48 ±2.03	<0,0001

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Table 3. Association between socio-economic variables and the probability of participation in mammography in 2005 and 2010: Adjusted[†] and unadjusted OR

Mammography 2005						Mammography 2010				
Socio-economic									p-tren	
variable	Unadjusted OR	(95% CI)	Adjusted OR	(95% CI)	Unadjusted OR	(95% CI)	Adjusted OR	(95 % CI)	2005-20	
Occupation									0,706	
manager	1,00		1.0		1,00		1.0			
farmer	0.28	(0.10, 0,77)*	0.31	(0.11, 0,87)*	0.66	(0.08, 5,45)	0.55	(0.06, 4,82)		
self-employed	0.30	(0.11, 0,81)*	0.31	(0.11, 0,87)*	0.57	(0.18, 1,86)	0.56	(0.17, 1,88)		
professional	0.51	(0.23, 1,10)	0.52	(0.24, 1,16)	0.67	(0.26, 1,72)	0.66	(0.25, 1,72)		
employee	0.37	(0.18, 0,77)*	0.39	(0.19, 0,81)*	0.90	(0.36, 2,26)	1.12	(0.43, 2,94)		
Manual worker	0.31	(0.13, 0,74)*	0.32	(0.13, 0,79)*	0.30	(0.11, 0,78)*	0.33	(0.12, 0,92)*		
Other	0.38	(0.16, 0,95)*	0.41	(0.16, 1,04)	0.48	(0.16, 1,47)	0.68	(0.21, 2,25)		
ncome									0,68	
>€1500	1,00		1,00		1,00		1,00			
€1000-€1500	0.68	(0.42, 1,11)	0.74	(0.45, 1,21)	0.66	(0.34, 1,27)	0.98	(0.47, 2,06)		
<€1000	0.44	(0.26, 0,73)*	0.49	(0.28, 0,87)*	0.55	(0.29, 1,06)	0.75	(0.36, 1,57)		
RII	0,29	(0,14, 0,64)*	0,36	(0,15, 0,85)*	0,37	(0,13, 1,00)	0,70	(0,21, 2,31)	0.69	
Education level									0,36	
superior BAC	1,00		1,00		1,00		1,00			
BAC	0.63	(0.32, 1,26)	0.61	(0.30,1,23)	2.13	(0.73, 6,18)	2.03	(0.68, 6,02)		
nferior BAC	0.52	(0.32, 0,86)*	0.55	(0.33, 0,91)*	0.91	(0.48, 1,73)	0.98	(0.50, 1,93)		
RII	0,36	(0,16, 0,79)*	0,40	(0,18, 0,90)*	0,62	(0,21, 1,81)	0,73	(0,23, 2,24)	0.40	
Employment									0,74	
employed	1,00		1,00		1,00		1,00			
unemployed	0.61	(0.23, 1,62)	0.60	(0.23, 1,60)	0.65	(0.19, 2,20)	0.70	(0.19, 2,50)		
nactive	0.68	(0.46, 1,01)	0.77	(0.51, 1,15)	0.81	(0.49, 1,36)	0.84	(0.49, 1,45)		
Complementary hea	Ith insurance								0,87	
Yes	1,00		1,00		1,00		1,00			
No	0.36	(0.16, 0,81)*	0.41	(0.18, 0,95)	0.48	(0.22, 1,06)	0.60	(0.25, 1,43)		
Basic health insuran	ce								0,11	
Yes	0.80	(0.41, 1,54)*	0.82	(0.42, 1,59)	0.30	(0.15, 0,58)*	0.39	(0.19, 0,81)*		
No	1.00		1.00		1.00		1.00			

Adjusted on the covariates: region, alcohol consumption, smoking status, close relative with cancer & living in couple

[†]Calculated by the interaction term for the change in Adjusted OR and Adjusted RII between 2005 and 2010*p<0.05 **p<0.001

		Cervical s	mear 2005			Cervical sme	ar 2010		
Socio-economic					Unadjusted		Adjusted		p-trend [‡]
variable	Unadjusted OR	(95% CI)	Adjusted OR	(95 % CI)	OR	(95% CI)	OR	(95% CI)	2005-2010
Occupation									0,480
manager	1,00		1.0		1,00		1.0		
armer	0.54	(0.20, 1,45)	0.55	(0.20, 1,52)	0.79	(0.19, 3,29)	0.78	(0.18, 3,35)	
self-employed	0.43	(0.20, 0,90)*	0.41	(0.19, 0,88)*	0.68	(0.31, 1,50)	0.68	(0.30, 1,52)	
professional	0.94	(0.57, 1,54)	0.97	(0.59, 1,61)	1.43	(0.89, 2,45)	1.52	(0.88, 2,62)	
employee	0.62	(0.40, 0,96)*	0.65	(0.41, 1,02)	0.85	(0.52, 1,37)	0.89	(0.54, 1,44)	
Manual worker	0.52	(0.29, 0,92)*	0.50	(0.28, 0,91)*	0.58	(0.33, 1,01)	0.68	(0.37, 1,22)	
Other	0.75	(0.38, 1,49)	0.78	(0.39, 1,58)	0.33	(0.18, 0,60)*	0.49	(0.25, 0,94)*	
ncome									0,339
>€1500	1,00		1,00		1,00		1,0		
€1000-1500	0.46	(0.32, 0,65)**	0.53	(0.37, 0,77)**	0.66	(0.43, 1,01)	0.76	(0.48, 1,21)	
<€1000	0.32	(0.21, 0,49)**	0.43	(0.27, 0,68)**	0.33	(0.22, 0,49)**	0.43	(0.27, 0,69)**	
RII	0,16	(0,09, 0,28)**	0,24	(0,13, 0,46)**	0,20	(0,11, 0,37)**	0,28	(0,14, 0,57)**	0.268
Education level									0,822
superior BAC	1,00		1,00		1,00		1,0		
BAC	0.95	(0.63, 1,45)	1.00	(0.66, 1,54)	0.97	(0.59, 1,58)	0.93	(0.57, 1,53)	
nferior BAC	0.57	(0.41, 0,77)**	0.56	(0.41, 0,78)**	0.51	(0.35, 0,73)**	0.53	(0.36, 0,77)**	
RII	0,36	(0,21, 0,61)**	0,35	(0,2, 0,60)**	0,28	(0,16, 0,51)**	0,3	(0,16, 0,54)**	0.887
Employment									0,349
Employed	1,00		1,00		1,00		1,0		
Unemployed	0.38	(0.23, 0,61)**	0.46	(0.28, 0,75)*	0.42	(0.26, 0,67)**	0.51	(0.31, 0,83)*	
Inactive	0.52	(0.38, 0,71)**	0.50	(0.36, 0,69)**	0.38	(0.28, 0,52)**	0.40	(0.29, 0,55)**	
Complementary h	ealth insurance								0,010
Yes	1,00		1,00		1,00		1,0		
No	0.25	(0.15, 0,40)**	0.29	(0.17, 0,49)**	0.54	(0.34, 0,88)*	0.69	(0.41, 1,17)	
Basic health insura	ance								0,524
yes	0.46	(0.29, 0,74)*	0.57	(0.35, 0,92)*	0.42	(0.28, 0,65)**	0.59	(0.36, 0,95) [*]	
no	1,00		1,00		1,00		1,00		

Table 5. Association between socio-economic variables and the probability of FOBT participation in 2005 and 2010: Adjusted[†] and unadjusted OR

		FOBT 200	5			FOBT 20	010		
Socio-economic	Unadjusted		Adjusted		Unadjusted		Adjusted		p-trend [‡]
variable	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)	OR	95% CI	2005-201
Occupation									0,301
Manager	1,00		1.0		1,00		1.0		
Farmer	0.57	(0.29, 1,10)	0.66	(0.34, 1,31)	0.97	(0.46, 2,05)	0.78	(0.35, 1,73)	
self-employed	0.78	(0.46, 1,31)	0.74	(0.43, 1,27)	0.82	(0.51, 1,31)	0.82	(0.50, 1,35)	
Professional	0.83	(0.57, 1,23)	0.88	(0.59, 1,30)	0.85	(0.60, 1,20)	0.91	(0.63, 1,31)	
Employee	0.66	(0.45, 0,96)*	0.79	(0.53, 1,17)	0.78	(0.54, 1,12)	0.96	(0.64, 1,44)	
Manual worker	0.67	(0.44, 1,03)	0.68	(0.44, 1,05)	0.66	(0.45, 0,96) [*]	0.63	(0.42, 0,95) *	
Other	0.76	(0.39, 1,46)	0.94	(0.47, 1,89)	0.58	(0.36, 0,95) [*]	0.60	(0.35, 1,02)	
Income									0,253
>€1500	1,00		1,00		1,00		1,00		
€1000-1500	0.85	(0.61, 1,18)	0.93	(0.66, 1,31)	0.94	(0.67, 1,31)	1.11	(0.77, 1,61)	
<€1000	0.63	(0.42, 0,94)*	0.74	(0.48, 1,15)	0.89	(0.62, 1,29)	1.13	(0.74, 1,72)	
RII	0,54	(0,31, 0,93) [*]	0,70	(0,38, 1,28)	0,83	(0,49, 1,41)	0,80	(0,43, 1,48)	0.275
Education level									0,485
superior BAC	1,00		1,00		1,00		1,00		
BAC	0.79	(0.50, 1,24)	0.85	(0.54, 1,33)	1.21	(0.81, 1,83)	1.27	(0.82, 1,97)	
inferior BAC	0.77	(0.58, 1,04)	0.79	(0.59, 1,07)	0.99	(0.74, 1,34)	0.99	(0.72, 1,36)	
RII	0,67	(0,41, 1,09)	0,69	(0,42, 1,14)	0,90	(0,56, 1,45)	1,14	(0,68, 1,36)	0.519
Employment									0,960
Employed	1,00		1,00		1,00		1,00		
Unemployed	0.86	(0.40, 1,88)	1.08	(0.49, 2,38	0.68	(0.37, 1,27)	0.87	(0.45, 1,68)	
Inactive	1.45	(1.12, 1,88)*	1.56	(1.19, 2,03)*	1.58	(1.25, 1,99)**	1.52	(1.18, 1,96) [*]	
Complementary health	insurance								0,441
Yes	1,00		1,00		1,00		1,00		
No	0.50	(0.25, 0,97)*	0.52	(0.26, 1,04)	0.65	(0.40, 1,05)	0.85	(0.50, 1,45)	
Basic Health insurance									0,257
Yes	0.70	(0.43, 1,16)	0.72	(0.45, 1,16)	1.03	(0.69, 1,54)	1.11	(0.71, 1,72)	
No	1.00		1,00		1.00		1,00		

Adjusted on the covariates : region, alcohol consumption, smoking status, close relative with cancer & living in couple

[†]Calculated by the interaction term for the change in Adjusted OR and Adjusted RII between 2005 and 2010*p<0.05 **p<0.001

STROBE Statement—c	checklist of items	that should be	included in re	eports of observa	ational studies
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		BMJ Open	Page 26
STROBE Statement-	check	tlist of items that should be included in reports of observational studies	rst publishe
	Item		d as
	No	Recommendation	1
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	- 136/
		and what was found VFS	Pro
г, т ,			- tec
Introduction	2	Evaluate the activities had been and activities for the investigation have accounted	_ ted ∠
Background/rationale	2	YES	by c
Objectives	3	State specific objectives, including any prespecified hypotheses YES	ору
Methods			righ
Study design	4	Present key elements of study design early in the paper YES	– ,ît on
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment,	- nclu
-		exposure, follow-up, and data collection YES	din
Participants	6	(a) Cohort study—Give the eligibility criteria, and the sources and methods of	g fo
		selection of participants. Describe methods of follow-up	r us
		Case-control study—Give the eligibility criteria, and the sources and methods of	ies
		case ascertainment and control selection. Give the rationale for the choice of cases	rela
		and controls	Ited
		Cross-sectional study—Give the eligibility criteria, and the sources and methods of	to
		selection of participants YES	_ text
		(b) Cohort study—For matched studies, give matching criteria and number of	an
		exposed and unexposed	d d
		<i>Case-control study</i> —For matched studies, give matching criteria and the number of	ita r
		controls per case	– nini
√ariables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria if applicable VFS	ing,
Data sources/	8*	For each variable of interest, give sources of data and details of methods of	
neasurement	0	assessment (measurement). Describe comparability of assessment methods if there	rain
neasurement		is more than one group VFS	ing
Rias	9	Describe any efforts to address potential sources of bias	– a
Study size	10	Explain how the study size was arrived at	_ id s
Duantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable	- in i
		describe which groupings were chosen and why YES	artı
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	ech
		YES	nolo
		(b) Describe any methods used to examine subgroups and interactions YES	- ogie
		(c) Explain how missing data were addressed YES	- š.
		(d) Cohort study—If applicable, explain how loss to follow-up was addressed	_
		Case-control study—If applicable, explain how matching of cases and controls was	
		addressed	
		Cross-sectional study-If applicable, describe analytical methods taking account of	ι Γ
		sampling strategy YES	_ 2
		(<u>e</u>) Describe any sensitivity analyses	
Continued on next page			
			- U U U U
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Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed YES
		(b) Give reasons for non-participation at each stage YES
		(c) Consider use of a flow diagram
Descriptive	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information
data		on exposures and potential confounders YES
		(b) Indicate number of participants with missing data for each variable of interest YES
		(c) Cohort study—Summarise follow-up time (eg, average and total amount)
Outcome data	15*	Cohort study-Report numbers of outcome events or summary measures over time
		<i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure
		Cross-sectional study-Report numbers of outcome events or summary measures YES
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their
		precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and
		why they were included YES
		(b) Report category boundaries when continuous variables were categorized
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful
		time period YES
Other analyses	17	Report other analyses done-eg analyses of subgroups and interactions, and sensitivity
		analyses
Discussion		
Key results	18	Summarise key results with reference to study objectives YES
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision.
		Discuss both direction and magnitude of any potential bias YES
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity
		of analyses, results from similar studies, and other relevant evidence YES
Generalisability	21	Discuss the generalisability (external validity) of the study results YES
Other informati	on	
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable,
		for the original study on which the present article is based YES

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*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

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Temporal trend in socio-economic inequalities in the uptake of cancer screening programs in France between 2005 and 2010: Results from the Cancer Barometer Surveys

Journal:	BMJ Open
Manuscript ID	bmjopen-2017-016941.R1
Article Type:	Research
Date Submitted by the Author:	29-May-2017
Complete List of Authors:	Kelly, David; Institut National du Cancer, Social sciences, Epidemiology, Public Health Estaquio, Carla Leon, Christophe Arwidson, Pierre Nabi, Hermann; Institut National du Cancer, Research in Social and Human Sciences, Epidemiology and Public Health
Primary Subject Heading :	Epidemiology
Secondary Subject Heading:	Epidemiology, Public health, Health services research
Keywords:	cancer screening, Social inequalities, cancer epidemiology

SCHOLARONE" Manuscripts Temporal trend in socio-economic inequalities in the uptake of cancer screening programs in France between 2005 and 2010: Results from the Cancer Barometer Surveys

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Word count: Abstract = 281; Text = 3557

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ABSTRACT

Objectives: Cancer screening is a form of secondary prevention for a disease which is now the leading cause of death in France. Various socio-economic indicators have been identified as potential factors for disparities in cancer screening uptake. Our study aimed to identify the socioeconomic inequalities which persisted for screening uptake, and to quantify these disparities over a 5-year period.

Setting: The Cancer Barometer is a population-based survey carried out in 2005 and 2010 in Metropolitan France.

Participants: A randomly selected inhabitants aged 15 to 85 years, 3820 in 2005 and 3727 in 2010 were interviewed on their participation in breast, cervical and colorectal cancer screening programs and their socio-economic profile.

Primary and secondary outcome measures: For each type of screening program, we calculated participation rates, odds ratios (OR) and relative inequality indices (RII) for participation. derived from logistic regression of socio-economic variables. Changes in participation between 2005 and 2010 were then analyzed.

Period of the section of the sec **Results:** Participation rates for breast and colorectal screening increased significantly along the majority of socio-economic categories, whereas for cervical screening there were no significant changes between 2005 and 2010. RIIs for income decreased for all 3 screening programs in 2010. RIIs for education in mammography (RII=0.40, 95% CI 0.18 to 0.90) and cervical smear (RII=0.35, 95% CI 0.20 to 0.60) were significant in 2005, and increased for cervical smear (RII=0.30, 95% CI 0.16 to 0.54) in 2010.

Conclusions: There was a persistence of socio-economic inequalities in uptake of opportunistic cervical cancer screening. Conversely, organized screening programs for breast and colorectal

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cancer saw a reduction in socio-economic inequalities. Deficiencies in knowledge of, access to and affordability of cancer screening are likely to be responsible for the socio-economic disparities in participation.

Key words: cancer screening, breast cancer, cervical cancer, social inequalities, cancer epidemiology

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Strengths and limitations of this study

- First study to examine temporal changes in inequalities for cancer screening uptake in • France using relative inequality index.
- Benefits from datasets of two identical questionnaires on cancer screening uptake, taken 5 years apart, using two comparable population samples, hence minimizing information bias.
- Evolution in the format of colorectal screening program in terms of technique and age limits may have led to measured differences in uptake between 2005 and 2010.
- Residents of nursing homes and other medical institutions without a personal telephone line were excluded from the survey, limiting the generalisability of the findings.
- Relatively small number for certain socio-economic strata, reducing therefore the precision of some estimates.



INTRODUCTION

Screening for cancer is an important form of secondary prevention for a disease which is now leading cause of death in France and worldwide [1]. The 2008 European report on cancer recommends that health systems focus their resources on cancer prevention and early detection rather than treatment alone, as the global disease burden of cancer threatens to become unsustainable in terms of financial costs, pressure on services, follow-up of patients and delivery of care [2].

To date, many European countries have rolled out screening programs for breast cancer, colorectal cancer, cervical cancer via mammography, faecal occult blood test (FOBT) and cervical smear, respectively [3,4]. However, for these screening programs to have a significant effect on reducing cancer mortality, they require a minimum level of participation among the eligible population; for instance 70% for mammography, and 50% for FOBT [5].

We reviewed several publications from France, UK, USA, Italy, Denmark, Korea and Argentina, which identified variables shown to have a significant effect on cancer screening uptake [6-19]. For breast cancer screening, various different social and economic variables were found to have an effect, including employment, living in a couple, occupation, education level, income, private health insurance, car/home ownership and rural residency. However, no single variable was consistently observed across studies except for participation in other screening programs [7,17]. For cervical cancer screening, the variables identified as having a significant effect on uptake were more numerous, and notably consistent for income [7,11,19], education level [10-12,17,19], employment [6,12,17,18] and private health insurance [6,7,17]. For colorectal screening, general practitioners' (GP) consultation [6,7,17,18] was consistently shown to have a significant effect on uptake of screening across the studies, as well as income [14,16,17]. However, it remains unclear

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whether the effect of these socio-economic variables on participation rates in screening programs persists over time.

pen⁶/₆ first published as 10.1136/bmjopen-2017-016941 on 14 December 2017. Downloaded from http://bmjopen.bmj.com/ on June 8, 2025 at Department GEZ-LTA Erasmushogeschool e Protected by copyright, including for uses related to text and data mining, Al training, and similar technologies. Only one study drawn from the 2006, 2008 and 2010 French Healthcare and Health Insurance surveys [1] has examined the temporal evolution in breast, cervical and colorectal cancer screening uptake along socio-economic strata in France to date. This study conducted among 10 000 participants found that those classified as unskilled workers were less likely to have undergone cervical cancer screening (OR = 1.64 [1.38-1.95]). The results also showed that women without (OR = 2.05 [1.68-2.51]) or receiving free complementary health insurance (OR = 1.79 [1.36-2.37])were less likely to have undergone breast cancer screening. In this study, the authors found that inequalities for participation in breast and colorectal cancer screening persisted over the study period from 2006 to 2010. Thus, we believe that there is a need to re-examine how these trends may have evolved with respect to expansion in the coverage and awareness of organized cancer screening programs. The third French National Cancer Action Plan for the 2014-2019 period has identified early detection of cancers as a primary priority [20]. Within this goal is the reduction of inequalities associated with cancer diagnosis, with the hope that it subsequently reduces mortality rates. Any widening or reduction in socio-economic inequalities in the uptake of screening programs that are identified may then be used to direct future policy of the French national cancer control plan, which specifically seeks to address this issue [20]. We aim therefore in the present study to identify the socio-economic inequalities which persist for uptake of breast, cervical and colorectal cancer screening, and to quantify these disparities over a 5 year period in France.
MATERIALS ANDMETHODS

Study population

We used data, obtained by formal permission, from the Cancer Barometer surveys, two telephone surveys on cancer-related knowledge, attitudes and practices conducted by the French National Institute for Prevention and Health (now part of Santé Publique France). Both surveys were carried out on a representative random sample of the general French population aged over 16 years old for the 2005 survey and aged 15–85 years old for the 2010 survey. A two-stage random sampling design was used. Residents of nursing homes or other medical institutions who did not possess a personal telephone line were not included in the samples. Private households with telephones were included in the sample. The first sampling step was household selection (by phone number). Within each selected household, one French speaking person aged 15–85 was randomly selected using the "next birthday" method. The interviews were conducted using a computer-assisted telephone interview (CATI) system.

In order to obtain adequate statistical power for measuring associations between variables and changes in participation rates along smaller levels, a sample size of between 3500 and 4000 was deemed appropriate. The 2005 Cancer Barometer sample [17],was comprised of 4046 participants aged over 16 years interviewed between April and June 2005.There were 226 individuals with missing observations in the 2005 Cancer Barometer sample, notably for all 3 of the dependent variables, and 7 out of 10 of the covariates and independent variables. These individuals terminated the survey prematurely, and were thus removed from the analysis as their data was non-contributive, leaving 3820 participants in the sample population. Females (51.5%) responded more often than males (48.5%) and mean age of interviewees was 46.7 years. The 2010 Cancer Barometer sample was comprised of 3727 participants aged 15 to 85 interviewed during the first semester of 2010 [18]. The mean age was 44.6 years and the majority of participants were also

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female (52.0% vs. 48.0%). The response rates for the 2005 and 2010 Cancer Barometers were 51.2% and 47.0%, respectively.

Measures

Socio-economic indicators (independent variables) were as follows: education level (inferior, equal to or superior to Baccalauréat (High-School Degree), employment status (employed, unemployed, and inactive), occupational class (farmer, trader, manager, professional, employee, manual worker, other), monthly income (below €1000, €1000-1500, above €1500) and health insurance (complementary vs. basic insurance coverage). The outcome variables were participation in breast, cervical and colorectal cancer screening programs (dependent variables). For breast cancer screening, participants aged over 40 years were asked if they had undergone mammography within the previous 2 years. For cervical cancer screening, participants aged over 20 years were asked if they had undergone a cervical smear within the previous 3 years. For colorectal cancer screening, participants aged 50-74 years were asked if they had undergone a faecal occult blood test (FOBT) within their lifetime. Covariates included gender, smoking status, alcohol consumption, region, living in a couple and having a close relative with cancer. For the calculation of screening participation rates, we added filters to select the target population eligible for each of the 3 different screening programs. Breast screening by mammography (n=1546): female gender and 49<age<75. Cervical screening by cervical smear (n=3085): female gender and 24<age<66. Colorectal screening by FOBT (n=2647): both genders where 49 < age < 75.

The weighting was based on the data of the 1999 and 2008 Employment Survey of the French population [21], taking into account age, gender, region, education level and number of persons per household [17]. This allowed us to effectively calculate age-adjusted standardized rates for

Page 9 of 29 screening participation, in addition to later adjusting the regression models on the covariates mentioned. Statistical analysis We calculated age-adjusted screening rates (AAR) for each stratum using the weighting provided by the INPES. The temporal evolution in the participation rate along each stratum between 2005 and 2010 was examined by adding an interaction term with the year of the survey. The disparity within each socio-economic variable was calculated as the absolute difference between the

AAR for the highest and lowest group within an ordinal or binary variable for the given year. Odds ratios (OR) derived from multiple logistic regression of screening participation on each socio-economic variable separately were used as a measure of participation likelihood for each stratum of the 6 socio-economic variables. The model was adjusted on the covariates: gender (colorectal screening only), region, alcohol, smoking, living in couple and close relative with cancer. For categorical variables, the higher socio-economic position was used as the reference group. The p-value for significance of the evolution of the odds ratios between 2005 and 2010 was calculated using an interaction term between the socio-economic variable and the time period, in order to be consistent with the methodology of previous studies on the topic [22,23].

For ordinal variables of income and education level, we calculated the Relative Inequality Index (RII) as a measure of health inequality as described by Mackenbach and Kunst [24]. Previous studies on health inequalities, including breast cancer screening uptake [4,9], employed a similar methodology for examining temporal evolutions along ordered socio-economic strata [22,25]. The RII is a regression-based measure that summarizes the association between two variables. It is computed by ranking income and education values on a scale from the lowest, which is 0, to the highest, which is 1. Each income or education level value covers a range on this scale that is

proportional to the number of participants who held that value and is given a new value on the scale corresponding to the cumulative midpoint of its range. The RII resembles relative risk in that it compares the probability of cancer screening uptake at the extremes of income and educational levels, but is estimated using the data on all income and education values and is weighted to account for the distribution of these values. Here the RII was fitted using logistic regression models. An RII of 0.5 for example indicates a lower probability of cancer screening uptake at the lower extreme of income and education levels compared to the higher extremes or vice versa. All statistical analysis was performed using SAS version 9.2.

RESULTS

Page 10-Ofirst published as 10.1136/bmjopen-2017-016941 on 14 December 2017. Downloaded from http://bmjopen.bmj.com/ on June 8, 2025 at Department GEZ-LTA Erasmushogeschool le it al to is er all down or a, ad by on ng ch on d, to 10 Table 1 presents the demographic and socio-economic characteristics of the study populations. The overall participation rates among the eligible populations for breast, cervical and colorectal cancer screenings are shown in Table 2. Chi-squared tests for the change in participation rates along each socio-economic stratum between 2005 and 2010 are also included. For mammography, participation rates increased significantly (p < 0.05) along all socio-economic strata. with the exception of farmers, managers, manual workers, unemployed, basic health insurance and education level superior to Baccalauréat. For FOBT, participation rates increased significantly along all socio-economic strata between, with the exception of those unemployed or occupation classified as other. For cervical smear there were no significant changes in participation rates along any of the socio-economic strata, except for those without complementary health insurance, which increased significantly from 52.51% to 71.0% (p=0.017).

Table 3 shows the results of the logistic regression models for mammography participation on each socio-economic variable separately, adjusted for covariates. In 2005, farmers, self-employed, employees and manual workers showed significantly reduced participation compared to

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managers/executives, whereas in 2010 only the association in manual workers remained significant. For income, those earning < \in 1000 (OR=0.49, 0.28-0.87) showed significantly reduced participation compared to those earning > \in 1500 in 2005, which became non-significant in 2010 (OR=0.75, 0.36-1.57). In 2005, those with an education inferior to Baccalauréat (OR=0.55, 0.33-0.91) showed significantly reduced participation compared to those superior to Baccalauréat, which became non-significant in 2010 (OR=0.98, 0.50-1.93).

Table 4 shows the results of the regression model for cervical smear participation for each socio-economic variable. In 2005, significantly reduced participation was observed for self-employed and manual workers, which became non-significant for both in 2010. In 2005, there was significantly reduced participation for those earning <£1000 and £1000-£1500, which remained significant in 2010 for those earning <£1000. An education level inferior to Baccalauréat showed significantly lower participation in both 2005 and in 2010. In 2005, being unemployed or inactive significantly reduced participation, and remained significant for both in 2010. The odds ratio for cervical smear participation changed significantly (p=0.010) for those without complementary health insurance from 0.29 (0.17-0.49) in 2005 to 0.69 (0.41-1.17) in 2010. Having only basic health insurance was significantly associated with reduced participation in both periods.

Table 5 shows the logistic regression results for FOBT participation on each socio-economic variable. In 2005, those classified as inactive showed increased participation (OR=1.56, 1.19-2.03) compared with those employed, and remained significant in 2010 (OR=1.52, 1.18-1.96). For occupation, manual workers (OR=0.63, 0.42-0.95) showed significantly reduced participation in 2010. Odds ratios for all other occupations showed reduced participation compared to managers, but at a non-significant level in 2005 and 2010. There were no significant temporal changes in any of the odds ratios for participation in breast or colorectal cancer screening between 2005 and 2010.

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The regression of screening participation on income distribution produced RIIs which can be found in Tables 3-5. The results showed significant inequalities for mammography (RII=0.36, 0.15-0.85) and cervical smear (RII=0.24, 0.13-0.46) in 2005, but not for FOBT (RII= 0.70, 0.38-1.28). The income-based RIIs decreased for all 3 screening programs in 2010, meaning reduction in income-based inequalities, and remained significant only for cervical smear (RII=0.28, 0.14-0.57). For education, mammography (RII=0.40, 0.18-0.90) and cervical smear (RII=0.35, 0.20-0.60) showed significant inequalities in 2005, whereas the RII for FOBT was non-significant (RII=0.69, 0.42-1.14). In 2010, the education-based RII decreased for mammography and became nonsignificant (RII=0.73, 0.23-2.24), whereas the RII for cervical smear increased and remained significant (RII=0.30, 0.16-0.54). The p-trend for the temporal change in the RIIs (adjusted model) measured by interaction term between 2005 and 2010, was found to be non-significant for all 3 screening programs for income and education level.

DISCUSSION

Our objective was to identify the socio-economic inequalities which persisted for uptake of breast, cervical and colorectal cancer screening, and to quantify these disparities between the 2005 and 2010. In absolute terms, we found a significant increase in participation rates across all socioeconomic strata for mammography and for FOBT between 2005 and 2010. Cervical cancer screening however saw no significant change in participation rates between 2005 and 2010 (except for those without complementary health insurance). A similar trend was observed when relative inequalities were considered. It should be noted that some of these inequalities were persistent between 2005 and 2010, even though formal statistical tests for trend were generally not significant.

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Findings in the context of the literature

It is encouraging to note the significant increase in participation rates across all socioeconomic strata for mammography between 2005 and 2010. This effect was not demonstrated in a French study by Sicsic et al. in 2006, 2008 and 2010, which showed a decrease in mammography participation rates over time [6]. This study did however show a large increase in colorectal cancer screening rates, in line with our findings. Cervical cancer screening however saw no significant change in participation rates between 2005 and 2010 (except for those without complementary health insurance), while Sicsic et al. showed an overall decrease in participation rates from 2006 to 2010.Our study confirmed significantly reduced participation for manual workers in breast and colorectal screening and for those with only basic health insurance in breast and cervical screening in 2010. This is consistent with Sicsic et al., which showed reduced participation in all 3 screening programs for manual workers and those with only basic health insurance.

Several factors may explain why some of our findings differ from those by Sicsic et al [6]. Their study was based on data collected using three modalities: telephone, face-to-face and self-administered questionnaires. The Cancer Barometer data used in our study was collected exclusively via telephone interview. In addition, the study by Sicsic et al. was based on three surveys carried out in 2006, 2008 and 2010, with therefore a two-year interval, whereas the Cancer Barometer survey was conducted at two points in time in 2005 and 2010. Another important difference between the two studies relies on their objectives and consequently on the methods used to reach them. The study by Sicsic et al. aimed to analyze the obstacles to and levers for breast, cervical, and colorectal cancer screening uptake and their trends over time, whereas the aim of our study was to identify the socio-economic inequalities which persist for uptake of breast, cervical and colorectal cancer screening, and to quantify these disparities over a 5 year period. Thus, Sicsic

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et al. pooled their three samples and did not conduct direct comparisons of associations between indicators of socioeconomic position and uptake of cancer screenings between periods.

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 Breast and colorectal cancer screening programs saw the absolute differences in participation rates reduced over time for all socio-economic variables in our study, with the exception of employment and basic health insurance. Sicsic et al.[6]found that disparities in participation did not decrease for mammography or FOBT screening from 2006 to 2010. An American study by Kim et al. showed the disparity in mammography participation based on income remained unchanged, while the disparity based on education decreased from 2000 to 2005 [9]. Cervical cancer screening however saw a persisting disparity in participation rates for the majority of socio-economic variables in our study, consistent with the results of De Maio et al. [19] and Sicsic et al.[6].

The relative inequalities for income and education decreased for breast and colorectal cancer screening in our study, consistent with De Maio et al., which showed a reduction in the RII for breast cancer screening from 2005 to 2009 [19]. In the study by Kim et al.[9], the income-based relative inequalities tended to decrease slightly, while those for education remained constant over time. The relative inequalities for cervical cancer screening decreased for income and increased for education from 2005 to 2010 in our study, both remaining statistically significant. This is consistent with the De Maio et al.[19], where the social gradient decreased for income and increased for education between 2005 and 2010.

Interpretation of results

Breast and colorectal screening programs are organized at a national level and differences in absolute participation rates and relative inequalities decreased over time for all socio-economic variables. For both breast and colorectal screening, the odds ratios for manual workers showed reduced participation compared to managers/executives in 2010. Education and occupation are

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strongly correlated, with manual workers having a higher proportion of participants with an educational level inferior to Baccalauréat (85%) than any other occupational category in 2010. Thus they may have been less aware of the health marketing campaigns for colorectal cancer screening and the recommendation of FOBT.

Cervical cancer remains without a nationally organized screening program in France. It is the duty of doctors to organize and falls to the individual to pay for opportunistic screening via cervical smear test. The lack of a nationally organised screening program may impose significant financial, educational and cultural barriers to screening uptake among certain sections of the French population. The financial costs for a consultation and laboratory processing of the screening test may deter those with only basic health insurance, as public reimbursement covers only 70% of the cost [26]. This may account for the persistence of the observed differences in participation rates and large RIIs. Improving the awareness, affordability and access to cervical cancer screening should be prioritised in order to increase participation rates and reduce socio-economic disparities.

Those classified as inactive (retired, homemakers) may have more free time to attend for colorectal cancer screening, explaining therefore the increased FOBT participation. It is possible that a greater proportion of inactive people is retired and hence falls within the eligible population for FOBT screening (50 to 74 years), compared with younger employed group.

Limitations and strengths of the study

Our study used two almost identical datasets to construct a temporal analysis of participation in screening programs in France between 2005 and 2010. The use of relative inequality indices to measure the evolution of socio-economic inequalities in our study is the first to employ this methodology among a French population for cancer screening. The comparability of the study populations minimized selection bias and the conservation of the questionnaire format minimized information bias. pen: first published as 10.1136/bmjopen-2017-016941 on 14 December 2017. Downloaded from http://bmjopen.bmj.com/ on June 8, 2025 at Department GEZ-LTA Erasmushogeschoo

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Page 16 Page 10.1136/bmjopen-2017-016941 on 14 December 2017. Downloaded from http://bmjopen.bmj.com/ on June 8, 2025 at Department GEZ-LTA Erasmushogeschool ne al he ly ch he ve ss he of al to ay al to is pt of ge de 16 16 The study still has several limitations however. It shares the usual shortcomings of phone surveys. There is a potential selection bias, as residents of nursing homes or other medical institutions who did not possess a personal telephone line were not included in the samples. The study includes only those who are French speakers, excluding individuals unable to answer fluently in French. There was no available data on ethnicity or nationality of participants in the study, which may have been an important source of confounding or effect modification. The exclusion of the above subpopulations, which are likely to be more socio-economically disadvantaged, may have overestimated the screening participation rates in our study.

Changes in screening policies concerning age limits, screening techniques and regional access left the 2005 and 2010 Cancer Barometers not directly comparable for certain programs. The question of screening participation for colorectal cancer was therefore limited to lifetime use of FOBT. Organized cervical screening was available in 13 regions in 2009, a source of regional variation not present in 2005. Some screening techniques are more memorable to patients, due to the invasiveness of the screening technique or the duration of the screening intervals, which may have led to recall bias.

The respective analytical sample sizes in 2005 and 2010 for breast (n=742, n=804), cervical (n=1571, n=1514) and colorectal (n=1222, n=1425) cancer screening may have been too small to capture disparities along socio-economic strata, leading to false observations and conclusions. Missing observations for each variable accounted for less than 5% of the total population, except for the variable income (16.3% missing in 2005 and 9.3% in 2010). This limited the precision of certain estimates, producing participation rates with large standard errors and odds ratios with large confidence intervals. We undertook multiple comparisons in our study. Thus, we cannot exclude that some of the results we have observed are due to chance.

Conclusion

The findings suggest that organized cancer screening programs have the potential to reduce socioeconomic disparities in participation.

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Acknowledgements

This article uses data collected from the 2005 and 2010 Barometre cancer studies, provided by the National Institute for prevention and health education, INPES (now Santé Publique France). Special thanks to the department of screening at the Institut National du Cancer (INCA).

Funding statement

This research received no specific grant from any funding agency in the public, commercial or notfor-profit sectors. The data collection was funded by the National Institute for prevention and health education, INPES (now Santé Publique France) in association with the French National Cancer Institute (INCa). The authors declare no external or private sources of funding.

Competing interest statement

All authors have completed the ICMJE uniform disclosure form at <u>www.icmje.org/coi_disclosure.pdf</u> and declare: no support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous three years; no other relationships or activities that could appear to have influenced the submitted work.

Contributors

HN conceived the study, advised on methodology, reviewed the results of statistical analyses and supervised the final edit of the manuscript. DK reviewed the background literature, run statistical analyses and drafted the manuscript. CE, CL, PA provided advice on methodology and statistical analyses. CL & PA directed the data collection. All authors contributed to the final draft of this manuscript.

Data sharing statement

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<text> All data presented in this manuscript came from 2 original datasets of the 2005 and 2010 Cancer Barometer surveys. The original files can be requested by contacting Santé Publique France (formerly INVS and INPES) via Pierre Arvidson (pierre.arwidson@santepubliquefrance.fr) or Christophe Léon (christophe.leon@santepubliquefrance.fr).

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Variables	Barometer 20	05 (n=3820)	Barometer	2010 (n=3727)	p-value
	n	%	n	%	
Gender					0.660
fale	1854	48,5	1790	48,0	
emale	1966	51,5	1937	52,0	0.076
egion e-de-France	701	18.4	696	18.7	0.970
/est Paris basin	380	10,1	348	9,3	
st Paris basin	305	8,0	290	7,8	
orth	257	6,7	238	6,4	
st	334	13,3	321	13,5	
uth West	414	10,9	412	11,1	
uth East	455	12,0	447	12,0	
diterranée	457	12,0	471	12,6	~0.001
cupation	117	2.1	Q1	2.2	<0.001
f-employed/craftsman	220	5,8	270	7,2	
nager/executive	589	15,4	595	16,0	
fessional	773	20,3	914	24,5	
ployee/office worker	970	25,4	829	22,3	
er	506	13.3	199	5.3	
lucation level		-)-		- 7-	< 0.001
Ferior BAC*	1946	52,0	2270	61,2	
C.	651	17,4	635	17,1	
erior BAC	1146	30,6	803	21,7	<0.001
	414	13.2	399	12.1	\$0.001
00-1500	663	21,0	499	12,1	
500	2075	65,8	2401	72,8	
ployment					< 0.001
ployed	2146	56,2	1851	49,7	
employed	1497	4,0	1615	43.3	
cohol consumption	1177	57,2	1015	13,5	< 0.001
3	3430	89,8	3195	85,7	
	389	10,2	532	14,3	
oking status					< 0.001
3	964	25,2	1195	32,1	
oso Dolotivo with concer	2856	/4,8	2532	67,9	0.950
s relative with cancer	2366	62.1	2198	62 1	0.750
~	1446	37,9	1339	37,9	
ving in couple		1			0.071
3	2465	64,6	2333	62,6	
	1351	35,4	1394	37,4	~0.001
mplementary Health Insurance	2510	02.6	2210	90.6	<0.001
	2.82	92,0	3210	89,6	
sic Health Insurance		,,.			0.003
8	361	10,2	441	12,4	
	3182	89,8	3109	87,6	

Table 2.Standardised[†] participation rates for eligible participants in 3 screening programs, Chisquared test for 2005-2010, p-trend

Socio-economic		Mammography			Cervical smear		FOBT participation rate (%) ± SE			
variable	p	articipation rate (%) ± SE	partic	ipation rate (%) \pm	SE				
variable	2005	2010	Chi2	2005	2010	Chi2	2005	2010	Chi2	
	(n=742)	(n=804)	<i>p</i> -value	(n=1571)	(n=1514)	<i>p</i> -value	(n=1222)	(n=1425)	<i>p</i> -valu	
Overall	88.0	88.3		79.7	81.4		34.0	51.6		
Occupation										
Farmer	62.49 ± 8.24	87.64 ±8.81	0.148	75.61 ±7.28	80.39 ±11.63	0.739	26.97 ± 6.69	$56.50\pm\!10.82$	0.006	
Self-employed	63.70 ±9.46	85.96 ±5.37	0.027	$71.02\pm\!\!7.00$	77.92 ±6.89	0.438	33.47 ±5.61	52.30 ±5.75	0.009	
Manager	85.50 ± 4.04	91.45 ±2.50	0.262	85.15 ±2.51	83.88 ± 3.05	0.740	39.33 ±3.89	57.33 ±3.31	0.0003	
Pprofessional	74.87 ± 3.74	87.82 ±2.95	0.004	84.31 ±1.95	88.17 ± 1.68	0.153	35.04 ±3.21	53.32 ±2.79	<0,000	
Employee	68.76 ± 3.00	90.58 ±1.98	<0.0001	78.05 ± 1.81	81.52 ±2.06	0.170	29.92 ±2.63	51.07 ±3.54	<0,000	
Manual worker	64.52 ± 6.01	76.02 ±5.29	0.161	74.70 ±3.96	75.00 ±4.22	0.956	30.29 ±3.74	46.95 ±4,23	0.001	
Other	69.37 ±6.19	83.70 ±5.28	0.097	81.14 ±4.21	62.94 ±6.53	0.010	32.87 ± 6.20	43.84 ±6.92	0.204	
Education level										
Inferior BAC	67.80 ±2.29	86.26 ±1.79	<0.0001	75.20 ±1.77	76.88 ± 1.97	0.484	31.55 ± 1.82	51.06 ±2.06	0	
BAC	71.86 ±5.71	93.63 ±2.15	0.0003	83.59 ±2.47	86.42 ±2.03	0.385	32.07 ±4.46	56.06 ±3.58	<0,000	
Superior BAC	80.17 ±3.49	87.34 ±2.56	0.153	84.27 ±1.65	86.81 ±1.67	0.318	37.39 ±3.27	51.23 ±2.92	0.002	
Difference	12.37	1.08		9.07	9.93		5.84	0.17		
Income										
<€1000	58.45 ± 4.48	82.62 ± 3.92	0.001	64.78 ±4.01	64.81 ±4.70	1	27.02 ±3.55	49.40 ±4.79	0.0001	
€1000-1500	68.62 ±4.19	84.95 ±3.57	0.006	72.43 ±2.96	78.81 ±3.49	0.161	33.29 ±3.35	50.61 ±4.33	0.001	
>€1500	76.21 ±2.65	89.57 ±1.59	< 0.0001	85.21 ±1.25	84.96 ±1.36	0.885	37.07 ±2.23	52.29 ± 1.96	<0,000	
difference	17.76	6.95		20.43	20.15		10.05	2.89		
Complementary 1	health									
insurance										
Yes	72.09 ± 1.84	88.08 ± 1.38	< 0.0001	81.77 ± 1.08	81.83 ±1.29	0.964	33.63 ±1.53	52.31 ± 1.64	<0,000	
No	48.35 ±9.53	78.06 ± 7.49	0.013	52.51 ±6.04	71.00 ±5.67	0.017	20.10 ±5.58	41.51 ±7.71	0.011	
difference	23.76	10.02		29.26	10.83		13.53	10.80		
Basic health insu	rance									
Yes	$66.12\pm\!\!7.38$	69.98 ± 8.60	0.694	67.20 ± 4.70	67.22 ±5.47	1	26.23 ±4.56	52.75 ±6.93	0.0001	
No	70.99 ± 1.93	$88.72\pm\!\!1.28$	< 0.0001	81.52 ±1.12	82.87 ± 1.24	0.399	33.83 ± 1.60	52.06 ±1.64	<0,000	
difference	4.87	18.74		14.32	15.65		7.60	0.69		
Employment										
Employed	76.23 ± 3.07	89.0 ±2.21	0.001	83.75 ±1.21	86.56 ± 1.34	0.097	28.37 ± 2.42	45.11 ±2.56	<0,000	
Unemployed	66.26 ± 9.44	84.1 ±8.73	0.176	66.00 ± 5.25	72.88 ±5.23	0.304	25.48 ± 6.60	35.91 ± 9.21	0.308	
nactive	68.58 ±2.32	86.79 ±1.75	< 0.0001	72.72 ±2.51	71.15 ±2.73	0.665	36.51 ±1.93	56.48 ±2.03	<0,000	

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		Mammograph (n=742)	y 2005			Mammograph (n=804)	y 2010		
Socio-economic		(11 / 12)	Adjusted		Unadjusted	(1 004)	Adjusted		<i>p</i> -trend ⁺
variable	Unadjusted OR	(95% CI)	OR	(95% CI)	OR	(95% CI)	OR	(95 % CI)	2005-2010
Occupation									0,706
Manager	1,00		1.0		1,00		1.0		
Farmer	0.28	(0.10, 0,77)*	0.31	(0.11, 0,87)*	0.66	(0.08, 5,45)	0.55	(0.06, 4,82)	
Self-employed	0.30	(0.11, 0,81)*	0.31	(0.11, 0,87)*	0.57	(0.18, 1,86)	0.56	(0.17, 1,88)	
Professional	0.51	(0.23, 1,10)	0.52	(0.24, 1,16)	0.67	(0.26, 1,72)	0.66	(0.25, 1,72)	
Employee	0.37	(0.18, 0,77)*	0.39	(0.19, 0,81)*	0.90	(0.36, 2,26)	1.12	(0.43, 2,94)	
Manual worker	0.31	(0.13, 0,74)*	0.32	(0.13, 0,79)*	0.30	(0.11, 0,78)*	0.33	(0.12, 0,92)*	
Other	0.38	(0.16, 0,95)*	0.41	(0.16, 1,04)	0.48	(0.16, 1,47)	0.68	(0.21, 2,25)	
Income			6						0,684
>€1500	1,00		1,00		1,00		1,00		
€1000-€1500	0.68	(0.42, 1,11)	0.74	(0.45, 1,21)	0.66	(0.34, 1,27)	0.98	(0.47, 2,06)	
<€1000	0.44	(0.26, 0,73)*	0.49	(0.28, 0,87)*	0.55	(0.29, 1,06)	0.75	(0.36, 1,57)	
RII	0,29	(0,14, 0,64)*	0,36	(0,15, 0,85)*	0,37	(0,13, 1,00)	0,70	(0,21, 2,31)	0.699
Education level									0,365
Superior BAC	1,00		1,00		1,00		1,00		
BAC	0.63	(0.32, 1,26)	0.61	(0.30,1,23)	2.13	(0.73, 6,18)	2.03	(0.68, 6,02)	
Inferior BAC	0.52	(0.32, 0,86)*	0.55	(0.33, 0,91)*	0.91	(0.48, 1,73)	0.98	(0.50, 1,93)	
RII	0,36	(0,16, 0,79)*	0,40	(0,18, 0,90)*	0,62	(0,21, 1,81)	0,73	(0,23, 2,24)	0.407
Employment									0,742
Employed	1,00		1,00		1,00		1,00		
Unemployed	0.61	(0.23, 1,62)	0.60	(0.23, 1,60)	0.65	(0.19, 2,20)	0.70	(0.19, 2,50)	
Inactive	0.68	(0.46, 1,01)	0.77	(0.51, 1,15)	0.81	(0.49, 1,36)	0.84	(0.49, 1,45)	
Complementary l	health insurance					Θ_{-}			0,872
Yes	1,00		1,00		1,00		1,00		
No	0.36	(0.16, 0,81)*	0.41	(0.18, 0,95)	0.48	(0.22, 1,06)	0.60	(0.25, 1,43)	
Basic health insu	rance								0,111
Yes	0.80	(0.41, 1,54)*	0.82	(0.42, 1,59)	0.30	(0.15, 0,58)*	0.39	(0.19, 0,81)*	
No	1,00		1,00		1,00		1,00		

Table 4. Association between socio-economic variables and the probability of cervical smear participation in 2005 and 2010: unadjusted[†] and adjusted Odds Ratios

		(n=1571	ar 2005 1)		(n=1514)				
Socio-									
economic	Unadjusted		Adjusted		Unadjusted		Adjusted		<i>p</i> -tren
variable	OR	(95% CI)	OR	(95 % CI)	OR	(95% CI)	OR	(95% CI)	2005-20
Occupation									0,480
Manager	1,00		1.0		1,00		1.0		
Farmer	0.54	(0.20, 1,45)	0.55	(0.20, 1,52)	0.79	(0.19, 3,29)	0.78	(0.18, 3,35)	
Self-employed	0.43	(0.20, 0,90)*	0.41	(0.19, 0,88)*	0.68	(0.31, 1,50)	0.68	(0.30, 1,52)	
Professional	0.94	(0.57, 1,54)	0.97	(0.59, 1,61)	1.43	(0.89, 2,45)	1.52	(0.88, 2,62)	
Employee	0.62	(0.40, 0,96)*	0.65	(0.41, 1,02)	0.85	(0.52, 1,37)	0.89	(0.54, 1,44)	
Manual worker	0.52	(0.29, 0,92)*	0.50	(0.28, 0,91)*	0.58	(0.33, 1,01)	0.68	(0.37, 1,22)	
Other	0.75	(0.38, 1,49)	0.78	(0.39, 1,58)	0.33	(0.18, 0,60)*	0.49	(0.25, 0,94)*	
Income									0,339
>€1500	1,00		1,00		1,00		1,0		
€1000-1500	0.46	(0.32, 0,65)**	0.53	(0.37, 0,77)**	0.66	(0.43, 1,01)	0.76	(0.48, 1,21)	
<€1000	0.32	(0.21, 0,49)**	0.43	(0.27, 0,68)**	0.33	(0.22, 0,49)**	0.43	(0.27, 0,69)**	
RII	0,16	(0,09, 0,28)**	0,24	(0,13, 0,46)**	0,20	(0,11, 0,37)**	0,28	(0,14, 0,57)**	0.268
Education									
level									0,822
Superior BAC	1,00		1,00		1,00		1,0		
BAC	0.95	(0.63, 1,45)	1.00	(0.66, 1,54)	0.97	(0.59, 1,58)	0.93	(0.57, 1,53)	
Inferior BAC	0.57	(0.41, 0,77)**	0.56	(0.41, 0,78)**	0.51	(0.35, 0,73)**	0.53	(0.36, 0,77)**	
RII	0,36	(0,21, 0,61)**	0,35	(0,2, 0,60)**	0,28	(0,16, 0,51)**	0,3	(0,16, 0,54)**	0.887
Employment									0,34
Employed	1,00		1,00		1,00		1,0		
Unemployed	0.38	(0.23, 0,61)**	0.46	$(0.28, 0, 75)^*$	0.42	(0.26, 0,67)**	0.51	(0.31, 0,83)*	
Inactive	0.52	(0.38, 0,71)**	0.50	(0.36, 0,69)**	0.38	(0.28, 0,52)**	0.40	(0.29, 0,55)**	
Complementary healt	th								
insurance									0,01
Yes	1,00		1,00		1,00		1,0		
No	0.25	(0.15, 0,40)**	0.29	(0.17, 0,49)**	0.54	(0.34, 0,88)*	0.69	(0.41, 1,17)	
Basic health insuranc	e								0,524
Yes	0.46	(0.29, 0,74)*	0.57	(0.35, 0,92)*	0.42	(0.28, 0,65)**	0.59	(0.36, 0,95)*	
No	1.00		1.00		1.00		1.00		

*p<0.05, **p<0.001.

Adjusted on the covariates: region, alcohol consumption, smoking status, close relative with cancer & living in couple

[†]Calculated by the interaction term for the change in Adjusted OR and Adjusted RII between 2005 and 2010

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		FOBT 2005				FOBT 2010			
		(n=1222)				(n=1425)			
Socio-economic	Unadjusted	Ad	justed		Unadjusted	Adj	usted		<i>p</i> -trend ⁺
ariable	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)	OR	95% CI	2005-2010
ccupation									0,301
anager	1,00		1.0		1,00		1.0		
armer	0.57	(0.29, 1,10)	0.66	(0.34, 1,31)	0.97	(0.46, 2,05)	0.78	(0.35, 1,73)	
elf-employed	0.78	(0.46, 1,31)	0.74	(0.43, 1,27)	0.82	(0.51, 1,31)	0.82	(0.50, 1,35)	
rofessional	0.83	(0.57, 1,23)	0.88	(0.59, 1,30)	0.85	(0.60, 1,20)	0.91	(0.63, 1,31)	
Employee	0.66	(0.45, 0,96)*	0.79	(0.53, 1,17)	0.78	(0.54, 1,12)	0.96	(0.64, 1,44)	
lanual worker	0.67	(0.44, 1,03)	0.68	(0.44, 1,05)	0.66	(0.45, 0,96)*	0.63	(0.42, 0,95)*	
ther	0.76	(0.39, 1,46)	0.94	(0.47, 1,89)	0.58	(0.36, 0,95)*	0.60	(0.35, 1,02)	
come									0,253
€1500	1,00		1,00		1,00		1,00		
1000-1500	0.85	(0.61, 1,18)	0.93	(0.66, 1,31)	0.94	(0.67, 1,31)	1.11	(0.77, 1,61)	
£1000	0.63	(0.42, 0,94)*	0.74	(0.48, 1,15)	0.89	(0.62, 1,29)	1.13	(0.74, 1,72)	
П	0,54	(0,31, 0,93)*	0,70	(0,38, 1,28)	0,83	(0,49, 1,41)	0,80	(0,43, 1,48)	0.275
ducation level									0,485
perior BAC	1,00		1,00		1,00		1,00		
AC	0.79	(0.50, 1,24)	0.85	(0.54, 1,33)	1.21	(0.81, 1,83)	1.27	(0.82, 1,97)	
ferior BAC	0.77	(0.58, 1,04)	0.79	(0.59, 1,07)	0.99	(0.74, 1,34)	0.99	(0.72, 1,36)	
II	0,67	(0,41, 1,09)	0,69	(0,42, 1,14)	0,90	(0,56, 1,45)	1,14	(0,68, 1,36)	0.519
mployment									0,960
mployed	1,00		1,00		1,00		1,00		
Inemployed	0.86	(0.40, 1,88)	1.08	(0.49, 2.38	0.68	(0.37, 1.27)	0.87	(0.45, 1,68)	
nactive	1.45	$(1.12, 1.88)^*$	1.56	(1.19.2.03)*	1.58	(1.25, 1.99)**	1.52	(1.18, 1.96)*	
amplementary health	insurance	(, -,)		(, _,)		(,,		(, .,, .)	0.441
	1 00		1.00		1.00		1 00		0,441
	1,00	(0.25, 0.07)*	0.52	(0.26, 1.04)	1,00	(0.40, 1.05)	1,00	(0.50, 1.45)	
H	0.30	(0.23, 0,97)	0.32	(0.20, 1,04)	0.03	(0.40, 1,03)	0.03	(0.50, 1,45)	0.257
oasic mealth insurance		(0.42, 1.10)	0.72	(0.45, 1.10)	1.02	(0, 60, 1, 54)	1 1 1	(0.71, 1.72)	0,257
C 3	0.70	(0.45, 1,10)	U./2	(0.43, 1,10)	1.03	(0.09, 1,54)	1.11	(0.71, 1,72)	
)	1,00		1,00		1,00		1,00		

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STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract
		(b) Provide in the abstract an informative and balanced summary of what was done
		and what was found: Included, please see page 1 and 2.
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported
C		Included, please see 5 and 6
Objectives	3	State specific objectives, including any prespecified hypotheses. Included please see
		page 6, last sentence.
Methods		
Study design	4	Present key elements of study design early in the paper. Included, please see page 7,
		study population section, first paragraph.
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment,
		exposure, follow-up, and data collection. Included, please see page 7, study
		population section, second paragraph.
Participants	6	(a) Cohort study—Give the eligibility criteria, and the sources and methods of
		selection of participants. Describe methods of follow-up
		Case-control study—Give the eligibility criteria, and the sources and methods of
		case ascertainment and control selection. Give the rationale for the choice of cases
		and controls
		Cross-sectional study—Give the eligibility criteria, and the sources and methods of
		selection of participants. Included, please see page 7, study population section,
		first paragraph.
		(b) Cohort study—For matched studies, give matching criteria and number of
		exposed and unexposed
		Case-control study—For matched studies, give matching criteria and the number of
		controls per case
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect
		modifiers. Give diagnostic criteria, if applicable. Included, please see page 8,
		Measures section.
Data sources/	8*	For each variable of interest, give sources of data and details of methods of
measurement		assessment (measurement). Describe comparability of assessment methods if there is
		more than one group. Included, please see page 8, Measures section.
Bias	9	Describe any efforts to address potential sources of bias. Included, please see page
		7, second sentence, study population section, and page 8, last paragraph,
		Measures section.
Study size	10	Explain how the study size was arrived at. Included, please page 7, second
		paragraph, study population section.
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable,
		describe which groupings were chosen and why. Included, please page 8, Measures
		sections.
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding
		Included, please page Statistical Analysis section pages 9-10
		(b) Describe any methods used to examine subgroups and interactions Included,

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please statistical analysis section, second and third paragraphs.

(c) Explain how missing data were addressed. Included, please see page 7, study population section, second paragraph.

erant for study—1, i.e. or not study—1, inging strategy. Included, () Describe any sensitivity mate.

Continued on next page

Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and
		analysed YES
		(b) Give reasons for non-participation at each stage YES
		(c) Consider use of a flow diagram
Descriptive	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information
data		on exposures and potential confounders YES
		(b) Indicate number of participants with missing data for each variable of interest YES
		(c) Cohort study—Summarise follow-up time (eg, average and total amount)
Outcome data	15*	Cohort study-Report numbers of outcome events or summary measures over time
		Case-control study-Report numbers in each exposure category, or summary measures of
		exposure
		Cross-sectional study—Report numbers of outcome events or summary measures YES
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their
		precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and
		why they were included YES
		(b) Report category boundaries when continuous variables were categorized
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful
		time period YES
Other analyses	17	Report other analyses done-eg analyses of subgroups and interactions, and sensitivity
		analyses
Discussion		
Key results	18	Summarise key results with reference to study objectives YES
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision.
		Discuss both direction and magnitude of any potential bias YES
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity
		of analyses, results from similar studies, and other relevant evidence YES
Generalisability	21	Discuss the generalisability (external validity) of the study results YES
Other informati	on	
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable,
-		for the original study on which the present article is based YES

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Temporal trend in socio-economic inequalities in the uptake of cancer screening programs in France between 2005 and 2010: Results from the Cancer Barometer Surveys

Journal:	BMJ Open
Manuscript ID	bmjopen-2017-016941.R2
Article Type:	Research
Date Submitted by the Author:	02-Aug-2017
Complete List of Authors:	Kelly, David; Institut National du Cancer, Social sciences, Epidemiology, Public Health Estaquio, Carla Leon, Christophe Arwidson, Pierre Nabi, Hermann; Institut National du Cancer, Research in Social and Human Sciences, Epidemiology and Public Health
Primary Subject Heading :	Epidemiology
Secondary Subject Heading:	Epidemiology, Public health, Health services research
Keywords:	cancer screening, Social inequalities, cancer epidemiology

SCHOLARONE" Manuscripts Temporal trend in socio-economic inequalities in the uptake of cancer screening programs in France between 2005 and 2010: Results from the Cancer Barometer Surveys

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Word count: Abstract = 307; Text = 3527

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ABSTRACT

Objectives: Cancer screening is a form of secondary prevention for a disease which is now the leading cause of death in France. Various socio-economic indicators have been identified as potential factors for disparities in breast, cervical and colorectal cancer screening uptake. We aimed to identify the socio-economic inequalities which persisted in screening uptake for these cancers, and to quantify these disparities over a 5-year period.

Setting: The Cancer-Barometer was a population-based survey carried out in 2005 and 2010 in Metropolitan France.

Participants: A randomly selected sample of participants aged 15 to 85 years, n=3820 in 2005 and n=3727 in 2010, were interviewed on their participation in breast, cervical and colorectal cancer screening programs and their socio-economic profile.

Primary and secondary outcome measures: For each type of screening-program, we calculated participation rates, odds ratios (OR) and relative inequality indices (RII) for participation, derived from logistic regression of the following socio-economic variables: income, education, occupation, employment and health insurance. Changes in participation between 2005 and 2010 were then analyzed.

Protected by copyright, including for uses related to text and data mining, Al training, and similar technologies. **Results:** Participation rates for breast and colorectal screening increased significantly along the majority of socio-economic categories, whereas for cervical screening there were no significant changes between 2005 and 2010. RIIs for income remained significant for cervical smear in 2005 (RII=0.25, 95% CI 0.13-0.48) and in 2010 (RII=0.31, 95% CI 0.15-0.64). RIIs for education in mammography (RII=0.43, 95% CI 0.19-0.98) and cervical smear (RII=0.36, 95% CI 0.21-0.64) were significant in 2005 and remained significant for cervical smear (RII=0.40, 95% CI 0.22-0.74) in 2010.

Conclusions: There was a persistence of socio-economic inequalities in uptake of opportunistic cervical cancer screening. Conversely, organized screening-programs for breast and colorectal cancer saw a reduction in relative socio-economic inequalities, even though the results did not reach statistical significance. The findings suggest that organized cancer screening programs have the potential to reduce socio-economic disparities in participation.

Key words: cancer screening, breast cancer, cervical cancer, social inequalities, cancer epidemiology

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Strengths and limitations of this study

- First study to examine temporal changes in inequalities for cancer screening uptake in • France using relative inequality index.
- Benefits from datasets of two identical questionnaires on cancer screening uptake, taken 5 years apart, using two comparable population samples, hence minimizing information bias.
- Evolution in the format of colorectal screening program in terms of technique and age limits may have led to measured differences in uptake between 2005 and 2010.
- Residents of nursing homes and other medical institutions without a personal telephone line were excluded from the survey, limiting the generalizability of the findings.
- Relatively small number for certain socio-economic strata, reducing therefore the precision of some estimates.



INTRODUCTION

Screening for cancer is an important form of secondary prevention for a disease which is now leading cause of death in France and worldwide [1]. The 2008 European report on cancer recommends that health systems focus their resources on cancer prevention and early detection rather than treatment alone, as the global disease burden of cancer threatens to become unsustainable in terms of financial costs, pressure on services, follow-up of patients and delivery of care [2].

To date, many European countries have rolled out screening programs for breast, colorectal and cervical cancer via mammography, faecal occult blood test (FOBT) and cervical smear respectively [3, 4]. However, for these screening programs to have a significant effect on reducing cancer mortality, they require a minimum level of participation among the eligible population; for instance 70% for mammography, and 50% for FOBT [5].

We reviewed several publications from France, UK, USA, Italy, Denmark, Korea and Argentina, which identified variables shown to have a significant effect on cancer screening uptake [6-19]. For breast cancer screening, various different social and economic variables were found to have a positive effect on uptake, including employment, living in a couple, higher occupation class, higher education level, income, private health insurance, car/home ownership and rural residency. However, no single variable was consistently observed across studies except for participation in other screening programs [7, 18]. For cervical cancer screening, the variables identified as having a significant positive effect on uptake were more numerous, and notably consistent for income [7, 11, 17], higher education level [10-12, 17, 18], employment [6, 12, 18, 19] and private health insurance [6, 7, 18]. For colorectal screening, general practitioners' (GP) consultation [6, 7, 18, 19] was consistently shown to have a significant positive effect on uptake of screening across the studies, as

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well as income [14, 16, 18]. However, it remains unclear whether the effect of these socioeconomic variables on participation rates in screening programs persists over time.

pen⁶/₆ first published as 10.1136/bmjopen-2017-016941 on 14 December 2017. Downloaded from http://bmjopen.bmj.com/ on June 8, 2025 at Department GEZ-LTA Erasmushogeschool e Protected by copyright, including for uses related to text and data mining, Al training, and similar technologies. Only one study drawn from the 2006, 2008 and 2010 French Healthcare and Health Insurance surveys has examined the temporal evolution in breast, cervical and colorectal cancer screening uptake along socio-economic strata in France to date [6]. This study conducted among 10 000 participants found that those classified as unskilled workers were less likely to have undergone cervical cancer screening (OR = 1.64 [1.38 - 1.95]). The results also showed that women without (OR = 2.05 [1.68-2.51]) or receiving free complementary health insurance (OR = 1.79 [1.36-2.37])were less likely to have undergone breast cancer screening. In this study, the authors found that inequalities for participation in breast and colorectal cancer screening persisted over the study period from 2006 to 2010 [6]. Thus, we believe that there is a need to re-examine how these trends may have evolved with respect to expansion in the coverage and awareness of organized cancer screening programs. The third French National Cancer Plan for the 2014-2019 period has identified early detection of cancers as a primary priority [20]. Within this goal is the reduction of inequalities associated with cancer diagnosis, with the hope that it subsequently reduces mortality rates. Any widening or reduction in socio-economic inequalities in the uptake of screening programs that are identified may then be used to direct future policy of the French national cancer control plan, which specifically seeks to address this issue [20]. We aim therefore in the present study to identify the socio-economic inequalities which persist for uptake of breast, cervical and colorectal cancer screening, and to quantify these disparities over a 5 year period in France.

MATERIALS AND METHODS

Study population

We used data, obtained by formal permission, from the Cancer Barometer surveys, two telephone surveys on cancer-related knowledge, attitudes and practices conducted by the French National Institute for Prevention and Health (now part of Santé Publique France). Both surveys were carried out on a representative random sample of the general French population aged over 16 years old for the 2005 survey and aged 15–85 years old for the 2010 survey. A two-stage random sampling design was used. Residents of nursing homes or other medical institutions who did not possess a personal telephone line were not included in the samples. Private households with telephones were included in the sample. The first sampling step was household selection (by phone number). Within each selected household, one French speaking person aged 15–85 was randomly selected using the "next birthday" method. The interviews were conducted using a computer-assisted telephone interview (CATI) system.

In order to obtain adequate statistical power for measuring associations between variables and changes in participation rates along smaller levels, a sample size of between 3500 and 4000 was deemed appropriate. The 2005 Cancer Barometer sample was comprised of 4046 participants aged over 16 years interviewed between April and June 2005 [18]. There were 226 individuals with missing observations in the 2005 Cancer Barometer sample, notably for all 3 of the dependent variables, and 7 out of 10 of the covariates and independent variables. These individuals terminated the survey prematurely, and were thus removed from the analysis as their data was non-contributive, leaving 3820 participants in the sample population. Females (51.5%) responded more often than males (48.5%) and mean age of interviewees was 46.7 years. The 2010 Cancer Barometer sample was comprised of 3727 participants aged 15 to 85 interviewed during the first semester of 2010 [19]. The mean age was 44.6 years and the majority of participants were also

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female (52.0%vs. 48.0%). The response rates for the 2005 and 2010 Cancer Barometers were 51.2% and 47.0%, respectively.

Measures

Socio-economic indicators (independent variables) were as follows: education level (inferior, equal to or superior to Baccalauréat (high-school diploma), employment status (employed, unemployed, and inactive), occupational class (farmer, trader, manager, professional, employee, manual worker, other), monthly income (below €1000, €1000-1500, above €1500) and health insurance (complementary vs. basic insurance coverage). The outcome variables were participation in breast, cervical and colorectal cancer screening programs (dependent variables). For breast cancer screening, participants aged over 40 years were asked if they had undergone mammography within the previous 2 years. For cervical cancer screening, participants aged over 20 years were asked if they had undergone a cervical smear within the previous 3 years. For colorectal cancer screening, participants aged 50-74 years were asked if they had undergone a faecal occult blood test (FOBT) within their lifetime. Covariates included gender, age, smoking status, alcohol consumption, region, living in a couple and having a close relative with cancer. For the calculation of screening participation rates, we added filters to select the target population eligible for each of the 3 different screening programs. Breast screening by mammography (n=1546): female gender and 49<age<75. Cervical screening by cervical smear (n=3085): female gender and 24<age<66. Colorectal screening by FOBT (n=2647): both genders where 49<age<75.

The weighting was based on the data of the 1999 and 2008 Employment Survey of the French population [21], taking into account age, gender, region, education level and number of persons per household [18]. This allowed us to effectively calculate age-adjusted standardized rates for

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screening participation, in addition to later adjusting the regression models on the covariates mentioned.

Statistical analysis

We calculated age-adjusted screening rates (AAR) for each stratum using the weighting provided by the INPES. The temporal evolution in the participation rate along each stratum between 2005 and 2010 was examined by adding an interaction term with the year of the survey. The disparity within each socio-economic variable was calculated as the absolute difference between the AAR for the highest and lowest group within an ordinal or binary variable for the given year.

Odds ratios (OR) derived from multiple logistic regression of screening participation on each socio-economic variable separately were used as a measure of participation likelihood for each stratum of the 6 socio-economic variables. The model was adjusted on the covariates: age, gender (colorectal screening only), region, alcohol, smoking, living in couple and close relative with cancer. For categorical variables, the higher socio-economic position was used as the reference group. The p-value for significance of the evolution of the odds ratios between 2005 and 2010 was calculated using an interaction term between the socio-economic variable and the time period, in order to be consistent with the methodology of previous studies on the topic [22, 23].

For ordinal variables of income and education level, we calculated the Relative Inequality Index (RII) as a measure of health inequality as described by Mackenbach and Kunst [24]. Previous studies on health inequalities, including breast cancer screening uptake [4, 9], employed a similar methodology for examining temporal evolutions along ordered socio-economic strata [23, 25]. The RII is a regression-based measure that summarizes the association between two variables. It is computed by ranking income and education values on a scale from the lowest, which is 0, to the highest, which is 1. Each income or education level value covers a range on this scale that is

proportional to the number of participants who held that value and is given a new value on the scale corresponding to the cumulative midpoint of its range. The RII resembles relative risk in that it compares the probability of cancer screening uptake at the extremes of income and educational levels, but is estimated using the data on all income and education values and is weighted to account for the distribution of these values. Here the RII was fitted using logistic regression models. An RII of 0.5 for example implies that participants in the most deprived group (those with lower incomes and educations levels) had a 50% lower probability of cancer screening uptake when compared to those in the least deprived group (those with higher incomes and education levels). All statistical analysis was performed using SAS version 9.2.

RESULTS

Table 1 presents the demographic and socio-economic characteristics of the study populations. The overall participation rates among the eligible populations for breast, cervical and colorectal cancer screenings are shown in Table 2. Chi-squared tests for the change in participation rates along each socio-economic stratum between 2005 and 2010 are also included. For mammography, participation rates increased significantly (p < 0.05) along all socio-economic strata. with the exception of farmers, managers, manual workers, unemployed, those with basic health insurance and education level superior to Baccalauréat. For FOBT, participation rates increased significantly along all socio-economic strata between 2005 and 2010, with the exception of those unemployed or occupation classified as other. For cervical smear there were no significant changes in participation rates along any of the socio-economic strata, except for those without complementary health insurance, which increased significantly from 52.51% to 71.0% (p=0.017).

Table 3 shows the results of the logistic regression models for mammography participation on each socio-economic variable separately, adjusted for covariates. In 2005, farmers, self-employed, Page 11 of 28

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employees and manual workers showed significantly reduced participation compared to managers/executives, whereas in 2010 only the association in manual workers remained significant. In 2005, those with an education level inferior to Baccalauréat (OR=0.57, 0.35-0.95) showed significantly reduced participation compared to those superior to Baccalauréat, which became non-significant in 2010 (OR=1.04, 0.53-2.05).

Table 4 shows the results of the regression model for cervical smear participation for each socio-economic variable. In 2005, significantly reduced participation was observed for self-employed and manual workers, which became non-significant for both in 2010. In 2005, there was significantly reduced participation for those earning <£1000 and £1000-£1500, which remained significant in 2010 for those earning <£1000 (OR=0.47, 95% CI 0.29-0.76). An education level inferior to Baccalauréat showed significantly lower participation in both 2005 and in 2010. In 2005, being unemployed or inactive significantly reduced participation, and remained significant for both in 2010. The odds ratio for cervical smear participation changed significantly (p=0.014) for those without complementary health insurance from 0.29 (95% CI 0.17-0.49) in 2005 to 0.64 (95% CI 0.38-1.08) in 2010. Having only basic health insurance was significantly associated with reduced participation in both periods.

Table 5 shows the logistic regression results for FOBT participation on each socio-economic variable. For occupation, manual workers (OR=0.63, 95% CI 0.42-0.96) showed significantly reduced participation in 2010. Odds ratios for all other occupations showed reduced participation compared to managers, but at a non-significant level in 2005 and 2010. Those earning <€1000 showed reduced participation in 2005 (OR=0.62, 95% CI 0.32-0.97), which became non-significant in 2010. There were no significant temporal changes in any of the odds ratios for participation in breast or colorectal cancer screening between 2005 and 2010.

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The regression of screening participation on income distribution produced RIIs which can be found in Tables 3-5. The results showed significant inequalities for cervical smear (RII=0.25, 95% CI 0.13-0.48) in 2005, but not for mammography (RII=0.47, 95% CI 0.19-1.29) or FOBT (RII= 0.70, 95% CI 0.38-1.28). In 2010 the income-based RII remained significant for cervical smear (RII=0.31, 0.15-0.64). For education, mammography (RII=0.43, 95% CI 0.19-0.98) and cervical smear (RII=0.36, 95% CI 0.21-0.64) showed significant inequalities in 2005, whereas the RII for FOBT was non-significant (RII=0.69, 95% CI 0.42-1.14). In 2010, the education-based RII for mammography became non-significant (RII=0.80, 95% CI 0.26-2.50), whereas the RII for cervical smear remained significant (RII=0.40, 95% CI 0.22-0.74). The p-trend for the temporal change in the RIIs (adjusted model) measured by interaction term between 2005 and 2010, was non-significant for all 3 screening programs for income and education level.

DISCUSSION

Our objective was to identify the socio-economic inequalities which persisted for uptake of breast, cervical and colorectal cancer screening, and to quantify these disparities between the 2005 and 2010. In absolute terms, we found a significant increase in participation rates across all socio-economic strata for mammography and for FOBT between 2005 and 2010. Cervical cancer screening however saw no significant change in participation rates between 2005 and 2010 (except for those without complementary health insurance). A similar trend was observed when relative inequalities were considered. It should be noted that some of these inequalities were persistent between 2005 and 2010, even though formal statistical tests for trend were generally not significant.

Findings in the context of the literature
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It is encouraging to note the significant increase in participation rates across all socioeconomic strata for mammography between 2005 and 2010. This effect was not demonstrated in a French study by Sicsic et al. in 2006, 2008 and 2010, which showed a decrease in mammography participation rates over time [6]. This study did however show a large increase in colorectal cancer screening rates, in line with our findings. Cervical cancer screening however saw no significant change in participation rates between 2005 and 2010 (except for those without complementary health insurance), while Sicsic et al. showed an overall decrease in participation rates from 2006 to 2010. Our study confirmed significantly reduced participation for manual workers in breast and colorectal screening and for those with only basic health insurance in breast and cervical screening in 2010. This is consistent with Sicsic et al., which showed reduced participation in all 3 screening programs for manual workers and those with only basic health insurance.

Several factors may explain why some of our findings differ from those by Sicsic et al. The study by Sicsic et al. was based on three surveys carried out in 2006, 2008 and 2010, with therefore a two-year interval, whereas the Cancer Barometer survey was conducted at two points in time in 2005 and 2010. Another important difference between the two studies relies on their objectives and consequently on the methods used to reach them. The study by Sicsic et al. aimed to analyze the obstacles to and levers for breast, cervical, and colorectal cancer screening uptake and their trends over time, whereas the aim of our study was to identify the socio-economic inequalities which persist for uptake of breast, cervical and colorectal cancer screening, and to quantify these disparities over a 5 year period. Thus, Sicsic et al. pooled their three samples and did not conduct direct comparisons of associations between indicators of socioeconomic position and uptake of cancer screenings between periods.

Breast and colorectal cancer screening programs saw the absolute differences in participation rates reduced over time for all socio-economic variables in our study, with the exception of pen: first published as 10.1136/bmjopen-2017-016941 on 14 December 2017. Downloaded from http://bmjopen.bmj.com/ on June 8, 2025 at Department GEZ-LTA Erasmushogeschool

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employment and basic health insurance. Sicsic et al. found that disparities in participation did not decrease for mammography or FOBT screening from 2006 to 2010 [6]. An American study by Kim et al. showed the disparity in mammography participation based on income remained unchanged, while the disparity based on education decreased from 2000 to 2005 [9]. Cervical cancer screening however saw a persisting disparity in participation rates for the majority of socio-economic variables in our study, consistent with the results of De Maio et al. and Sicsic et al. [6, 17].

The relative inequalities for income and education decreased for breast and colorectal cancer screening in our study, albeit non-significantly. This is somewhat consistent with DeMaio et al., which showed a reduction in the RII for breast cancer screening from 2005 to 2009 [17]. In the study by Kim et al., the income-based relative inequalities tended to decrease slightly, while those for education remained constant over time [9]. The relative inequalities for cervical cancer screening persisted for both income and education from 2005 to 2010 in our study, both remaining statistically significant. This is partially consistent with the De Majo et al., where the social gradient decreased for income and increased for education between 2005 and 2010 [17].

Interpretation of results

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Dent Of Interpretent of the second of the seco Breast and colorectal screening programs are organized at a national level and differences in absolute participation rates and relative inequalities decreased over time for all socio-economic variables. For both breast and colorectal screening, the odds ratios for manual workers showed reduced participation compared to managers/executives in 2010. Education and occupation are strongly correlated, with manual workers having a higher proportion of participants with an educational level inferior to Baccalauréat (85%) than any other occupational category in 2010. Thus they may have been less aware of the health marketing campaigns for colorectal cancer screening and the recommendation for FOBT, due to the negative effect of lower education on health literacy [14, 26, 27].

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Cervical cancer remains without a nationally organized screening program in France. It is the duty of doctors to organize and falls to the individual to pay for opportunistic screening via cervical smear test. The lack of a nationally organised screening program may impose significant financial, educational and cultural barriers to screening uptake among certain sections of the French population. The financial costs for a consultation and laboratory processing of the screening test may deter those with only basic health insurance, as public reimbursement covers only 70% of the cost [28]. This may account for the persistence of the observed differences in participation rates and large RIIs. Improving the awareness, affordability and access to cervical cancer screening should be prioritised in order to increase participation rates and reduce socio-economic disparities.

Limitations and strengths of the study

Our study used two almost identical datasets to construct a temporal analysis of participation in screening programs in France between 2005 and 2010. The use of relative inequality indices to measure the evolution of socio-economic inequalities in our study is the first to employ this methodology among a French population for cancer screening. The comparability of the study populations minimized selection bias and the conservation of the questionnaire format minimized information bias.

The study still has several limitations however. It shares the usual shortcomings of phone surveys. There is a potential selection bias, as residents of nursing homes or other medical institutions who did not possess a personal telephone line were not included in the samples. The study includes only those who are French speakers, excluding individuals unable to answer fluently in French. There was no available data on ethnicity or nationality of participants in the study, which may have been an important source of confounding or effect modification. The exclusion of the above subpopulations, which are likely to be more socio-economically disadvantaged, may have overestimated the screening participation rates in our study.

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Our study used two separate sample populations, whose distributions in Table 2 differed significantly for all of the socio-economic indicators and several covariates. The difference in sample distributions may have accounted for the observed differences in screening participation.

Changes in screening policies concerning age limits, screening techniques and regional access left the 2005 and 2010 Cancer Barometers not directly comparable for certain programs. The question of screening participation for colorectal cancer was therefore limited to lifetime use of FOBT. Organized cervical screening was available in 13 regions in 2009, a source of regional variation not present in 2005. Some screening techniques are more memorable to patients, due to the invasiveness of the screening technique or the duration of the screening intervals, which may have led to recall bias.

Page and in the of all to ay the of all to ay the ds we object to the object of the ds we are the The respective analytical sample sizes in 2005 and 2010 for breast (n=742, n=804), cervical (n=1571, n=1514) and colorectal (n=1222, n=1425) cancer screening may have been too small to capture disparities along socio-economic strata, leading to false observations and conclusions. Missing observations for each variable accounted for less than 5% of the total population, except for the variable income (16.3% missing in 2005 and 9.3% in 2010). This might have limited the precision of certain estimates, producing participation rates with large standard errors and odds ratios with large confidence intervals. We undertook multiple comparisons in our study. Thus, we cannot exclude that some of the results we have observed are due to chance.

Conclusion

The findings suggest that organized cancer screening programs have the potential to reduce socioeconomic disparities in participation.

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This article uses data collected from the 2005 and 2010 Barometre cancer studies, provided by the National Institute for prevention and health education, INPES (now Santé Publique France). Special thanks to the department of screening at the Institut National du Cancer (INCA).

Funding statement

This research received no specific grant from any funding agency in the public, commercial or notfor-profit sectors. The data collection was funded by the National Institute for prevention and health education, INPES (now Santé Publique France) in association with the French National Cancer Institute (INCa). The authors declare no external or private sources of funding.

Competing interest statement

All authors have completed the ICMJE uniform disclosure form at <u>www.icmje.org/coi_disclosure.pdf</u> and declare: no support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous three years; no other relationships or activities that could appear to have influenced the submitted work.

Contributors

HN conceived the study, advised on methodology, reviewed the results of statistical analyses and supervised the final edit of the manuscript. DK reviewed the background literature, run statistical analyses and drafted the manuscript. CE, CL, PA provided advice on methodology and statistical analyses. CL & PA directed the data collection. All authors contributed to the final draft of this manuscript.

Data sharing statement

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All data presented in this manuscript came from 2 original datasets of the 2005 and 2010 Cancer Barometer surveys. The original files can be requested by contacting Santé Publique France (formerly INVS and INPES) via Pierre Arvidson (pierre.arwidson@santepubliquefrance.fr) or Christophe Léon (christophe.leon@santepubliquefrance.fr).

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Table 1. Standardized distribution of study populations for 2005 and 2010 Cancer Barometersurveys, p-value for Chi-squared test							
Variables	Barometer 20	005 (n=3820)	Baromete	p-value			
	n	%	n	%			
Gender					0.660		
Male	1854	48,5	1790	48,0			
Female	1966	51,5	1937	52,0			

Female	1966	51,5	1937	52,0	
Region					0.976
Ile-de-France	701	18,4	696	18,7	
West Paris basin	380	10,0	348	9,3	
East Paris basin	305	8,0	290	7,8	
North	257	6,7	238	6,4	
West	508	13,3	504	13,5	
East	334	8,8	321	8,6	
South West	414	10,9	412	11,1	
South East	455	12,0	447	12,0	
Mediterranée	457	12,0	471	12,6	
Occupation					< 0.001
Farmer	117	3,1	81	2,2	
Self-employed/craftsman	220	5,8	270	7,2	
Manager/executive	589	15,4	595	16,0	
Professional	773	20,3	914	24,5	
Employee/office worker	970	25,4	829	22,3	
Manual worker	642	16,8	839	22,5	
Oher	506	13,3	199	5,3	
Education level				· · · · · · · · · · · · · · · · · · ·	< 0.001
Inferior BAC*	1946	52.0	2270	61.2	
BAC	651	17.4	635	17.1	
Superior BAC	1146	30.6	803	21.7	
Monthly Income	1110	50,0	000	,	< 0.001
	414	13.2	300	12.1	
<u>61000</u>	662	21.0	400	12,1	
>€1500	2075	65.8	2401	72.8	
Employee A	2075	05,8	2401	72,0	<0.001
Employment	0146		1051	10.7	<0.001
Employed	2146	56,2	1851	49,7	
Unemployed	1//	4,6	260	7,0	
Inactive	1497	39,2	1615	43,3	<0.001
Alcohol consumption					<0.001
Yes	3430	89,8	3195	85,7	
No	389	10,2	532	14,3	
Smoking status					< 0.001
Yes	964	25,2	1195	32,1	
No	2856	74,8	2532	67,9	
Close Relative with cancer					0.950
Yes	2366	62,1	2198	62,1	
No	1446	37,9	1339	37,9	
Living in couple					0.071
Ves	2465	64.6	2333	62.6	
No	1351	35.4	1394	37.4	
Complementary Health Insurance	1551	55,4	1574	57,4	<0.001
Vog	2510	02.6	2210	00.7	-0.001
I CS No	3518	92,6	3210	89,6	
Desie Heelth Learne see	282	/,4	3/3	10,5	0.002
Basic Health Insurance	2.11	10.2		10.1	0.003
Yes	361	10,2	441	12,4	
NO * DAC = Decoelouránt (high school distance)	3182	89,8	3109	87,6	
· DAC = Baccalaureat (nign-school diploma)					

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		Mammography		(Cervical smear			FOBT	
Socio-economic	p	articipation rate (%) ± SE	partic	ipation rate (%) \pm S	SE	partic	ipation rate (%) \pm	SE
variable	2005	2010	Chi2	2005	2010	Chi2	2005	2010	Chi2
	(n=742)	(n=804)	<i>p</i> -value	(n=1571)	(n=1514)	<i>p</i> -value	(n=1222)	(n=1425)	<i>p</i> -value
Overall	88.0	88.3		79.7	81.4		34.0	51.6	
Occupation									
armer	62.49 ±8.24	87.64 ±8.81	0.148	75.61 ±7.28	80.39 ±11.63	0.739	26.97 ±6.69	$56.50\pm\!10.82$	0.006
self-employed	63.70 ±9.46	85.96 ±5.37	0.027	$71.02\pm\!7.00$	77.92 ±6.89	0.438	33.47 ±5.61	52.30 ± 5.75	0.009
Manager	85.50 ±4.04	91.45 ±2.50	0.262	85.15 ±2.51	83.88 ±3.05	0.740	39.33 ±3.89	57.33 ±3.31	0.0003
rofessional	74.87 ±3.74	87.82 ±2.95	0.004	84.31 ±1.95	88.17 ±1.68	0.153	35.04 ±3.21	53.32 ±2.79	<0,0001
Employee	68.76 ±3.00	90.58 ±1.98	<0.0001	78.05 ± 1.81	81.52 ±2.06	0.170	29.92 ±2.63	51.07 ±3.54	<0,0001
Ianual worker	64.52 ±6.01	76.02 ±5.29	0.161	74.70 ±3.96	75.00 ±4.22	0.956	30.29 ±3.74	46.95 ±4,23	0.001
ther	69.37 ±6.19	83.70 ±5.28	0.097	81.14 ±4.21	62.94 ±6.53	0.010	32.87 ±6.20	$43.84\pm\!\!6.92$	0.204
ducation level									
nferior BAC	67.80 ±2.29	86.26±1.79	< 0.0001	75.20 ±1.77	76.88 ±1.97	0.484	31.55 ±1.82	51.06 ±2.06	0
AC	71.86 ±5.71	93.63 ±2.15	0.0003	83.59 ±2.47	86.42 ±2.03	0.385	32.07 ±4.46	56.06 ±3.58	<0,0001
uperior BAC	80.17 ±3.49	87.34 ±2.56	0.153	84.27 ±1.65	86.81 ±1.67	0.318	37.39 ±3.27	51.23 ±2.92	0.002
ifference	12.37	1.08		9.07	9.93		5.84	0.17	
e1000	59 15 ±1 19	82 62 +2 02	0.001	64 78 ±4 01	64 81 ±4 70	1	27.02 ±2.55	49 40 ±4 79	0.0001
000 1500	58.45 ±4.48	82.02 ±3.92	0.001	04.78 ±4.01	04.81 ±4.70	1	27.02 ±3.33	49.40 ±4.79	0.0001
E1500	08.02 ± 4.19	84.93 ± 3.37	<0.0001	72.43 ±2.90	76.61 ± 5.49	0.101	33.29 ±3.33	52 20 ±1 06	<0.001
ifference	70.21 ±2.05	6.05	<0.0001	20 43	20.15	0.885	10.05	2 80	<0,0001
omnlementary l	health	0.75		20.45	20.15		10.05	2.09	
surance									
es	72.09 ±1.84	88.08±1.38	< 0.0001	81.77 ±1.08	81.83 ±1.29	0.964	33.63 ±1.53	52.31 ± 1.64	<0,0001
ło	48.35 ±9.53	78.06 ±7.49	0.013	52.51 ±6.04	71.00 ±5.67	0.017	20.10 ±5.58	41.51 ±7.71	0.011
ifference	23.76	10.02		29.26	10.83		13.53	10.80	
asic health insu	rance								
es	66.12 ±7.38	69.98 ± 8.60	0.694	67.20 ±4.70	67.22 ±5.47	1	26.23 ±4.56	52.75 ±6.93	0.0001
ło	70.99 ±1.93	88.72 ±1.28	< 0.0001	81.52 ±1.12	82.87 ± 1.24	0.399	33.83 ±1.60	52.06 ±1.64	<0,0001
ifference	4.87	18.74		14.32	15.65		7.60	0.69	
mployment									
mployed	76.23 ±3.07	89.0 ±2.21	0.001	83.75 ±1.21	86.56 ±1.34	0.097	28.37 ±2.42	45.11 ±2.56	<0,0001
nemployed	66.26 ±9.44	84.1 ±8.73	0.176	66.00 ±5.25	72.88 ±5.23	0.304	25.48 ±6.60	35.91 ± 9.21	0.308
nactive	68.58 ±2.32	86.79 ±1.75	< 0.0001	72.72 ±2.51	71.15 ±2.73	0.665	36.51 ±1.93	56.48 ±2.03	<0,0001

Table 3. Association between socio-economic variables and the probability of participation in mammography in 2005 and 2010: unadjusted[†] and adjusted Odds Ratios

	Mammography 2005				Mammography 2010				
Socio-economic	Unadjusted	(n=/4	Adjusted		Unadjusted	(n=804	4) Adjusted		
variable	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)	OR	(95 % CI)	2005-201
Occupation									0.521
Manager	1.00		1.0		1.00		1.0		
Farmer	0.28	(0.10, 0.77)*	0.33	$(0.12, 0.92)^*$	0.66	(0.08, 5.45)	0.64	(0.07, 5.54)	
Self-employed	0.30	(0.11, 0.81)*	0.33	(0.12, 0.93)*	0.57	(0.18, 1.86)	0.60	(0.18, 2.00)	
Professional	0.51	(0.23, 1.10)	0.53	(0.24, 1.18)	0.67	(0.26, 1.72)	0.66	(0.25, 1.74)	
Employee	0.37	(0.18, 0.77)*	0.39	(0.19, 0.82)*	0.90	(0.36, 2.26)	1.13	(0.43, 2.95)	
Manual worker	0.31	(0.13, 0.74)*	0.34	(0.14, 0.84)*	0.30	(0.11, 0.78)*	0.34	(0.12, 0.94)*	
Other	0.38	(0.16, 0.95)*	0.45	(0.17, 1.14)	0.48	(0.16, 1.47)	0.59	(0.18, 1.95)	
Income									0.775
>€1500	1.00		1.00		1.00		1.00		
€1000-€1500	0.68	(0.42, 1.11)	0.83	(0.50, 1.39)	0.66	(0.34, 1.27)	1.04	(0.49, 2.20)	
<€1000	0.44	(0.26, 0.73)*	0.57	(0.32, 1.03)	0.55	(0.29, 1.06)	0.80	(0.38, 1.68)	
RII	0.29	(0.14, 0.64)*	0.47	(0.19, 1.29)	0.37	(0.13, 1.00)	0.78	(0.23, 2.64)	0.781
Education level									0.403
Superior BAC	1.00		1.00		1.00		1.00		
BAC	0.63	(0.32, 1.26)	0.61	(0.30, 1.23)	2.13	(0.73, 6.18)	2.09	(0.70, 6.22)	
Inferior BAC	0.52	(0.32, 0.86)*	0.57	(0.35, 0.95)*	0.91	(0.48, 1.73)	1.04	(0.53, 2.05)	
RII	0.36	(0.16, 0.79)*	0.43	(0.19, 0.98)*	0.62	(0.21, 1.81)	0.80	(0.26, 2.50)	0.450
Employment									0.786
Employed	1.00		1.00		1.00		1.00		
Unemployed	0.61	(0.23, 1.62)	0.60	(0.23, 1.61)	0.65	(0.19, 2.20)	0.74	(0.21, 2.68)	
Inactive	0.68	(0.46, 1.01)	0.93	(0.57, 1.54)	0.81	(0.49, 1.36)	1.30	(0.65, 2.60)	
Complementary hea	lth insurance								0.859
Yes	1.00		1.00		1.00		1.00		
No	0.36	(0.16, 0.81)*	0.41	(0.18, 0.95)*	0.48	(0.22, 1.06)	0.60	(0.26, 1.42)	
Basic health insurar	ice								0.121
Yes	0.80	(0.41, 1.54)*	0.83	(0.43, 1.61)	0.30	(0.15, 0.58)*	0.41	(0.20, 0.85)*	
No	1.00		1.00		1.00		1.00		

*p<0.05, **p<0.001.

Adjusted on the covariates: age, region, alcohol consumption, smoking status, close relative with cancer & living in couple

[†]Calculated by the interaction term for the change in Adjusted OR and Adjusted RII between 2005 and 2010

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		Cervical sme	ar 2005			Cervical smea	ar 2010		
Socio-economic	Unadjusted	(n=1571) Adjusted		Unadjusted	(n=1514	4) Adjusted		<i>p</i> -trend ⁺
ariable	OR	(95% CI)	OR	(95 % CI)	OR	(95% CI)	OR	(95% CI)	2005-2010
Occupation									0.483
lanager	1.00		1.0		1.00		1.0		
armer	0.54	(0.20, 1.45)	0.59	(0.21, 1.65)	0.79	(0.19, 3.29)	0.79	(0.18, 3.44)	
elf-employed	0.43	(0.20, 0.90)*	0.43	(0.20, 0.92)*	0.68	(0.31, 1.50)	0.78	(0.35, 1.75)	
rofessional	0.94	(0.57, 1.54)	0.98	(0.59, 1.61)	1.43	(0.89, 2.45)	1.50	(0.87, 2.61)	
Employee	0.62	(0.40, 0.96)*	0.66	(0.42, 1.03)	0.85	(0.52, 1.37)	0.89	(0.54, 1.46)	
Ianual worker	0.52	(0.29, 0.92)*	0.51	(0.28, 0.92)*	0.58	(0.33, 1.01)	0.67	(0.37, 1.21)	
Other	0.75	(0.38, 1.49)	0.81	(0.40, 1.62)	0.33	(0.18, 0.60)*	0.51	(0.26, 1.00)	
icome									0.364
€1500	1.00		1.00		1.00		1.0		
1000-1500	0.46	(0.32, 0.65)**	0.54	(0.37, 0.79)**	0.66	(0.43, 1.01)	0.79	(0.50, 1.25)	
€1000	0.32	(0.21, 0.49)**	0.44	(0.28, 0.70)**	0.33	(0.22, 0.49)**	0.47	(0.29, 0.76)**	
II	0.16	(0.09, 0.28)**	0.25	(0.13, 0.48)**	0.20	(0.11, 0.37)**	0.31	(0.15, 0.64)*	0.295
Education level									0.828
uperior BAC	1.00		1.00		1.00		1.0		
AC	0.95	(0.63, 1.45)	1.01	(0.66, 1.55)	0.97	(0.59, 1.58)	0.99	(0.60, 1.63)	
ferior BAC	0.57	(0.41, 0.77)**	0.57	(0.41, 0.80)**	0.51	(0.35, 0.73)**	0.63	(0.43, 0.94)*	
ЯП	0.36	(0.21, 0.61)**	0.36	(0.21, 0.64)**	0.28	(0.16, 0.51)**	0.40	(0.22, 0.74)*	0.881
mployment									0.392
mployed	1.00		1.00		1.00		1.0		
Inemployed	0.38	(0.23, 0.61)**	0.46	(0.28, 0.75)*	0.42	(0.26, 0.67)**	0.49	(0.30, 0.81)*	
active	0.52	(0.38, 0.71)**	0.50	(0.36, 0.71)**	0.38	(0.28, 0.52)**	0.50	(0.35, 0.73)**	
complementary heal	th insurance								0.014
/es	1.00		1.00		1.00		1.0		
0	0.25	(0.15, 0.40)**	0.29	(0.17, 0.49)**	0.54	(0.34, 0.88)*	0.64	(0.38, 1.08)	
asic health insuranc	ce								0.677
es	0.46	(0.29, 0.74)*	0.57	(0.35, 0.92)*	0.42	(0.28, 0.65)**	0.52	(0.32, 0.85)*	
lo	1.00		1.00		1.00		1.00		

Table 5. Association between socio-economic variables and the probability of FOBT participation in 2005 and 2010: unadjusted[†] and adjusted Odds Ratios

FOBT 2005					FOBT 2010				
		(n=122	2)			(n=142	5)		
Socio-economic	Unadjusted		Adjusted		Unadjusted		Adjusted		<i>p</i> -trend ⁺
variable	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)	OR	95% CI	2005-2010
Occupation									0.372
Manager	1.00		1.0		1.00		1.0		
Farmer	0.57	(0.29, 1.10)	0.61	(0.31, 1.21)	0.97	(0.46, 2.05)	0.72	(0.32, 1.61)	
Self-employed	0.78	(0.46, 1.31)	0.70	(0.41, 1.20)	0.82	(0.51, 1.31)	0.80	(0.48, 1.32)	
Professional	0.83	(0.57, 1.23)	0.90	(0.60, 1.34)	0.85	(0.60, 1.20)	0.94	(0.65, 1.37)	
Employee	0.66	(0.45, 0.96)*	0.83	(0.60, 1.24)	0.78	(0.54, 1.12)	0.99	(0.66, 1.50)	
Manual worker	0.67	(0.44, 1.03)	0.69	(0.44, 1.07)	0.66	(0.45, 0.96)*	0.63	(0.42, 0.96)*	
Other	0.76	(0.39, 1.46)	0.85	(0.42, 1.73)	0.58	(0.36, 0.95)*	0.71	(0.41, 1.23)	
Income									0.114
>€1500	1.00		1.00		1.00		1.00		
€1000-1500	0.85	(0.61, 1.18)	0.93	(0.66, 1.31)	0.94	(0.67, 1.31)	1.00	(0.68, 1.46)	
<€1000	0.63	(0.42, 0.94)*	0.62	(0.39, 0.97)*	0.89	(0.62, 1.29)	0.99	(0.64, 1.52)	
RII	0.54	(0.31, 0.93)*	0.70	(0.38, 1.28)	0.83	(0.49, 1.41)	0.99	(0.52, 1.86)	0.137
Education level									0.441
Superior BAC	1.00		1.00		1.00		1.00		
BAC	0.79	(0.50, 1.24)	0.85	(0.53, 1.34)	1.21	(0.81, 1.83)	1.25	(0.80, 1.95)	
Inferior BAC	0.77	(0.58, 1.04)	0.75	(0.55, 1.02)	0.99	(0.74, 1.34)	0.94	(0.68, 1.30)	
RII	0.67	(0.41, 1.09)	0.69	(0.42, 1.14)	0.90	(0.56, 1.45)	0.81	(0.48, 1.35)	0.466
Employment									0.800
Employed	1.00		1.00		1.00		1.00		
Unemployed	0.86	(0.40, 1.88)	1.09	(0.49, 2.40)	0.68	(0.37, 1.27)	0.86	(0.45, 1.66)	
Inactive	1.45	(1.12, 1.88)*	1.18	(0.83, 1.67)	1.58	(1.25, 1.99)**	1.14	(0.82, 1.58)	
Complementary healt	h insurance								0.485
Yes	1.00		1.00		1.00		1.00		
No	0.50	(0.25, 0.97)*	0.53	(0.26, 1.05)	0.65	(0.40, 1.05)	0.81	(0.47, 1.38)	
Basic health insuranc	e								0.388
Yes	0.70	(0.43, 1.16)	0.75	(0.47, 1.22)	1.03	(0.69, 1.54)	1.06	(0.68, 1.65)	
No	1.00		1.00		1.00		1.00		

*p<0.05, **p<0.001.

Adjusted on the covariates: age, region, alcohol consumption, smoking status, close relative with cancer & living in couple

[†]Calculated by the interaction term for the change in Adjusted OR and Adjusted RII between 2005 and 2010

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TROBE Statement	-chec	klist of items that should be included in reports of observational studies
	Item	
241	<u>No</u>	Recommendation
itle and abstract	1	(a) Indicate the study's design with a commonly used term in the title of the abstract
		(b) Provide in the abstract an informative and balanced summary of what was done
		and what was found: Included, please see page 1 and 2.
ntroduction		
ackground/rationale	2	Explain the scientific background and rationale for the investigation being reported Included , please see 5 and 6
bjectives	3	State specific objectives, including any prespecified hypotheses. Included please see
		page 6, last sentence.
lethods		
udy design	4	Present key elements of study design early in the paper. Included , please see page 7,
atting	5	Survey population section, first paragraph.
ounig	5	exposure follow-up and data collection Included plasse see page 7 study
		nonulation section second paragraph
articipante	6	(a) Cohort study. Give the eligibility criteria, and the sources and methods of
inticipants	0	(a) Conort study—Give the englority effectia, and the sources and methods of selection of participants. Describe methods of follow-up
		<i>Case-control study</i> —Give the eligibility criteria and the sources and methods of
		case ascertainment and control selection. Give the rationale for the choice of cases
		and controls
		<i>Cross-sectional study</i> —Give the eligibility criteria and the sources and methods of
		selection of participants. Included, please see page 7. study population section.
		first paragraph.
		(b) Cohort study—For matched studies, give matching criteria and number of
		exposed and unexposed
		<i>Case-control study</i> —For matched studies, give matching criteria and the number of
		controls per case
riables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect
		modifiers. Give diagnostic criteria, if applicable. Included, please see page 8,
		Measures section.
ata sources/	8*	For each variable of interest, give sources of data and details of methods of
easurement		assessment (measurement). Describe comparability of assessment methods if there is
		more than one group. Included, please see page 8, Measures section.
as	9	Describe any efforts to address potential sources of bias. Included, please see page
		7, second sentence, study population section, and page 8, last paragraph,
		Measures section.
tudy size	10	Explain how the study size was arrived at. Included, please page 7, second
		paragraph, study population section.
uantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable,
		describe which groupings were chosen and why. Included, please page 8, Measures sections.
tatistical methods	12	(a) Describe all statistical methods including those used to control for confounding
	14	Included, please page Statistical Analysis section pages 9-10

1		
2		please statistical analysis section, second and third paragraphs.
3 4		(c) Explain how missing data were addressed. Included , please see page 7, study
5		(d) Cohort study—If applicable, explain how loss to follow-up was addressed
6 7		<i>Case-control study</i> —If applicable, explain how matching of cases and controls was
8		addressed
9		Cross-sectional study-If applicable, describe analytical methods taking account of
10		sampling strategy. Included, please see page 8, Measures section, last paragraph.
12		(\underline{e}) Describe any sensitivity analyses. N/A.
13	Continued on next page	
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Results		
Participants	13*	(a) Report numbers of individuals at each stage of study-eg numbers potentially eligible,
		examined for eligibility, confirmed eligible, included in the study, completing follow-up, and
		analysed YES
		(b) Give reasons for non-participation at each stage YES
		(c) Consider use of a flow diagram
Descriptive	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information
data		on exposures and potential confounders YES
		(b) Indicate number of participants with missing data for each variable of interest YES
		(c) Cohort study—Summarise follow-up time (eg, average and total amount)
Outcome data	15*	Cohort study—Report numbers of outcome events or summary measures over time
		Case-control study-Report numbers in each exposure category, or summary measures of
		exposure
		Cross-sectional study-Report numbers of outcome events or summary measures YES
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their
		precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and
		why they were included YES
		(b) Report category boundaries when continuous variables were categorized
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful
		time period YES
Other analyses	17	Report other analyses done-eg analyses of subgroups and interactions, and sensitivity
		analyses
Discussion		
Key results	18	Summarise key results with reference to study objectives YES
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision.
		Discuss both direction and magnitude of any potential bias YES
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity
		of analyses, results from similar studies, and other relevant evidence YES
Generalisability	21	Discuss the generalisability (external validity) of the study results YES
Other information	on	
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable,
		for the original study on which the present article is based YES

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Temporal trend in socio-economic inequalities in the uptake of cancer screening programs in France between 2005 and 2010: Results from the Cancer Barometer Surveys

Journal:	BMJ Open
Manuscript ID	bmjopen-2017-016941.R3
Article Type:	Research
Date Submitted by the Author:	22-Oct-2017
Complete List of Authors:	Kelly, David; Institut National du Cancer, Social sciences, Epidemiology, Public Health Estaquio, Carla Leon, Christophe Arwidson, Pierre Nabi, Hermann; Institut National du Cancer, Research in Social and Human Sciences, Epidemiology and Public Health
Primary Subject Heading :	Epidemiology
Secondary Subject Heading:	Epidemiology, Public health, Health services research
Keywords:	cancer screening, Social inequalities, cancer epidemiology

SCHOLARONE" Manuscripts Temporal trend in socio-economic inequalities in the uptake of cancer screening programs in France between 2005 and 2010: Results from the Cancer Barometer surveys

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Word count: Abstract = 307; Text = 3527

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ABSTRACT

Objectives: Cancer screening is a form of secondary prevention for a disease which is now the leading cause of death in France. Various socio-economic-indicators have been identified as potential factors for disparities in breast, cervical and colorectal cancer screening uptake. We aimed to identify the socioeconomic-inequalities which persisted in screening uptake for these cancers, and to quantify these disparities over a 5-year period.

Setting: The Cancer-Barometer was a population-based-survey carried out in 2005 and 2010 in France.

Participants: A randomly selected sample of participants aged 15 to 85 years (n=3820 in 2005 and n=3727 in 2010) were interviewed on their participation in breast, cervical and colorectal cancer screening programs and their socioeconomic profile.

Primary and secondary outcome measures: For each type of screening-program, we calculated participation rates, odds ratios (OR) and relative inequality indices (RII) for participation, derived from logistic regression of the following socioeconomic variables: income, education, occupation, employment and health insurance. Changes in participation between 2005 and 2010 were then analyzed.

Protected by copyright, including for uses related to text and data mining, Al training, and similar technologies. Results: Participation rates for breast and colorectal screening increased significantly along the majority of socioeconomic categories, whereas for cervical cancer screening there were no significant changes between 2005 and 2010. RIIs for income remained significant for cervical smear in 2005 (RII=0.25, 95% CI 0.13-0.48) and in 2010 (RII=0.31, 95% CI 0.15-0.64). RIIs for education in mammography (RII=0.43, 95% CI 0.19-0.98) and cervical smear (RII=0.36, 95% CI 0.21-0.64) were significant in 2005 and remained significant for cervical smear (RII=0.40, 95% CI 0.22-0.74) in 2010.

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Conclusions: There was a persistence of socioeconomic inequalities in uptake of opportunistic cervical cancer screening. Conversely, organized screening-programs for breast and colorectal cancer saw a reduction in relative socioeconomic inequalities, even though the results were not statistically significance. The findings suggest that organized-cancer-screening programs may have the potential to reduce socio-economic disparities in participation.

Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies. Key words: cancer screening, breast cancer, cervical cancer, social inequalities, cancer epidemiology

Strengths and limitations of this study

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First study to examine temporal changes in inequalities for cancer screening uptake in France using relative inequality index.

- Benefits from datasets of two identical questionnaires on cancer screening uptake, taken 5 years apart, using two comparable population samples, hence minimizing information bias.
- Evolution in the format of colorectal screening program in terms of technique and age limits may have led to measured differences in uptake between 2005 and 2010.
- Residents of nursing homes and other medical institutions without a personal telephone line were excluded from the survey, limiting the generalizability of the findings.
- Relatively small number for certain socio-economic strata, reducing therefore the precision of some estimates.

INTRODUCTION

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Screening for cancer is an important form of secondary prevention for a disease which is now leading cause of death in France and worldwide [1]. The 2008 European report on cancer recommends that health systems focus their resources on cancer prevention and early detection rather than treatment alone, as the global disease burden of cancer threatens to become unsustainable in terms of financial costs, pressure on services, follow-up of patients and delivery of care [2].

To date, many European countries have rolled out screening programs for breast, colorectal and cervical cancer via mammography, faecal occult blood test (FOBT) and cervical smear respectively [3, 4]. However, for these screening programs to have a significant effect on reducing cancer mortality, they require a minimum level of participation among the eligible population; for instance 70% for mammography, and 50% for FOBT [5].

We reviewed several publications from France, UK, USA, Italy, Denmark, Korea and Argentina, which identified variables shown to have a significant effect on cancer screening uptake [6-19]. For breast cancer screening, various different social and economic variables were found to have a positive effect on uptake, including employment, higher occupation class, higher education level, income, private health insurance, car/home ownership. However, no single variable was consistently observed across studies except for participation in other screening programs [7, 18]. For cervical cancer screening, the variables identified as having a significant positive effect on uptake were more numerous, and notably consistent for income [7, 11, 17], higher education level [10-12, 17, 18], employment [6, 12, 18, 19] and private health insurance [6, 7, 18]. For colorectal screening, income was consistently shown to have a significant positive effect on uptake of screening across the studies [14, 16, 18]. However, it remains unclear whether the effect of these socio-economic variables on participation rates in screening programs persists over time.

Only one study drawn from the 2006, 2008 and 2010 French Healthcare and Health Insurance surveys has examined the temporal evolution in breast, cervical and colorectal cancer screening uptake in France to date [6]. This study conducted among 10 000 participants found that those classified as unskilled workers were more likely to have not undergone cervical cancer screening (OR = 1.64 [1.38-1.95]) when compared to those with an intermediate profession. The results also showed that women without (OR = 2.05 [1.68-2.51]) or receiving free complementary health insurance (OR = 1.79 [1.36-2.37]) were more likely to have not undergone breast cancer screening when compared to those with a private complementary health insurance. In this study, the authors found that inequalities for participation in breast and colorectal cancer screening persisted over the study period from 2006 to 2010 [6]. Thus, we believe that there is a need to re-examine how these trends may have evolved with respect to expansion in the coverage and awareness of organized cancer screening programs. The third French National Cancer Plan for the 2014-2019 period has identified early detection of cancers as a primary priority [20]. Within this goal is the reduction of inequalities associated with cancer diagnosis, with the hope that it subsequently reduces mortality rates. Any widening or reduction in socio-economic inequalities in the uptake of screening programs that are identified may then be used to direct future policy of the French national cancer control plan, which specifically seeks to address this issue [20]. We aim therefore in the present study to identify the socio-economic inequalities which persist for uptake of breast, cervical and colorectal cancer screening, and to quantify these disparities over a 5 year period in France.

MATERIALS AND METHODS

Study population

We used data, obtained by formal permission, from the Cancer Barometer surveys, two telephone surveys on cancer-related knowledge, attitudes and practices conducted by the French National Institute for Prevention and Health (now part of Santé Publique France). Both surveys were carried out on a representative random sample of the general French population aged over 16 years old for the 2005 survey and aged 15–85 years old for the 2010 survey. A two-stage random sampling design was used. Residents of nursing homes or other medical institutions who did not possess a personal telephone line were not included in the samples. Private households with telephones were included in the sample. The first sampling step was household selection (by phone number). Within each selected household, one French speaking person aged 15–85 was randomly selected using the "next birthday" method. The study protocol included a formal request to participate, explaining the objectives of the study that was delivered by mail before the first telephone call. Informed consent was obtained at the start of the telephone interview, in accordance with the guidelines of the French Data Protection Authority (CNIL). The interviews were conducted using a computer-assisted telephone interview (CATI) system.

In order to obtain adequate statistical power for measuring associations between variables and changes in participation rates along smaller levels, a sample size of between 3500 and 4000 was deemed appropriate. The 2005 Cancer Barometer sample was comprised of 4046 participants aged over 16 years interviewed between April and June 2005 [18]. There were 226 individuals with missing observations in the 2005 Cancer Barometer sample, notably for all 3 of the dependent variables, and 7 out of 10 of the covariates and independent variables. These individuals terminated the survey prematurely, and were thus removed from the analysis as their data was non-contributive, leaving 3820 participants in the sample population. Females (51.5%) responded more

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often than males (48.5%) and mean age of interviewees was 46.7 years. The 2010 Cancer Barometer sample was comprised of 3727 participants aged 15 to 85 interviewed during the first semester of 2010 [19]. The mean age was 44.6 years and the majority of participants were also female (52.0%vs. 48.0%). The response rates for the 2005 and 2010 Cancer Barometers were 51.2% and 47.0%, respectively.

Measures

Dem⁵first published as 10.1136/bmjopen-2017-016941 on 14 December 2017. Downloaded from http://bmjopen.bmj.com/ on June 8, 2025 at Department GEZ-LTA Erasmushogeschool em⁵first published as 10.1136/bmjopen-2017-016941 on 14 December 2017. Downloaded from http://bmjopen.bmj.com/ on June 8, 2025 at Department GEZ-LTA Erasmushogeschool em⁶first published as 10.1136/bmjopen-2017-016941 on 14 December 2017. Downloaded from http://bmjopen.bmj.com/ on June 8, 2025 at Department GEZ-LTA Erasmushogeschool em⁶first published as 10.1136/bmjopen-2017-016941 on 14 December 2017. Downloaded from http://bmjopen.bmj.com/ on June 8, 2025 at Department GEZ-LTA Erasmushogeschool em⁶first published as 10.1136/bmjopen-2017-016941 on 14 December 2017. Downloaded from http://bmjopen.bmj.com/ on June 8, 2025 at Department GEZ-LTA Erasmushogeschool em⁶first published as 10.1136/bmjopen-2017-016941 on 14 December 2017. Downloaded from http://bmjopen.bmj.com/ on June 8, 2025 at Department GEZ-LTA Erasmushogeschool em⁶first published as 10.1136/bmjopen-2017-016941 on 14 December 2017. Downloaded from http://bmjopen.bmj.com/ on June 8, 2025 at Department GEZ-LTA Erasmushogeschool em⁶first published as 10.1136/bmjopen-2017-016941 on 14 December 2017. Downloaded from http://bmjopen.bmj.com/ on June 8, 2025 at Department GEZ-LTA Erasmushogeschool em⁶first published as 10.1136/bmjopen-2017-016941 on 14 December 2017. Downloaded from http://bmjopen.bmj.com/ on June 8, 2025 at Department GEZ-LTA Erasmushogeschool em⁶first published as 10.1136/bmjopen-2017-016941 on 14 December 2017. Downloaded from http://bmjopen.bmj.com/ on June 8, 2025 at Department GEZ-LTA Erasmushogeschool em⁶first published as 10.1136/bmjopen-2017-016941 on 14 December 2017. Downloaded from http://bmjopen.bmj.com/ on June 8, 2025 at Department GEZ-LTA Erasmushogeschool em⁶first published as 10.1136/bmjopen-2017-016941 on 14 December 2017. Downloaded from http://bmjopen.bmj.com/ on June 8, 2025 at Department 2017. Downloaded from http://bmjopen.bmj Socio-economic indicators (independent variables) were as follows: education level (inferior, equal to or superior to baccalauréat (high-school diploma), employment status (employed, unemployed, and inactive), occupational class (farmer, trader, manager, professional, employee, manual worker, other), monthly income (below €1000, €1000-1500, above €1500) and health insurance (private complementary vs. basic insurance coverage). The outcome variables were participation in breast, cervical and colorectal cancer screening programs (dependent variables). For breast cancer screening, participants aged over 40 years were asked if they had undergone mammography within the previous 2 years. For cervical cancer screening, participants aged over 20 vears were asked if they had undergone a cervical smear within the previous 3 years. For colorectal cancer screening, participants aged 50-74 years were asked if they had undergone a faecal occult blood test (FOBT) within their lifetime. Covariates included gender, age, smoking status, alcohol consumption, region, living in a couple and having a close relative with cancer. For the calculation of screening participation rates, we added filters to select the target population eligible for each of the 3 different screening programs. Breast screening by mammography (n=1546): female gender and 49<age<75. Cervical screening by cervical smear (n=3085): female gender and 24<age<66. Colorectal screening by FOBT (n=2647): both genders where 49<age<75.

The weighting was based on the data of the 1999 and 2008 Employment Survey of the French population [21], taking into account age, gender, region, education level and number of persons per

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household [18]. This allowed us to effectively calculate age-adjusted standardized rates for screening participation, in addition to later adjusting the regression models on the covariates mentioned.

Statistical analysis

We created a pooled dataset of the two surveys conducted in 2005 and 2010. We calculated age-adjusted screening rates (AAR) for each stratum using the weighting provided by the INPES. The temporal evolution in the participation rate along each stratum between 2005 and 2010 was examined by adding an interaction term with the year of the survey. The disparity within each socio-economic variable was calculated as the absolute difference between the AAR for the highest and lowest group within an ordinal or binary variable for the given year.

Odds ratios (OR) derived from multiple logistic regression of screening participation on each socio-economic variable separately were used as a measure of participation likelihood for each stratum of the 6 socio-economic variables. The model was adjusted on the covariates: age, gender (colorectal screening only), region, alcohol, smoking, living in couple and close relative with cancer. For categorical variables, the higher socio-economic variable for each survey was then estimated and compared using a two way interaction term composed of socioeconomic variable of interest and survey year dummy variable (2010 vs. 2006), in order to be consistent with the methodology of previous studies on the topic [22, 23].

For ordinal variables of income and education level, we calculated the Relative Inequality Index (RII) as a measure of health inequality as described by Mackenbach and Kunst [24]. Previous studies on health inequalities, including breast cancer screening uptake [4, 9], employed a similar methodology for examining temporal evolutions along ordered socio-economic strata [23, 25]. The trend of RII for each survey was estimated and compared using a two way interaction term

Page 10.1136/bmjopen-2017-016941 on 14 December 2017. Downloaded from http://bmjopen.bmj.com/ on June 8, 2025 at Department GEZ-LTA Erasmushogeschool b) is he is le it al to ls er en all dy he on or a, th ed se es 10 composed of socioeconomic variable of interest and survey year dummy variable (2010 vs. 2006). The RII is a regression-based measure that summarizes the association between two variables. It is computed by ranking income and education values on a scale from the lowest, which is 0, to the highest, which is 1. Each income or education level value covers a range on this scale that is proportional to the number of participants who held that value and is given a new value on the scale corresponding to the cumulative midpoint of its range. The RII resembles relative risk in that it compares the probability of cancer screening uptake at the extremes of income and educational levels, but is estimated using the data on all income and education values and is weighted to account for the distribution of these values. Here the RII was fitted using logistic regression models. An RII of 0.5 for example implies that participants in the most deprived group (those with lower incomes and educations levels) had a 50% lower probability of cancer screening uptake when compared to those in the least deprived group (those with higher incomes and education levels). All statistical analysis was performed using SAS version 9.2.

RESULTS

Table 1 presents the demographic and socio-economic characteristics of the study populations. The overall participation rates among the eligible populations for breast, cervical and colorectal cancer screenings are shown in Table 2. Chi-squared tests for the change in participation rates along each socio-economic stratum between 2005 and 2010 are also included. For mammography, participation rates increased significantly (p<0.05) along all socio-economic strata, with the exception of farmers, managers, manual workers, unemployed, those with basic health insurance and education level superior to baccalauréat. For FOBT, participation rates increased significantly along all socio-economic strata between 2005 and 2010, with the exception of those unemployed or occupation classified as other. For cervical smear there were no significant changes

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in participation rates along any of the socio-economic strata, except for those without complementary health insurance, which increased significantly from 52.51% to 71.0% (p=0.017).

Table 3 shows the results of the logistic regression models for mammography participation on each socio-economic variable separately, adjusted for covariates. In 2005, farmers, self-employed, employees and manual workers showed significantly reduced participation compared to managers/executives, whereas in 2010 only the association in manual workers remained significant. In 2005, those with an education level inferior to baccalauréat (OR=0.57, 0.35-0.95) showed significantly reduced participation compared to those superior to baccalauréat, which became non-significant in 2010 (OR=1.04, 0.53-2.05).

Table 4 shows the results of the regression model for cervical smear participation for each socio-economic variable. In 2005, significantly reduced participation was observed for self-employed and manual workers, which became non-significant for both in 2010. In 2005, there was significantly reduced participation for those earning <£1000 and £1000-£1500, which remained significant in 2010 for those earning <£1000 (OR=0.47, 95% CI 0.29-0.76). An education level inferior to baccalauréat showed significantly reduced participation in both 2005 and in 2010. In 2005, being unemployed or inactive significantly reduced participation, and remained significant for both in 2010. The odds ratio for cervical smear participation changed significantly (p=0.014) for those without complementary health insurance from 0.29 (95% CI 0.17-0.49) in 2005 to 0.64 (95% CI 0.38-1.08) in 2010. Having only basic health insurance was significantly associated with reduced participation in both periods.

Table 5 shows the logistic regression results for FOBT participation on each socio-economic variable. For occupation, manual workers (OR=0.63, 95% CI 0.42-0.96) showed significantly reduced participation in 2010. Odds ratios for all other occupations showed reduced participation compared to managers, but at a non-significant level in 2005 and 2010. Those earning <€1000

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showed reduced participation in 2005 (OR=0.62, 95% CI 0.32-0.97), which became non-significant in 2010. There were no significant temporal changes in any of the odds ratios for participation in breast or colorectal cancer screening between 2005 and 2010.

The regression of screening participation on income distribution produced RIIs which can be found in Tables 3-5. The results showed significant inequalities for cervical smear (RII=0.25, 95% CI 0.13-0.48) in 2005, but not for mammography (RII=0.47, 95% CI 0.19-1.29) or FOBT (RII= 0.70, 95% CI 0.38-1.28). In 2010 the income-based RII remained significant for cervical smear (RII=0.31, 0.15-0.64). For education, mammography (RII=0.43, 95% CI 0.19-0.98) and cervical smear (RII=0.36, 95% CI 0.21-0.64) showed significant inequalities in 2005, whereas the RII for FOBT was non-significant (RII=0.69, 95% CI 0.42-1.14). In 2010, the education-based RII for mammography became non-significant (RII=0.80, 95% CI 0.26-2.50), whereas the RII for cervical smear remained significant (RII=0.40, 95% CI 0.22-0.74). The p-trend for the temporal change in the RIIs (adjusted model) measured by interaction term between 2005 and 2010, was non-significant for all 3 screening programs for income and education level.

DISCUSSION

Our objective was to identify the socio-economic inequalities which persisted for uptake of breast, cervical and colorectal cancer screening, and to quantify these disparities between the 2005 and 2010. In absolute terms, a significant increase in participation rates was observed for most socio-economic strata for mammography and for FOBT between 2005 and 2010. Cervical cancer screening however saw no significant change in participation rates between 2005 and 2010 (except for those without complementary health insurance). A similar trend was observed when relative inequalities were considered. It should be noted that some of these inequalities were persistent between 2005 and 2010, even though formal statistical tests for trend were generally not significant.

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Findings in the context of the literature

We found only one study that has examined the temporal evolution in breast, cervical and colorectal cancer screening uptake in France to date [6]. However, an important difference between our study and that study conducted by Sicsic and Franc relies on their objectives and consequently on the methods used to reach them. The study by Sicsic and Franc aimed to analyze the obstacles to and levers for breast, cervical, and colorectal cancer screening uptake and their trends over time, whereas the aim of our study was to identify the socio-economic inequalities which persist for uptake of breast, cervical and colorectal cancer screening, and to quantify these disparities over a 5 year period. Thus, Sicsic and Franc pooled their three samples but did not conduct direct comparisons of associations between indicators of socioeconomic position and uptake of cancer screenings between periods.

The sole point of comparison between the two studies concerns the overall participation in screening programs. Sicsic and Franc found that the screening rate for breast cancer decreased between 2006 and 2010, from 77.6% in 2006 to 74.0% in 2010", but the difference was not statistically significant. Although, we found an increase in participation rates for breast cancer screening, it was not statistically significant at the level of 5%. They also found that colorectal cancer screening uptake increased significantly between 2006 and 2010, from 18.2% in 2006 to 38.9% in 2010. This is consistent with our result showing that colorectal cancer screening uptake significantly increased from 34.0% in 2005 to 51% in 2010. Finally, they found that the screening rate for cervical cancer significantly decreased from 75.3% in 2006 to 71.9% in 2010. For cervical cancer, we found that the rate was stable between 2006 (79.7) and 2010 (81.4). In definitive, differences in sampling, sample sizes, number of data collection phases, and in desirability bias may explain these differences in participation rates. It should be also noted that the study by Sicsic and Franc was based on three surveys carried out in 2006, 2008 and 2010, with therefore a two-year

Page 14thfirst published as 10.1136/bmjopen-2017-016941 on 14 December 2017. Downloaded from http://bmjopen.bmj.com/ on June 8, 2025 at Department GEZ-LTA Erasmushogeschool nd nd ng on ist ed nd ny on in he er 1, he se er ng nt in ic ed 14 interval, whereas the Cancer Barometer survey was conducted at two points in time in 2005 and 2010. Our study confirmed significantly reduced participation for manual workers in breast and colorectal screening and for those with only basic health insurance in breast and cervical screening in 2010. This is consistent with the study by Sicsic and Franc which showed reduced participation in all 3 screening programs for manual workers and those with only basic health insurance. Breast and colorectal cancer screening programs saw the absolute differences in participation rates reduced over time for all socio-economic variables in our study, with the exception of employment and basic health insurance. An American study by Kim et al. showed the disparity in mammography participation based on income remained unchanged, while the disparity based on education decreased from 2000 to 2005 [9]. Cervical cancer screening however saw a persisting disparity in participation rates for the majority of socio-economic variables in our study, consistent with the results of De Maio et al. and Sicsic and Franc [6, 17].

The relative inequalities for income and education decreased for breast and colorectal cancer screening in our study, albeit non-significantly. This is somewhat consistent with DeMaio et al., which showed a reduction in the RII for breast cancer screening from 2005 to 2009 [17]. In the study by Kim et al., the income-based relative inequalities tended to decrease slightly, while those for education remained constant over time [9]. The relative inequalities for cervical cancer screening persisted for both income and education from 2005 to 2010 in our study, both remaining statistically significant. This is partially consistent with the De Maio et al., where the social gradient decreased for income and increased for education between 2005 and 2010 [17].

Interpretation of results

Breast and colorectal screening programs are organized at a national level and differences in absolute participation rates and relative inequalities decreased over time for all socio-economic variables. For both breast and colorectal screening, the odds ratios for manual workers showed

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reduced participation compared to managers/executives in 2010. Education and occupation are strongly correlated, with manual workers having a higher proportion of participants with an educational level inferior to baccalauréat (85%) than any other occupational category in 2010. Thus they may have been less aware of the health marketing campaigns for colorectal cancer screening and the recommendation for FOBT, due to the negative effect of lower education on health literacy [14, 26, 27].

Cervical cancer remains without a nationally organized screening program in France. It is the duty of doctors to organize and falls to the individual to pay for opportunistic screening via cervical smear test. The lack of a nationally organised screening program may impose significant financial, educational and cultural barriers to screening uptake among certain sections of the French population. The financial costs for a consultation and laboratory processing of the screening test may deter those with only basic health insurance, as public reimbursement covers only 70% of the cost [28]. This may account for the persistence of the observed differences in participation rates and large RIIs. Improving the awareness, affordability and access to cervical cancer screening should be prioritised in order to increase participation rates and reduce socio-economic disparities.

Limitations and strengths of the study

Our study used two almost identical datasets to construct a temporal analysis of participation in screening programs in France between 2005 and 2010. The use of relative inequality indices to measure the evolution of socio-economic inequalities in our study is the first to employ this methodology among a French population for cancer screening. The comparability of the study populations minimized selection bias and the conservation of the questionnaire format minimized information bias.

The study still has several limitations however. It shares the usual shortcomings of phone surveys. There is a potential selection bias, as residents of nursing homes or other medical pen: first published as 10.1136/bmjopen-2017-016941 on 14 December 2017. Downloaded from http://bmjopen.bmj.com/ on June 8, 2025 at Department GEZ-LTA Erasmushogeschool

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Page 10.1136/bmjopen-2017-016941 on 14 December 2017. Downloaded from http://bmjopen.bmj.com/ on June 8, 2025 at Department GEZ-LTA Erasmushogeschool he ly he we ed in on use related to text and data mining, Al training, and similar technologies. he of al to ay eal to is pt he 16 he is pt he 16 institutions who did not possess a personal telephone line were not included in the samples. The study includes only those who are French speakers, excluding individuals unable to answer fluently in French. There was no available data on ethnicity or nationality of participants in the study, which may have been an important source of confounding or effect modification. The exclusion of the above subpopulations, which are likely to be more socio-economically disadvantaged, may have overestimated the screening participation rates in our study.

Our study used two separate sample populations, whose distributions in Table 2 differed significantly for all of the socio-economic indicators and several covariates. The difference in sample distributions may have accounted for the observed differences in screening participation rates. Thus, we cannot rule out that reductions observed in inequalities over time are not simply due to changes in socioeconomic distributions rather than an actual reduction in social inequalities in screening participation.

Changes in screening policies concerning age limits, screening techniques and regional access left the 2005 and 2010 Cancer Barometers not directly comparable for certain programs. The question of screening participation for colorectal cancer was therefore limited to lifetime use of FOBT. Organized cervical screening was available in 13 regions in 2009, a source of regional variation not present in 2005. Some screening techniques are more memorable to patients, due to the invasiveness of the screening technique or the duration of the screening intervals, which may have led to recall bias.

The respective analytical sample sizes in 2005 and 2010 for breast (n=742, n=804), cervical (n=1571, n=1514) and colorectal (n=1222, n=1425) cancer screening may have been too small to capture disparities along socio-economic strata, leading to false observations and conclusions. Missing observations for each variable accounted for less than 5% of the total population, except for the variable income (16.3% missing in 2005 and 9.3% in 2010). This might have limited the

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precision of certain estimates, producing participation rates with large standard errors and odds ratios with large confidence intervals. We undertook multiple comparisons in our study. Thus, we cannot exclude that some of the results we have observed are due to chance.

Conclusion

The findings suggest that organized cancer screening programs may have the potential to reduce socio-economic disparities in participation.

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This article uses data collected from the 2005 and 2010 Barometre cancer studies, provided by the National Institute for prevention and health education, INPES (now Santé Publique France). Special thanks to the department of screening at the Institut National du Cancer (INCA).

Funding statement

This research received no specific grant from any funding agency in the public, commercial or notfor-profit sectors. The data collection was funded by the National Institute for prevention and health education, INPES (now Santé Publique France) in association with the French National Cancer Institute (INCa). The authors declare no external or private sources of funding.

Competing interest statement

All authors have completed the ICMJE uniform disclosure form at <u>www.icmje.org/coi_disclosure.pdf</u> and declare: no support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous three years; no other relationships or activities that could appear to have influenced the submitted work.

Contributors

HN conceived the study, advised on methodology, reviewed the results of statistical analyses and supervised the final edit of the manuscript. DK reviewed the background literature, run statistical analyses and drafted the manuscript. CE, CL, PA provided advice on methodology and statistical analyses. CL & PA directed the data collection. All authors contributed to the final draft of this manuscript.

Data sharing statement

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All data presented in this manuscript came from 2 original datasets of the 2005 and 2010 Cancer Barometer surveys. The original files can be requested by contacting Santé Publique France (formerly INVS and INPES) via Pierre Arvidson (pierre.arwidson@santepubliquefrance.fr) or Christophe Léon (christophe.leon@santepubliquefrance.fr).

Variables	Barometer 20	005 (n=3820)	Baromete	Barometer 2010 (n=3727)			
	n	%	n	%			
Gender					0.660		
Male	1854	48.5	1790	48.0			
Female	1966	51.5	1937	52.0			
Region				,•	0.976		
Ile-de-France	701	18.4	696	187			
West Paris basin	380	10.0	348	9.3			
East Paris basin	305	8,0	290	7,8			
North	257	6,7	238	6,4			
West	508	13,3	504	13,5			
East	334	8,8	321	8,6			
South West	414	10,9	412	11,1			
South East	455	12,0	447	12,0			
Mediterranée	457	12,0	471	12,6			
Occupation					< 0.001		
Farmer	117	3,1	81	2,2			
Self-employed/craftsman	220	5,8	270	7,2			
Manager/executive	589	15,4	595	16,0			
Professional	773	20,3	914	24,5			
Employee/office worker	970	25,4	829	22,3			
Manual worker	642	16,8	839	22,5			
Oher	506	13,3	199	5,3			
Education level					< 0.001		
Inferior BAC*	1946	52,0	2270	61,2			
BAC	651	17,4	635	17,1			
Superior BAC	1146	30,6	803	21,7			
Monthly Income					< 0.001		
<€1000	414	13,2	399	12,1			
€1000-1500	663	21,0	499	15,1			
>€1500	2075	65,8	2401	72,8			
Employment					< 0.001		
Employed	2146	56.2	1851	49.7			
Unemployed	177	4,6	260	7,0			
Inactive	1497	39,2	1615	43,3			
Alcohol consumption					< 0.001		
Ves	3430	89.8	3195	85.7			
No	389	10.2	532	14 3			
Smaking status				,.	< 0.001		
	964	25.2	1105	32.1			
No	2856	74.8	2532	67.9			
Class Deletive with sensor	2050	74,0	2552	07,7	0.950		
Close Relative with cancer	22(((2.1	2100	(21	0.950		
Yes	2366	62,1	2198	62,1			
	1440	57,9	1559	37,9	0.071		
Living in couple					0.071		
Yes	2465	64,6	2333	62,6			
No	1351	35,4	1394	37,4			
Complementary Health Insurance					< 0.001		
Yes	3518	92,6	3210	89,6			
No	282	7,4	375	10,5			
Basic Health Insurance					0.003		
Yes	361	10,2	441	12,4			
No	3182	89,8	3109	87,6			

Table 1. Standardized[†] distribution of study populations for 2005 and 2010 Cancer Barometer surveys, p-value for Chi-squared test

* BAC = Baccalauréat (high-school diploma)

[†]Weighted by age, gender, region and educational level according to standard population of the 1999 and 2008 Employment Surveys (INSEE)

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		Mammography		(Cervical smear			FOBT	
Socio-economic	р	articipation rate (√₀) ± SE	partic	pation rate (%) \pm S	SE	partic	ipation rate (%) \pm	SE
variable	2005	2010	Chi2	2005	2010	Chi2	2005	2010	Chi2
	(n=742)	(n=804)	<i>p</i> -value	(n=1571)	(n=1514)	<i>p</i> -value	(n=1222)	(n=1425)	<i>p</i> -value
Overall	72.1	88.3		79.7	81.4		34.0	51.6	
ccupation									
armer	62.49 ±8.24	87.64 ±8.81	0.148	75.61 ±7.28	80.39 ± 11.63	0.739	26.97 ± 6.69	$56.50\pm\!10.82$	0.006
elf-employed	63.70 ±9.46	85.96 ±5.37	0.027	$71.02\pm\!7.00$	77.92 ±6.89	0.438	33.47 ±5.61	$52.30\pm\!\!5.75$	0.009
lanager	$85.50~{\pm}4.04$	91.45 ±2.50	0.262	85.15 ±2.51	83.88 ± 3.05	0.740	39.33 ±3.89	57.33 ±3.31	0.0003
rofessional	74.87 ± 3.74	87.82 ±2.95	0.004	84.31 ±1.95	88.17 ± 1.68	0.153	35.04 ±3.21	53.32 ±2.79	<0,0001
mployee	$68.76\pm\!\!3.00$	90.58 ±1.98	<0.0001	78.05 ± 1.81	81.52 ± 2.06	0.170	29.92 ±2.63	51.07 ± 3.54	<0,0001
lanual worker	$64.52\pm\!\!6.01$	76.02±5.29	0.161	$74.70\pm\!\!3.96$	75.00 ± 4.22	0.956	30.29 ± 3.74	46.95 ±4,23	0.001
ther	69.37 ±6.19	83.70 ±5.28	0.097	81.14 ±4.21	62.94 ± 6.53	0.010	32.87 ± 6.20	$43.84\pm\!\!6.92$	0.204
ducation level									
nferior BAC	67.80 ±2.29	86.26 ± 1.79	<0.0001	75.20 ±1.77	76.88 ± 1.97	0.484	31.55 ±1.82	51.06 ±2.06	0
AC	71.86 ± 5.71	93.63 ±2.15	0.0003	83.59 ±2.47	86.42 ±2.03	0.385	32.07 ±4.46	56.06 ±3.58	<0,0001
uperior BAC	80.17 ±3.49	87.34 ±2.56	0.153	84.27 ±1.65	86.81 ±1.67	0.318	37.39 ±3.27	51.23 ±2.92	0.002
ifference	12.37	1.08		9.07	9.93		5.84	0.17	
come									
€1000	58.45 ±4.48	82.62 ±3.92	0.001	64.78 ±4.01	64.81 ±4.70	1	27.02 ±3.55	49.40 ±4.79	0.0001
1000-1500	68.62 ±4.19	84.95 ±3.57	0.006	72.43 ±2.96	78.81 ±3.49	0.161	33.29 ±3.35	50.61 ±4.33	0.001
€1500	76.21 ±2.65	89.57 ±1.59	< 0.0001	85.21 ±1.25	84.96 ±1.36	0.885	37.07 ±2.23	52.29 ±1.96	<0,0001
fference	17.76	6.95		20.43	20.15		10.05	2.89	
omplementary h	ealth								
surance	70 00 11 04	00.00.1.00	.0.0001	01 55 1 00	01.00 + 1.00		22 (2 1 52	50.01 . 1.64	.0.0001
es	/2.09 ±1.84	88.08 ±1.38	< 0.0001	81.//±1.08	81.83 ±1.29	0.964	33.63 ±1.53	52.31 ± 1.64	<0,0001
:0	48.35 ±9.53	/8.06 ±7.49	0.013	52.51 ±6.04	/1.00 ±5.67	0.017	20.10 ±5.58	41.51 ±/./1	0.011
gjerence	23.70	10.02		29.20	10.83		13.53	10.80	
asic nearth insur	66 12 +7 38	69 98 +8 60	0 694	67 20 +4 70	67 22 +5 47	1	26 23 +4 56	52 75 +6 03	0.0001
03 Io	50.12 ± 7.50 70.90 ±1.02	88 72 ±1 20	<0.024	81.52 ± 1.12	87.22 ± 3.47	0 300	20.23 ± 4.30	52.13 ± 0.93	<0.0001
ifference	4 87	18 74	~0.0001	14 32	15 65	0.399	7 60	0.69	-0,0001
mnlovment	7.07	10./7		17.32	15.05		7.00	0.07	
		89 0 +2 21	0.001	83 75 +1 21	86 56 +1 34	0.097	28 37 +2 12	45 11 +2 56	<0.0001
mployed	76 22 +2 07	07.0 = 4.4	0.001	05.75 ± 1.21	50.50 ± 1.54	0.077	20.31 = 2.42	→ <i>J</i> .11 <i>±2</i> .30	~0,0001
mployed	76.23 ±3.07	84 1 + 8 72	0.176	66 00 ±5 25	72 88 +5 22	0 304	25 18 +6 60	35.01 ± 0.21	0 300

Table 3.	Association	between	socio-economic	variables	and	the	probability	of participa	tion in
mammogi	raphy in 2005	5 and 201	0: unadjusted [†] an	d adjusted	odds	s rati	os		

	Mammography 2005 (n=742)				Mammography 2010 (n=804)				
Socio-economic	Unadjusted	Adjus	sted	Uı	nadjusted		Adjusted		<i>p</i> -tren
variable	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)	OR	(95 % CI)	2005-20
Occupation									0.521
Manager	1.00		1.0		1.00		1.0		
Farmer	0.28	(0.10, 0.77)*).33	(0.12, 0.92)*	0.66	(0.08, 5.45)	0.64	(0.07, 5.54)	
Self-employed	0.30	(0.11, 0.81)*).33	(0.12, 0.93)*	0.57	(0.18, 1.86)	0.60	(0.18, 2.00)	
Professional	0.51	(0.23, 1.10)).53	(0.24, 1.18)	0.67	(0.26, 1.72)	0.66	(0.25, 1.74)	
Employee	0.37	(0.18, 0.77)*).39	(0.19, 0.82)*	0.90	(0.36, 2.26)	1.13	(0.43, 2.95)	
Manual worker	0.31	(0.13, 0.74)*).34	$(0.14, 0.84)^*$	0.30	(0.11, 0.78)*	0.34	(0.12, 0.94)*	
Other	0.38	(0.16, 0.95)*).45	(0.17, 1.14)	0.48	(0.16, 1.47)	0.59	(0.18, 1.95)	
Income									0.775
>€1500	1.00	1	1.00		1.00		1.00		
€1000-€1500	0.68	(0.42, 1.11)).83	(0.50, 1.39)	0.66	(0.34, 1.27)	1.04	(0.49, 2.20)	
<€1000	0.44	(0.26, 0.73)*).57	(0.32, 1.03)	0.55	(0.29, 1.06)	0.80	(0.38, 1.68)	
RII	0.29	(0.14, 0.64)*).47	(0.19, 1.29)	0.37	(0.13, 1.00)	0.78	(0.23, 2.64)	0.781
Education level									0.403
Superior BAC	1.00	1	1.00		1.00		1.00		
BAC	0.63	(0.32, 1.26)).61	(0.30, 1.23)	2.13	(0.73, 6.18)	2.09	(0.70, 6.22)	
Inferior BAC	0.52	(0.32, 0.86)*).57	(0.35, 0.95)*	0.91	(0.48, 1.73)	1.04	(0.53, 2.05)	
RII	0.36	(0.16, 0.79)*).43	(0.19, 0.98)*	0.62	(0.21, 1.81)	0.80	(0.26, 2.50)	0.450
Employment				Č.					0.786
Employed	1.00	1	1.00		1.00		1.00		
Unemployed	0.61	(0.23, 1.62)).60	(0.23, 1.61)	0.65	(0.19, 2.20)	0.74	(0.21, 2.68)	
Inactive	0.68	(0.46, 1.01)).93	(0.57, 1.54)	0.81	(0.49, 1.36)	1.30	(0.65, 2.60)	
Complementary hea	lth insurance								0.859
Yes	1.00	1	1.00		1.00		1.00		
No	0.36	(0.16, 0.81)*).41	(0.18, 0.95)*	0.48	(0.22, 1.06)	0.60	(0.26, 1.42)	
Basic health insurar	ice								0.12
Yes	0.80	(0.41, 1.54)*).83	(0.43, 1.61)	0.30	(0.15, 0.58)*	0.41	(0.20, 0.85)*	
No	1.00	1	1.00		1.00		1.00		

*p<0.05, **p<0.001.

[†]Adjusted on the covariates: age, region, alcohol consumption, smoking status, close relative with cancer & living in couple

⁺ Calculated using a two way interaction term composed of socioeconomic variable of interest and survey year dummy variable (2010 vs. 2006).

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Table 4. Association between socio-economic variables and the probability of cervical smear participation in 2005 and 2010: unadjusted[†] and adjusted odds ratios

		Cervical sm	near 2005		Cervical smear 2010				
Socio-economic	Unadjusted	(11-13	Adjusted		Unadjusted	(11-131-	Adjusted		<i>p</i> -trend ⁺
variable	OR	(95% CI)	OR	(95 % CI)	OR	(95% CI)	OR	(95% CI)	2005-2010
Occupation									0.483
Manager	1.00		1.0		1.00		1.0		
Farmer	0.54	(0.20, 1.45)	0.59	(0.21, 1.65)	0.79	(0.19, 3.29)	0.79	(0.18, 3.44)	
Self-employed	0.43	(0.20, 0.90)*	0.43	$(0.20, 0.92)^*$	0.68	(0.31, 1.50)	0.78	(0.35, 1.75)	
Professional	0.94	(0.57, 1.54)	0.98	(0.59, 1.61)	1.43	(0.89, 2.45)	1.50	(0.87, 2.61)	
Employee	0.62	(0.40, 0.96)*	0.66	(0.42, 1.03)	0.85	(0.52, 1.37)	0.89	(0.54, 1.46)	
Manual worker	0.52	(0.29, 0.92)*	0.51	$(0.28, 0.92)^*$	0.58	(0.33, 1.01)	0.67	(0.37, 1.21)	
Other	0.75	(0.38, 1.49)	0.81	(0.40, 1.62)	0.33	(0.18, 0.60)*	0.51	(0.26, 1.00)	
Income			\mathbf{O}						0.364
>€1500	1.00		1.00		1.00		1.0		
€1000-1500	0.46	(0.32, 0.65)**	0.54	(0.37, 0.79)**	0.66	(0.43, 1.01)	0.79	(0.50, 1.25)	
<€1000	0.32	(0.21, 0.49)**	0.44	(0.28, 0.70)**	0.33	(0.22, 0.49)**	0.47	(0.29, 0.76)**	
RII	0.16	(0.09, 0.28)**	0.25	(0.13, 0.48)**	0.20	(0.11, 0.37)**	0.31	(0.15, 0.64)*	0.295
Education level									0.828
Superior BAC	1.00		1.00		1.00		1.0		
BAC	0.95	(0.63, 1.45)	1.01	(0.66, 1.55)	0.97	(0.59, 1.58)	0.99	(0.60, 1.63)	
Inferior BAC	0.57	(0.41, 0.77)**	0.57	(0.41, 0.80)**	0.51	(0.35, 0.73)**	0.63	(0.43, 0.94)*	
RII	0.36	(0.21, 0.61)**	0.36	(0.21, 0.64)**	0.28	(0.16, 0.51)**	0.40	(0.22, 0.74)*	0.881
Employment									0.392
Employed	1.00		1.00		1.00		1.0		
Unemployed	0.38	(0.23, 0.61)**	0.46	(0.28, 0.75)*	0.42	(0.26, 0.67)**	0.49	(0.30, 0.81)*	
Inactive	0.52	(0.38, 0.71)**	0.50	(0.36, 0.71)**	0.38	(0.28, 0.52)**	0.50	(0.35, 0.73)**	
Complementary heal	th insurance								0.014
Yes	1.00		1.00		1.00		1.0		
No	0.25	(0.15, 0.40)**	0.29	(0.17, 0.49)**	0.54	(0.34, 0.88)*	0.64	(0.38, 1.08)	
Basic health insurance	ce								0.677
Yes	0.46	(0.29, 0.74)*	0.57	(0.35, 0.92)*	0.42	(0.28, 0.65)**	0.52	(0.32, 0.85)*	
No	1.00		1.00		1.00		1.00		

*p<0.05, **p<0.001.

[†]Adjusted on the covariates: age, region, alcohol consumption, smoking status, close relative with cancer & living in couple

⁺ Calculated using a two way interaction term composed of socioeconomic variable of interest and survey year dummy variable (2010 vs. 2006

Table 5. Association between socio-economic variables and the probability of FOBT participation in 2005 and 2010: unadjusted[†] and adjusted Odds Ratios

FOBT 2005				FOBT 2010					
		(n=122	2)			(n=1425	5)		
Socio-economic	Unadjusted		Adjusted		Unadjusted		Adjusted		<i>p</i> -trend [†]
variable	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)	OR	95% CI	2005-201
Occupation									0.372
Manager	1.00		1.0		1.00		1.0		
Farmer	0.57	(0.29, 1.10)	0.61	(0.31, 1.21)	0.97	(0.46, 2.05)	0.72	(0.32, 1.61)	
Self-employed	0.78	(0.46, 1.31)	0.70	(0.41, 1.20)	0.82	(0.51, 1.31)	0.80	(0.48, 1.32)	
Professional	0.83	(0.57, 1.23)	0.90	(0.60, 1.34)	0.85	(0.60, 1.20)	0.94	(0.65, 1.37)	
Employee	0.66	(0.45, 0.96)*	0.83	(0.60, 1.24)	0.78	(0.54, 1.12)	0.99	(0.66, 1.50)	
Manual worker	0.67	(0.44, 1.03)	0.69	(0.44, 1.07)	0.66	(0.45, 0.96)*	0.63	(0.42, 0.96)*	
Other	0.76	(0.39, 1.46)	0.85	(0.42, 1.73)	0.58	(0.36, 0.95)*	0.71	(0.41, 1.23)	
Income									0.114
>€1500	1.00		1.00		1.00		1.00		
E1000-1500	0.85	(0.61, 1.18)	0.93	(0.66, 1.31)	0.94	(0.67, 1.31)	1.00	(0.68, 1.46)	
<€1000	0.63	(0.42, 0.94)*	0.62	(0.39, 0.97)*	0.89	(0.62, 1.29)	0.99	(0.64, 1.52)	
RII	0.54	(0.31, 0.93)*	0.70	(0.38, 1.28)	0.83	(0.49, 1.41)	0.99	(0.52, 1.86)	0.137
Education level									0.441
Superior BAC	1.00		1.00		1.00		1.00		
BAC	0.79	(0.50, 1.24)	0.85	(0.53, 1.34)	1.21	(0.81, 1.83)	1.25	(0.80, 1.95)	
Inferior BAC	0.77	(0.58, 1.04)	0.75	(0.55, 1.02)	0.99	(0.74, 1.34)	0.94	(0.68, 1.30)	
RII	0.67	(0.41, 1.09)	0.69	(0.42, 1.14)	0.90	(0.56, 1.45)	0.81	(0.48, 1.35)	0.466
Employment									0.800
Employed	1.00		1.00		1.00		1.00		
Unemployed	0.86	(0.40, 1.88)	1.09	(0.49, 2.40)	0.68	(0.37, 1.27)	0.86	(0.45, 1.66)	
Inactive	1.45	(1.12, 1.88)*	1.18	(0.83, 1.67)	1.58	(1.25, 1.99)**	1.14	(0.82, 1.58)	
Complementary health	insurance								0.485
Yes	1.00		1.00		1.00		1.00		
No	0.50	(0.25, 0.97)*	0.53	(0.26, 1.05)	0.65	(0.40, 1.05)	0.81	(0.47, 1.38)	
Basic health insurance									0.388
Yes	0.70	(0.43, 1.16)	0.75	(0.47, 1.22)	1.03	(0.69, 1.54)	1.06	(0.68, 1.65)	
		,						,	

*p<0.05, **p<0.001.

[†]Adjusted on the covariates: age, region, alcohol consumption, smoking status, close relative with cancer & living in couple [†]Calculated using a two way interaction term composed of socioeconomic variable of interest and survey year dummy variable (2010 vs. 2006 pen: first published as 10.1136/bmjopen-2017-016941 on 14 December 2017. Downloaded from http://bmjopen.bmj.com/ on June 8, 2025 at Department GEZ-LTA Erasmushogeschool

		BMJ Open
STROBE Statement-	-chec	klist of items that should be included in reports of observational studies
	Item	
	No	Recommendation
itle and abstract	1	(<i>a</i>) Indicate the study's design with a commonly used term in the title or the abstract
		(b) Provide in the abstract an informative and balanced summary of what was done
		and what was found: Included, please see page 1 and 2.
troduction		
ackground/rationale	2	Explain the scientific background and rationale for the investigation being reported Included, please see 5 and 6
Objectives	3	State specific objectives, including any prespecified hypotheses. Included please see
		page 6, last sentence.
lethods		
udy design	4	Present key elements of study design early in the paper. Included, please see page 7,
		study population section, first paragraph.
etting	5	Describe the setting, locations, and relevant dates, including periods of recruitment,
		exposure, follow-up, and data collection. Included, please see page 7, study
		population section, second paragraph.
articipants	6	(a) Cohort study—Give the eligibility criteria, and the sources and methods of
		selection of participants. Describe methods of follow-up
		Case-control study—Give the eligibility criteria, and the sources and methods of
		case ascertainment and control selection. Give the rationale for the choice of cases
		and controls
		Cross-sectional study—Give the eligibility criteria, and the sources and methods of
		selection of participants. Included, please see page 7, study population section,
		first paragraph.
		(b) Cohort study—For matched studies, give matching criteria and number of
		exposed and unexposed
		Case-control study—For matched studies, give matching criteria and the number of
		controls per case
riables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect
		modifiers. Give diagnostic criteria, if applicable. Included, please see page 8,
		Measures section.
ata sources/	8*	For each variable of interest, give sources of data and details of methods of
easurement		assessment (measurement). Describe comparability of assessment methods if there is
		more than one group. Included, please see page 8, Measures section.
IS	9	Describe any efforts to address potential sources of bias. Included, please see page
		7, second sentence, study population section, and page 8, last paragraph,
		Measures section.
udy size	10	Explain how the study size was arrived at. Included, please page 7, second
		paragraph, study population section.
antitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable,
		describe which groupings were chosen and why. Included, please page 8, Measures
		sections.
tatistical methods	12	(<i>a</i>) Describe all statistical methods, including those used to control for confounding
		Included, please page Statistical Analysis section pages 9-10
		(b) Describe any methods used to examine subgroups and interactions Included ,
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2		please statistical analysis section, second and third paragraphs.
3		(c) Explain how missing data were addressed. Included, please see page 7, study
4 5		population section, second paragraph.
6		(d) Cohort study—If applicable, explain how loss to follow-up was addressed
7		Case-control study-If applicable, explain how matching of cases and controls was
8		addressed
9 10		Cross-sectional study-If applicable, describe analytical methods taking account of
10		sampling strategy. Included, please see page 8, Measures section, last paragraph.
12		(\underline{e}) Describe any sensitivity analyses. N/A.
13	Continued on next page	
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Results		
Participants	13*	(a) Report numbers of individuals at each stage of study-eg numbers potentially eligible,
		examined for eligibility, confirmed eligible, included in the study, completing follow-up, and
		analysed YES
		(b) Give reasons for non-participation at each stage YES
		(c) Consider use of a flow diagram
Descriptive	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information
data		on exposures and potential confounders YES
		(b) Indicate number of participants with missing data for each variable of interest YES
		(c) Cohort study—Summarise follow-up time (eg, average and total amount)
Outcome data	15*	Cohort study—Report numbers of outcome events or summary measures over time
		Case-control study-Report numbers in each exposure category, or summary measures of
		exposure
		Cross-sectional study-Report numbers of outcome events or summary measures YES
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their
		precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and
		why they were included YES
		(b) Report category boundaries when continuous variables were categorized
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful
		time period YES
Other analyses	17	Report other analyses done-eg analyses of subgroups and interactions, and sensitivity
		analyses
Discussion		
Key results	18	Summarise key results with reference to study objectives YES
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision.
		Discuss both direction and magnitude of any potential bias YES
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity
		of analyses, results from similar studies, and other relevant evidence YES
Generalisability	21	Discuss the generalisability (external validity) of the study results YES
Other informati	on	
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable,
-		for the original study on which the present article is based YES

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Temporal trend in socio-economic inequalities in the uptake of cancer screening programs in France between 2005 and 2010: Results from the Cancer Barometer surveys

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Word count: Abstract = 307; Text = 3527

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ABSTRACT

Objectives: Cancer screening is a form of secondary prevention for a disease which is now the leading cause of death in France. Various socio-economic-indicators have been identified as potential factors for disparities in breast, cervical and colorectal cancer screening uptake. We aimed to identify the socioeconomic-inequalities which persisted in screening uptake for these cancers, and to quantify these disparities over a 5-year period.

Setting: The Cancer-Barometer was a population-based-survey carried out in 2005 and 2010 in France.

Participants: A randomly selected sample of participants aged 15 to 85 years (n=3820 in 2005 and n=3727 in 2010) were interviewed on their participation in breast, cervical and colorectal cancer screening programs and their socioeconomic profile.

Primary and secondary outcome measures: For each type of screening-program, we calculated participation rates, odds ratios (OR) and relative inequality indices (RII) for participation, derived from logistic regression of the following socioeconomic variables: income, education, occupation, employment and health insurance. Changes in participation between 2005 and 2010 were then analyzed.

Results: Participation rates for breast and colorectal screening increased significantly along the majority of socioeconomic categories, whereas for cervical cancer screening there were no significant changes between 2005 and 2010. RIIs for income remained significant for cervical smear in 2005 (RII=0.25, 95% CI 0.13-0.48) and in 2010 (RII=0.31, 95% CI 0.15-0.64). RIIs for education in mammography (RII=0.43, 95% CI 0.19-0.98) and cervical smear (RII=0.36, 95% CI 0.21-0.64) were significant in 2005 and remained significant for cervical smear (RII=0.40, 95% CI 0.22-0.74) in 2010.

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Conclusions: There was a persistence of socioeconomic inequalities in uptake of opportunistic cervical cancer screening. Conversely, organized screening-programs for breast and colorectal cancer saw a reduction in relative socioeconomic inequalities, even though the results were not statistically significance. The findings suggest that organized-cancer-screening programs may have the potential to reduce socio-economic disparities in participation.

Key words: cancer screening, breast cancer, cervical cancer, social inequalities, cancer epidemiology

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Strengths and limitations of this study

- First study to examine temporal changes in inequalities for cancer screening uptake in • France using relative inequality index.
- Benefits from datasets of two identical questionnaires on cancer screening uptake, taken 5 years apart, using two comparable population samples, hence minimizing information bias.
- Evolution in the format of colorectal screening program in terms of technique and age limits may have led to measured differences in uptake between 2005 and 2010.
- Residents of nursing homes and other medical institutions without a personal telephone line were excluded from the survey, limiting the generalizability of the findings.
- Relatively small number for certain socio-economic strata, reducing therefore the precision of some estimates.



INTRODUCTION

Screening for cancer is an important form of secondary prevention for a disease which is now leading cause of death in France and worldwide [1]. The 2008 European report on cancer recommends that health systems focus their resources on cancer prevention and early detection rather than treatment alone, as the global disease burden of cancer threatens to become unsustainable in terms of financial costs, pressure on services, follow-up of patients and delivery of care [2].

To date, many European countries have rolled out screening programs for breast, colorectal and cervical cancer via mammography, faecal occult blood test (FOBT) and cervical smear respectively [3, 4]. However, for these screening programs to have a significant effect on reducing cancer mortality, they require a minimum level of participation among the eligible population; for instance 70% for mammography, and 50% for FOBT [5].

We reviewed several publications from France, UK, USA, Italy, Denmark, Korea and Argentina, which identified variables shown to have a significant effect on cancer screening uptake [6-19]. For breast cancer screening, various different social and economic variables were found to have a positive effect on uptake, including employment, living in a couple, higher occupation class, higher education level, income, private health insurance, car/home ownership and rural residency. However, no single variable was consistently observed across studies except for participation in other screening programs [7, 18]. For cervical cancer screening, the variables identified as having a significant positive effect on uptake were more numerous, and notably consistent for income [7, 11, 17], higher education level [10-12, 17, 18], employment [6, 12, 18, 19] and private health insurance [6, 7, 18]. For colorectal screening, general practitioners' (GP) consultation [6, 7, 18, 19] was consistently shown to have a significant positive effect on uptake of screening across the studies, as well as income [14, 16, 18]. For colorectal screening, income was consistently shown to have a

significant positive effect on uptake of screening across the studies [14, 16, 18]. However, it remains unclear whether the effect of these socio-economic variables on participation rates in screening programs persists over time.

Demofirst published as 10.1136/bmjopen-2017-016941 on 14 December 2017. Downloaded from http://bmjopen.bmj.com/ on June 8, 2025 at Department GEZ-LTA Erasmushogeschool 36 Protected by copyright, including for uses related to text and data mining, Al training, and similar technologies. Only one study drawn from the 2006, 2008 and 2010 French Healthcare and Health Insurance surveys has examined the temporal evolution in breast, cervical and colorectal cancer screening uptake in France to date [6]. This study conducted among 10 000 participants found that those classified as unskilled workers were less more likely to have not undergone cervical cancer screening (OR = 1.64 [1.38-1.95]) when compared to those with an intermediate profession. The results also showed that women without (OR = 2.05 [1.68-2.51]) or receiving free complementary health insurance (OR = 1.79 [1.36-2.37]) were less more likely to have not undergone breast cancer screening when compared to those with a private complementary health insurance. In this study, the authors found that inequalities for participation in breast and colorectal cancer screening persisted over the study period from 2006 to 2010 [6]. Thus, we believe that there is a need to re-examine how these trends may have evolved with respect to expansion in the coverage and awareness of organized cancer screening programs. The third French National Cancer Plan for the 2014-2019 period has identified early detection of cancers as a primary priority [20]. Within this goal is the reduction of inequalities associated with cancer diagnosis, with the hope that it subsequently reduces mortality rates. Any widening or reduction in socio-economic inequalities in the uptake of screening programs that are identified may then be used to direct future policy of the French national cancer control plan, which specifically seeks to address this issue [20]. We aim therefore in the present study to identify the socio-economic inequalities which persist for uptake of breast, cervical and colorectal cancer screening, and to quantify these disparities over a 5 year period in France.

MATERIALS AND METHODS

Study population

We used data, obtained by formal permission, from the Cancer Barometer surveys, two telephone surveys on cancer-related knowledge, attitudes and practices conducted by the French National Institute for Prevention and Health (now part of Santé Publique France). Both surveys were carried out on a representative random sample of the general French population aged over 16 years old for the 2005 survey and aged 15–85 years old for the 2010 survey. A two-stage random sampling design was used. Residents of nursing homes or other medical institutions who did not possess a personal telephone line were not included in the samples. Private households with telephones were included in the sample. The first sampling step was household selection (by phone number). Within each selected household, one French speaking person aged 15–85 was randomly selected using the "next birthday" method. The study protocol included a formal request to participate, explaining the objectives of the study that was delivered by mail before the first telephone call. Informed consent was obtained at the start of the telephone interview, in accordance with the guidelines of the French Data Protection Authority (CNIL). The interviews were conducted using a computer-assisted telephone interview (CATI) system.

In order to obtain adequate statistical power for measuring associations between variables and changes in participation rates along smaller levels, a sample size of between 3500 and 4000 was deemed appropriate. The 2005 Cancer Barometer sample was comprised of 4046 participants aged over 16 years interviewed between April and June 2005 [18]. There were 226 individuals with missing observations in the 2005 Cancer Barometer sample, notably for all 3 of the dependent variables, and 7 out of 10 of the covariates and independent variables. These individuals terminated the survey prematurely, and were thus removed from the analysis as their data was non-contributive, leaving 3820 participants in the sample population. Females (51.5%) responded more

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often than males (48.5%) and mean age of interviewees was 46.7 years. The 2010 Cancer Barometer sample was comprised of 3727 participants aged 15 to 85 interviewed during the first semester of 2010 [19]. The mean age was 44.6 years and the majority of participants were also female (52.0%vs. 48.0%). The response rates for the 2005 and 2010 Cancer Barometers were 51.2% and 47.0%, respectively.

Measures

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 < Socio-economic indicators (independent variables) were as follows: education level (inferior, equal to or superior to baccalauréat (high-school diploma), employment status (employed, unemployed, and inactive), occupational class (farmer, trader, manager, professional, employee, manual worker, other), monthly income (below €1000, €1000-1500, above €1500) and health insurance (private complementary vs. basic insurance coverage). The outcome variables were participation in breast, cervical and colorectal cancer screening programs (dependent variables). For breast cancer screening, participants aged over 40 years were asked if they had undergone mammography within the previous 2 years. For cervical cancer screening, participants aged over 20 vears were asked if they had undergone a cervical smear within the previous 3 years. For colorectal cancer screening, participants aged 50-74 years were asked if they had undergone a faecal occult blood test (FOBT) within their lifetime. Covariates included gender, age, smoking status, alcohol consumption, region, living in a couple and having a close relative with cancer. For the calculation of screening participation rates, we added filters to select the target population eligible for each of the 3 different screening programs. Breast screening by mammography (n=1546): female gender and 49<age<75. Cervical screening by cervical smear (n=3085): female gender and 24<age<66. Colorectal screening by FOBT (n=2647): both genders where 49<age<75.

The weighting was based on the data of the 1999 and 2008 Employment Survey of the French population [21], taking into account age, gender, region, education level and number of persons per

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household [18]. This allowed us to effectively calculate age-adjusted standardized rates for screening participation, in addition to later adjusting the regression models on the covariates mentioned.

Statistical analysis

We created a pooled dataset of the two surveys conducted in 2005 and 2010. We calculated age-adjusted screening rates (AAR) for each stratum using the weighting provided by the INPES. The temporal evolution in the participation rate along each stratum between 2005 and 2010 was examined by adding an interaction term with the year of the survey. The disparity within each socio-economic variable was calculated as the absolute difference between the AAR for the highest and lowest group within an ordinal or binary variable for the given year.

Odds ratios (OR) derived from multiple logistic regression of screening participation on each socio-economic variable separately were used as a measure of participation likelihood for each stratum of the 6 socio-economic variables. The model was adjusted on the covariates: age, gender (colorectal screening only), region, alcohol, smoking, living in couple and close relative with cancer. For categorical variables, the higher socio-economic variable for each survey was then estimated and compared using a two way interaction term composed of socioeconomic variable of interest and survey year dummy variable (2010 vs. 2006), in order to be consistent with the methodology of previous studies on the topic [22, 23].

For ordinal variables of income and education level, we calculated the Relative Inequality Index (RII) as a measure of health inequality as described by Mackenbach and Kunst [24]. Previous studies on health inequalities, including breast cancer screening uptake [4, 9], employed a similar methodology for examining temporal evolutions along ordered socio-economic strata [23, 25]. The trend of RII for each survey was estimated and compared using a two way interaction term

composed of socioeconomic variable of interest and survey year dummy variable (2010 vs. 2006).

Page 40^c first published as 10.1136/bmjopen-2017-016941 on 14 December 2017. Downloaded from http://bmjopen.bmj.com/ on June 8, 2025 at Department GEZ-LTA Erasmushogeschool is he is le it al to ls er en all dy he on or a, th ed se es 10 The RII is a regression-based measure that summarizes the association between two variables. It is computed by ranking income and education values on a scale from the lowest, which is 0, to the highest, which is 1. Each income or education level value covers a range on this scale that is proportional to the number of participants who held that value and is given a new value on the scale corresponding to the cumulative midpoint of its range. The RII resembles relative risk in that it compares the probability of cancer screening uptake at the extremes of income and educational levels, but is estimated using the data on all income and education values and is weighted to account for the distribution of these values. Here the RII was fitted using logistic regression models. An RII of 0.5 for example implies that participants in the most deprived group (those with lower incomes and educations levels) had a 50% lower probability of cancer screening uptake when compared to those in the least deprived group (those with higher incomes and education levels). All statistical analysis was performed using SAS version 9.2.

RESULTS

Table 1 presents the demographic and socio-economic characteristics of the study populations. The overall participation rates among the eligible populations for breast, cervical and colorectal cancer screenings are shown in Table 2. Chi-squared tests for the change in participation rates along each socio-economic stratum between 2005 and 2010 are also included. For mammography, participation rates increased significantly (p<0.05) along all socio-economic strata, with the exception of farmers, managers, manual workers, unemployed, those with basic health insurance and education level superior to baccalauréat. For FOBT, participation rates increased significantly along all socio-economic strata between 2005 and 2010, with the exception of those unemployed or occupation classified as other. For cervical smear there were no significant changes

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in participation rates along any of the socio-economic strata, except for those without complementary health insurance, which increased significantly from 52.51% to 71.0% (p=0.017).

Table 3 shows the results of the logistic regression models for mammography participation on each socio-economic variable separately, adjusted for covariates. In 2005, farmers, self-employed, employees and manual workers showed significantly reduced participation compared to managers/executives, whereas in 2010 only the association in manual workers remained significant. In 2005, those with an education level inferior to baccalauréat (OR=0.57, 0.35-0.95) showed significantly reduced participation compared to those superior to baccalauréat, which became non-significant in 2010 (OR=1.04, 0.53-2.05).

Table 4 shows the results of the regression model for cervical smear participation for each socio-economic variable. In 2005, significantly reduced participation was observed for self-employed and manual workers, which became non-significant for both in 2010. In 2005, there was significantly reduced participation for those earning <£1000 and £1000-£1500, which remained significant in 2010 for those earning <£1000 (OR=0.47, 95% CI 0.29-0.76). An education level inferior to baccalauréat showed significantly reduced participation in both 2005 and in 2010. In 2005, being unemployed or inactive significantly reduced participation, and remained significant for both in 2010. The odds ratio for cervical smear participation changed significantly (p=0.014) for those without complementary health insurance from 0.29 (95% CI 0.17-0.49) in 2005 to 0.64 (95% CI 0.38-1.08) in 2010. Having only basic health insurance was significantly associated with reduced participation in both periods.

Table 5 shows the logistic regression results for FOBT participation on each socio-economic variable. For occupation, manual workers (OR=0.63, 95% CI 0.42-0.96) showed significantly reduced participation in 2010. Odds ratios for all other occupations showed reduced participation compared to managers, but at a non-significant level in 2005 and 2010. Those earning <€1000

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showed reduced participation in 2005 (OR=0.62, 95% CI 0.32-0.97), which became non-significant in 2010. There were no significant temporal changes in any of the odds ratios for participation in breast or colorectal cancer screening between 2005 and 2010.

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 The regression of screening participation on income distribution produced RIIs which can be found in Tables 3-5. The results showed significant inequalities for cervical smear (RII=0.25, 95% CI 0.13-0.48) in 2005, but not for mammography (RII=0.47, 95% CI 0.19-1.29) or FOBT (RII= 0.70, 95% CI 0.38-1.28). In 2010 the income-based RII remained significant for cervical smear (RII=0.31, 0.15-0.64). For education, mammography (RII=0.43, 95% CI 0.19-0.98) and cervical smear (RII=0.36, 95% CI 0.21-0.64) showed significant inequalities in 2005, whereas the RII for FOBT was non-significant (RII=0.69, 95% CI 0.42-1.14). In 2010, the education-based RII for mammography became non-significant (RII=0.80, 95% CI 0.26-2.50), whereas the RII for cervical smear remained significant (RII=0.40, 95% CI 0.22-0.74). The p-trend for the temporal change in the RIIs (adjusted model) measured by interaction term between 2005 and 2010, was nonsignificant for all 3 screening programs for income and education level.

DISCUSSION

Our objective was to identify the socio-economic inequalities which persisted for uptake of breast, cervical and colorectal cancer screening, and to quantify these disparities between the 2005 and 2010. In absolute terms, a significant increase in participation rates was observed for most socio-economic strata for mammography and for FOBT between 2005 and 2010. Cervical cancer screening however saw no significant change in participation rates between 2005 and 2010 (except for those without complementary health insurance). A similar trend was observed when relative inequalities were considered. It should be noted that some of these inequalities were persistent between 2005 and 2010, even though formal statistical tests for trend were generally not significant.

Findings in the context of the literature

We found only one study that has examined the temporal evolution in breast, cervical and colorectal cancer screening uptake in France to date [6]. However, an important difference between our study and that study conducted by Sicsic and Franc relies on their objectives and consequently on the methods used to reach them. The study by Sicsic and Franc aimed to analyze the obstacles to and levers for breast, cervical, and colorectal cancer screening uptake and their trends over time, whereas the aim of our study was to identify the socio-economic inequalities which persist for uptake of breast, cervical and colorectal cancer screening, and to quantify these disparities over a 5 year period. Thus, Sicsic and Franc pooled their three samples but did not conduct direct comparisons of associations between indicators of socioeconomic position and uptake of cancer screenings between periods.

The sole point of comparison between the two studies concerns the overall participation in screening programs. Sicsic and Franc found that the screening rate for breast cancer decreased between 2006 and 2010, from 77.6% in 2006 to 74.0% in 2010", but the difference was not statistically significant. Although, we found an increase in participation rates for breast cancer screening, it was not statistically significant at the level of 5%. They also found that colorectal cancer screening uptake increased significantly between 2006 and 2010, from 18.2% in 2006 to 38.9% in 2010. This is consistent with our result showing that colorectal cancer screening uptake significantly increased from 34.0% in 2005 to 51% in 2010. Finally, they found that the screening rate for cervical cancer significantly decreased from 75.3% in 2006 to 71.9% in 2010. For cervical cancer, we found that the rate was stable between 2006 (79.7) and 2010 (81.4). In definitive, differences in sampling, sample sizes, number of data collection phases, and in desirability bias may explain these differences in participation rates. It should be also noted that the study by Sicsic and Franc was based on three surveys carried out in 2006, 2008 and 2010, with therefore a two-year

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interval, whereas the Cancer Barometer survey was conducted at two points in time in 2005 and 2010

It is encouraging to note the significant increase in participation rates for most socioeconomic strata for mammography between 2005 and 2010. This effect was not demonstrated in a French study by Siesie and Franc in 2006, 2008 and 2010, which showed a non-significant slight decrease in mammography participation rates over time [6]. This study did however show a large increase in colorectal cancer screening rates, in line with our findings. Cervical cancer screening however saw no significant change in participation rates between 2005 and 2010 (except for those without complementary health insurance), while Siesie and Franc showed an overall decrease in participation rates from 2006 to 2010. Our study confirmed significantly reduced participation for manual workers in breast and colorectal screening and for those with only basic health insurance in breast and cervical screening in 2010. This is consistent with the study by Siesic and Franc which showed reduced participation in all 3 screening programs for manual workers and those with only basic health insurance.

Several factors may explain why some of our findings differ from those by Siesic et al. The study by Siesic et al. was based on three surveys carried out in 2006, 2008 and 2010, with therefore a two year interval, whereas the Cancer Barometer survey was conducted at two points in time in 2005 and 2010. Another important difference between the two studies relies on their objectives and consequently on the methods used to reach them. The study by Siesic and Frane aimed to analyze the obstacles to and levers for breast, cervical, and colorectal cancer screening uptake and their trends over time, whereas the aim of our study was to identify the socio-economic inequalities which persist for uptake of breast, cervical and colorectal cancer screening, and to quantify these disparities over a 5 year period. Thus, Siesic and Frane pooled their three samples and did not

conduct direct comparisons of associations between indicators of socioeconomic position and uptake of cancer screenings between periods.

Breast and colorectal cancer screening programs saw the absolute differences in participation rates reduced over time for all socio-economic variables in our study, with the exception of employment and basic health insurance. Siesie and Frane found that disparities in participation did not decrease for mammography or FOBT screening from 2006 to 2010 [6]. An American study by Kim et al. showed the disparity in mammography participation based on income remained unchanged, while the disparity based on education decreased from 2000 to 2005 [9]. Cervical cancer screening however saw a persisting disparity in participation rates for the majority of socio-economic variables in our study, consistent with the results of De Maio et al. and Sicsic and Franc [6, 17].

The relative inequalities for income and education decreased for breast and colorectal cancer screening in our study, albeit non-significantly. This is somewhat consistent with DeMaio et al., which showed a reduction in the RII for breast cancer screening from 2005 to 2009 [17]. In the study by Kim et al., the income-based relative inequalities tended to decrease slightly, while those for education remained constant over time [9]. The relative inequalities for cervical cancer screening persisted for both income and education from 2005 to 2010 in our study, both remaining statistically significant. This is partially consistent with the De Maio et al., where the social gradient decreased for income and increased for education between 2005 and 2010 [17].

Interpretation of results

Breast and colorectal screening programs are organized at a national level and differences in absolute participation rates and relative inequalities decreased over time for all socio-economic variables. For both breast and colorectal screening, the odds ratios for manual workers showed reduced participation compared to managers/executives in 2010. Education and occupation are

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strongly correlated, with manual workers having a higher proportion of participants with an educational level inferior to baccalauréat (85%) than any other occupational category in 2010. Thus they may have been less aware of the health marketing campaigns for colorectal cancer screening and the recommendation for FOBT, due to the negative effect of lower education on health literacy [14, 26, 27].

Page 46^{first} published as 10.1136/bmjopen-2017-016941 on 14 December 2017. Downloaded from http://bmjopen.bmj.com/ on June 8, 2025 at Department GEZ-LTA Erasmushogeschool an us ng cy he al al, ch est and data mining, Al training, and similar technologies. In to is dy ed he al he 16 Cervical cancer remains without a nationally organized screening program in France. It is the duty of doctors to organize and falls to the individual to pay for opportunistic screening via cervical smear test. The lack of a nationally organised screening program may impose significant financial, educational and cultural barriers to screening uptake among certain sections of the French population. The financial costs for a consultation and laboratory processing of the screening test may deter those with only basic health insurance, as public reimbursement covers only 70% of the cost [28]. This may account for the persistence of the observed differences in participation rates and large RIIs. Improving the awareness, affordability and access to cervical cancer screening should be prioritised in order to increase participation rates and reduce socio-economic disparities.

Limitations and strengths of the study

Our study used two almost identical datasets to construct a temporal analysis of participation in screening programs in France between 2005 and 2010. The use of relative inequality indices to measure the evolution of socio-economic inequalities in our study is the first to employ this methodology among a French population for cancer screening. The comparability of the study populations minimized selection bias and the conservation of the questionnaire format minimized information bias.

The study still has several limitations however. It shares the usual shortcomings of phone surveys. There is a potential selection bias, as residents of nursing homes or other medical institutions who did not possess a personal telephone line were not included in the samples. The

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study includes only those who are French speakers, excluding individuals unable to answer fluently in French. There was no available data on ethnicity or nationality of participants in the study, which may have been an important source of confounding or effect modification. The exclusion of the above subpopulations, which are likely to be more socio-economically disadvantaged, may have overestimated the screening participation rates in our study.

Our study used two separate sample populations, whose distributions in Table 2 differed significantly for all of the socio-economic indicators and several covariates. The difference in sample distributions may have accounted for the observed differences in screening participation rates. Thus, we cannot rule out that reductions observed in inequalities over time are not simply due to changes in socioeconomic distributions rather than an actual reduction in social inequalities in screening participation.

Changes in screening policies concerning age limits, screening techniques and regional access left the 2005 and 2010 Cancer Barometers not directly comparable for certain programs. The question of screening participation for colorectal cancer was therefore limited to lifetime use of FOBT. Organized cervical screening was available in 13 regions in 2009, a source of regional variation not present in 2005. Some screening techniques are more memorable to patients, due to the invasiveness of the screening technique or the duration of the screening intervals, which may have led to recall bias.

The respective analytical sample sizes in 2005 and 2010 for breast (n=742, n=804), cervical (n=1571, n=1514) and colorectal (n=1222, n=1425) cancer screening may have been too small to capture disparities along socio-economic strata, leading to false observations and conclusions. Missing observations for each variable accounted for less than 5% of the total population, except for the variable income (16.3% missing in 2005 and 9.3% in 2010). This might have limited the precision of certain estimates, producing participation rates with large standard errors and odds

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ratios with large confidence intervals. We undertook multiple comparisons in our study. Thus, we cannot exclude that some of the results we have observed are due to chance.

Conclusion

The findings suggest that organized cancer screening programs may have the potential to reduce socio-economic disparities in participation.

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Acknowledgements

This article uses data collected from the 2005 and 2010 Barometre cancer studies, provided by the National Institute for prevention and health education, INPES (now Santé Publique France). Special thanks to the department of screening at the Institut National du Cancer (INCA).

Funding statement

This research received no specific grant from any funding agency in the public, commercial or notfor-profit sectors. The data collection was funded by the National Institute for prevention and health education, INPES (now Santé Publique France) in association with the French National Cancer Institute (INCa). The authors declare no external or private sources of funding.

Competing interest statement

A11 uniform authors have completed the ICMJE disclosure form at www.icmje.org/coi disclosure.pdf and declare: no support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous three years; no other relationships or activities that could appear to have influenced the submitted work.

Contributors

HN conceived the study, advised on methodology, reviewed the results of statistical analyses and supervised the final edit of the manuscript. DK reviewed the background literature, run statistical analyses and drafted the manuscript. CE, CL, PA provided advice on methodology and statistical analyses. CL & PA directed the data collection. All authors contributed to the final draft of this manuscript.

Data sharing statement

All data presented in this manuscript came from 2 original datasets of the 2005 and 2010 Cancer Barometer surveys. The original files can be requested by contacting Santé Publique France (formerly INVS and INPES) via Pierre Arvidson (pierre.arwidson@santepubliquefrance.fr) or Christophe Léon (christophe.leon@santepubliquefrance.fr).

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	Barometer 2005 (n=3820)		Barometer 20	p-value	
	n	%	n	%	
Gender					0.660
fale	1854	48,5	1790	48,0	
emale	1966	51,5	1937	52,0	0.076
Kegion le-de-France	701	18.4	696	18.7	0.970
Vest Paris basin	380	10,4	348	9,3	
ast Paris basin	305	8,0	290	7,8	
orth	257	6,7	238	6,4	
/est	508	13,3	321	13,5	
buth West	414	10,9	412	11,1	
outh East	455	12,0	447	12,0	
diterranée	457	12,0	471	12,6	.0.00
ccupation	117	2 1	01	2.2	< 0.001
Iffemployed/craftsman	220	5,1	270	7.2	
anager/executive	589	15,4	595	16,0	
ofessional	773	20,3	914	24,5	
nployee/office worker	970	25,4	829	22,3	
anual worker	506	10,8	199	53	
lucation level		10,0		0,0	< 0.001
Ferior BAC*	1946	52,0	2270	61,2	
AC	651	17,4	635	17,1	
perior BAC	1146	30,6	803	21,7	<0.001
onthly Income	414	12.2	200	12.1	<0.001
000-1500	663	21.0	499	12,1	
1500	2075	65,8	2401	72,8	
ployment					< 0.001
ployed	2146	56,2	1851	49,7	
employed	177	4,6	260	7,0	
cohol consumption	1497	39,2	1015	45,5	< 0.001
s	3430	89.8	3195	85.7	0.001
-)	389	10,2	532	14,3	
noking status					< 0.001
S	964	25,2	1195	32,1	
	2856	74,8	2532	67,9	0.050
lose Relative with cancer	2266	62.1	2102	62.1	0.950
)	1446	37.9	1339	37.9	
iving in couple					0.071
es s	2465	64,6	2333	62,6	
)	1351	35,4	1394	37,4	
omplementary Health Insurance	2510		2210	00.6	<0.001
25	3518	92,6	3210	89,6	
asic Health Insurance	202	7,4	375	10,5	0.003
es	361	10,2	441	12,4	
	3182	89,8	3109	87,6	

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Table 2. Standardized^{\dagger} participation rates for eligible participants in 3 screening programs, Chisquared test for 2005-2010, *p*-trend

Socio-economic variable	Mammography participation rate (%) ± SE			Cervical smear participation rate (%) ± SE			FOBT participation rate (%) ± SE		
	(n=742)	(n=804)	<i>p</i> -value	(n=1571)	(n=1514)	<i>p</i> -value	(n=1222)	(n=1425)	<i>p</i> -value
	Overall	72.1	88.3		79.7	81.4		34.0	51.6
Occupation									
Farmer	62.49 ± 8.24	87.64 ±8.81	0.148	75.61 ±7.28	80.39 ±11.63	0.739	26.97 ±6.69	$56.50\pm\!\!10.82$	0.006
Self-employed	63.70 ±9.46	85.96 ±5.37	0.027	71.02 ± 7.00	77.92 ±6.89	0.438	33.47 ±5.61	52.30 ±5.75	0.009
Manager	85.50 ± 4.04	91.45 ±2.50	0.262	85.15 ±2.51	83.88 ± 3.05	0.740	39.33 ±3.89	57.33 ±3.31	0.0003
Professional	74.87 ± 3.74	87.82 ±2.95	0.004	84.31 ±1.95	88.17 ± 1.68	0.153	35.04 ±3.21	53.32 ±2.79	<0,000
Employee	68.76 ± 3.00	90.58 ±1.98	<0.0001	78.05 ± 1.81	81.52 ±2.06	0.170	29.92 ±2.63	51.07 ±3.54	<0,000
Manual worker	64.52 ± 6.01	76.02 ±5.29	0.161	74.70 ±3.96	75.00 ±4.22	0.956	30.29 ± 3.74	46.95 ±4,23	0.001
Other	69.37 ±6.19	83.70 ±5.28	0.097	81.14 ±4.21	62.94 ±6.53	0.010	32.87 ±6.20	$43.84\pm\!\!6.92$	0.204
Education level									
nferior BAC	67.80 ±2.29	86.26 ±1.79	<0.0001	75.20 ±1.77	76.88 ±1.97	0.484	31.55 ±1.82	51.06 ±2.06	0
BAC	71.86 ±5.71	93.63 ±2.15	0.0003	83.59 ±2.47	86.42 ±2.03	0.385	32.07 ±4.46	56.06 ±3.58	<0,000
Superior BAC	80.17 ±3.49	87.34 ±2.56	0.153	84.27 ±1.65	86.81 ±1.67	0.318	37.39 ±3.27	51.23 ±2.92	0.002
Difference	12.37	1.08		9.07	9.93		5.84	0.17	
ncome									
<€1000	58.45 ± 4.48	82.62 ±3.92	0.001	64.78 ±4.01	64.81 ±4.70	1	27.02 ±3.55	49.40 ±4.79	0.0001
E1000-1500	68.62 ±4.19	84.95 ±3.57	0.006	72.43 ±2.96	78.81 ±3.49	0.161	33.29 ±3.35	50.61 ±4.33	0.001
€1500	76.21 ±2.65	89.57 ±1.59	< 0.0001	85.21 ±1.25	84.96 ±1.36	0.885	37.07 ±2.23	52.29 ±1.96	<0,000
lifference	17.76	6.95		20.43	20.15		10.05	2.89	
Complementary	health								
nsurance									
Yes	72.09 ± 1.84	88.08 ± 1.38	< 0.0001	81.77 ± 1.08	81.83 ±1.29	0.964	33.63 ±1.53	52.31 ± 1.64	<0,000
No	$48.35\pm\!\!9.53$	78.06 ± 7.49	0.013	52.51 ±6.04	71.00 ± 5.67	0.017	20.10 ±5.58	41.51 ±7.71	0.011
lifference	23.76	10.02		29.26	10.83		13.53	10.80	
Basic health insu	rance					(
Yes	$66.12\pm\!\!7.38$	69.98 ± 8.60	0.694	67.20 ± 4.70	67.22 ±5.47	1	26.23 ±4.56	52.75 ±6.93	0.0001
No	70.99 ± 1.93	88.72 ±1.28	< 0.0001	81.52 ±1.12	82.87 ±1.24	0.399	33.83 ±1.60	52.06 ±1.64	<0,000
lifference	4.87	18.74		14.32	15.65		7.60	0.69	
Employment									
Employed	76.23 ± 3.07	89.0 ±2.21	0.001	83.75 ±1.21	86.56 ±1.34	0.097	28.37 ±2.42	45.11 ±2.56	<0,000
Unemployed	66.26 ±9.44	84.1 ±8.73	0.176	66.00 ±5.25	72.88 ±5.23	0.304	25.48 ±6.60	35.91 ± 9.21	0.308
Inactive	68.58 ±2.32	86.79 ±1.75	< 0.0001	72.72 ±2.51	71.15 ±2.73	0.665	36.51 ±1.93	56.48 ±2.03	<0,000

[†]Weighted by age, gender, region and educational level according to standard population of the 1999 and 2008 Employment Surveys (INSEE)

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16	Professional	0.51 (
17	Employee	0.37 (
10		

Table 3.	Association	between	socio-economic	variables	and	the	probability	of	participation	in
mammog	raphy in 2005	5 and 201	0: unadjusted [†] an	d adjusted	odds	rati	OS			

		Mammography (n=742)	y 2005			Mammography (n=804)	y 2010		_
Socio-economic	Unadjusted	(11/42)	Adjusted		Unadjusted	(1 004)	Adjusted		<i>p</i> -trend ⁺
ariable	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)	OR	(95 % CI)	2005-2010
Occupation									0.521
lanager	1.00		1.0		1.00		1.0		
armer	0.28	(0.10, 0.77)*	0.33	(0.12, 0.92)*	0.66	(0.08, 5.45)	0.64	(0.07, 5.54)	·
elf-employed	0.30	(0.11, 0.81)*	0.33	(0.12, 0.93)*	0.57	(0.18, 1.86)	0.60	(0.18, 2.00)	-
rofessional	0.51	(0.23, 1.10)	0.53	(0.24, 1.18)	0.67	(0.26, 1.72)	0.66	(0.25, 1.74)	c
mployee	0.37	(0.18, 0.77)*	0.39	(0.19, 0.82)*	0.90	(0.36, 2.26)	1.13	(0.43, 2.95)	
fanual worker	0.31	(0.13, 0.74)*	0.34	(0.14, 0.84)*	0.30	(0.11, 0.78)*	0.34	(0.12, 0.94)*	
Other	0.38	(0.16, 0.95)*	0.45	(0.17, 1.14)	0.48	(0.16, 1.47)	0.59	(0.18, 1.95)	
ncome									0.775
€1500	1.00		1.00		1.00		1.00		
1000-€1500	0.68	(0.42, 1.11)	0.83	(0.50, 1.39)	0.66	(0.34, 1.27)	1.04	(0.49, 2.20)	
€1000	0.44	(0.26, 0.73)*	0.57	(0.32, 1.03)	0.55	(0.29, 1.06)	0.80	(0.38, 1.68)	
II	0.29	(0.14, 0.64)*	0.47	(0.19, 1.29)	0.37	(0.13, 1.00)	0.78	(0.23, 2.64)	0.781
ducation level									0.403
uperior BAC	1.00		1.00		1.00		1.00		
AC	0.63	(0.32, 1.26)	0.61	(0.30, 1.23)	2.13	(0.73, 6.18)	2.09	(0.70, 6.22)	
ferior BAC	0.52	(0.32, 0.86)*	0.57	(0.35, 0.95)*	0.91	(0.48, 1.73)	1.04	(0.53, 2.05)	
II	0.36	(0.16, 0.79)*	0.43	(0.19, 0.98)*	0.62	(0.21, 1.81)	0.80	(0.26, 2.50)	0.450
mployment									0.786
mployed	1.00		1.00		1.00		1.00		
Inemployed	0.61	(0.23, 1.62)	0.60	(0.23, 1.61)	0.65	(0.19, 2.20)	0.74	(0.21, 2.68)	
nactive	0.68	(0.46, 1.01)	0.93	(0.57, 1.54)	0.81	(0.49, 1.36)	1.30	(0.65, 2.60)	ę
omplementary hea	lth insurance								0.859
es	1.00		1.00		1.00		1.00		
lo	0.36	(0.16, 0.81)*	0.41	(0.18, 0.95)*	0.48	(0.22, 1.06)	0.60	(0.26, 1.42)	
asic health insuran	ice								0.121
es	0.80	(0.41, 1.54)*	0.83	(0.43, 1.61)	0.30	(0.15, 0.58)*	0.41	(0.20, 0.85)*	
0	1.00		1.00		1.00		1.00		(

Table 4. Association between socio-economic variables and the probability of cervical smear participation in 2005 and 2010: unadjusted^{\dagger} and adjusted odds ratios

		Cervical sme	ar 2005 1)			Cervical smea (n=1514	ar 2010		_	
Socio-economic	Unadjusted	(11.137	Adjusted		Unadjusted	(1 1314	Adjusted		<i>p</i> -tren	
variable	OR	(95% CI)	OR	(95 % CI)	OR	(95% CI)	OR	(95% CI)	2005-20	
Occupation									0.483	
Manager	1.00		1.0		1.00		1.0			
Farmer	0.54	(0.20, 1.45)	0.59	(0.21, 1.65)	0.79	(0.19, 3.29)	0.79	(0.18, 3.44)		
Self-employed	0.43	(0.20, 0.90)*	0.43	(0.20, 0.92)*	0.68	(0.31, 1.50)	0.78	(0.35, 1.75)		
Professional	0.94	(0.57, 1.54)	0.98	(0.59, 1.61)	1.43	(0.89, 2.45)	1.50	(0.87, 2.61)		
Employee	0.62	(0.40, 0.96)*	0.66	(0.42, 1.03)	0.85	(0.52, 1.37)	0.89	(0.54, 1.46)		
Manual worker	0.52	(0.29, 0.92)*	0.51	(0.28, 0.92)*	0.58	(0.33, 1.01)	0.67	(0.37, 1.21)		
Other	0.75	(0.38, 1.49)	0.81	(0.40, 1.62)	0.33	(0.18, 0.60)*	0.51	(0.26, 1.00)		
Income									0.364	
>€1500	1.00		1.00		1.00		1.0			
E1000-1500	0.46	(0.32, 0.65)**	0.54	(0.37, 0.79)**	0.66	(0.43, 1.01)	0.79	(0.50, 1.25)		
<€1000	0.32	(0.21, 0.49)**	0.44	(0.28, 0.70)**	0.33	(0.22, 0.49)**	0.47	(0.29, 0.76)**		
RH	0.16	(0.09, 0.28)**	0.25	(0.13, 0.48)**	0.20	(0.11, 0.37)**	0.31	(0.15, 0.64)*	0.295	
Education level									0.82	
Superior BAC	1.00		1.00		1.00		1.0			
BAC	0.95	(0.63, 1.45)	1.01	(0.66, 1.55)	0.97	(0.59, 1.58)	0.99	(0.60, 1.63)		
Inferior BAC	0.57	(0.41, 0.77)**	0.57	(0.41, 0.80)**	0.51	(0.35, 0.73)**	0.63	(0.43, 0.94)*		
RII	0.36	(0.21, 0.61)**	0.36	(0.21, 0.64)**	0.28	(0.16, 0.51)**	0.40	(0.22, 0.74)*	0.881	
Employment									0.392	
Employed	1.00		1.00		1.00		1.0			
Unemployed	0.38	(0.23, 0.61)**	0.46	(0.28, 0.75)*	0.42	(0.26, 0.67)**	0.49	(0.30, 0.81)*		
nactive	0.52	(0.38, 0.71)**	0.50	(0.36, 0.71)**	0.38	(0.28, 0.52)**	0.50	(0.35, 0.73)**		
Complementary he	alth insurance								0.01	
Yes	1.00		1.00		1.00		1.0			
No	0.25	(0.15, 0.40)**	0.29	(0.17, 0.49)**	0.54	(0.34, 0.88)*	0.64	(0.38, 1.08)		
Basic health insura	nce								0.67	
Yes	0.46	(0.29, 0.74)*	0.57	(0.35, 0.92)*	0.42	(0.28, 0.65)**	0.52	(0.32, 0.85)*		
No	1.00		1.00		1.00		1.00			

*p<0.05, **p<0.001.

[†]Adjusted on the covariates: age, region, alcohol consumption, smoking status, close relative with cancer & living in couple [†]Calculated using a two way interaction term composed of socioeconomic variable of interest and survey year dummy variable (2010 vs. 2006 pen: first published as 10.1136/bmjopen-2017-016941 on 14 December 2017. Downloaded from http://bmjopen.bmj.com/ on June 8, 2025 at Department GEZ-LTA Erasmushogeschool

		FOBT 2005				FOBT 2010			
		(n=1222)				(n=1425)			-
ocio-economic U ariable	nadjusted OR	Adju (95% CI)	usted OR	Unadjus (95% CI)	ted OR	Adju (95% CI)	sted OR	95% CI	<i>p</i> -trend [*] 2005-2010
Occupation									0.372
Manager	1.00		1.0	1	.00		1.0		
Farmer	0.57	(0.29, 1.10)	0.61	(0.31, 1.21) 0).97	(0.46, 2.05)	0.72	(0.32, 1.61)	
Self-employed	0.78	(0.46, 1.31)	0.70	(0.41, 1.20) 0).82	(0.51, 1.31)	0.80	(0.48, 1.32)	
Professional	0.83	(0.57, 1.23)	0.90	(0.60, 1.34) 0).85	(0.60, 1.20)	0.94	(0.65, 1.37)	
Employee	0.66	(0.45, 0.96)*	0.83	(0.60, 1.24)	0.78	(0.54, 1.12)	0.99	(0.66, 1.50)	
Manual worker	0.67	(0.44, 1.03)	0.69	(0.44, 1.07) 0).66	(0.45, 0.96)*	0.63	(0.42, 0.96)*	
Other	0.76	(0.39, 1.46)	0.85	(0.42, 1.73) 0).58	(0.36, 0.95)*	0.71	(0.41, 1.23)	
Income									0.114
€1500	1.00		1.00	1	.00		1.00		
21000-1500	0.85	(0.61, 1.18)	0.93	(0.66, 1.31) 0).94	(0.67, 1.31)	1.00	(0.68, 1.46)	
€1000	0.63	(0.42, 0.94)*	0.62	(0.39, 0.97)* 0).89	(0.62, 1.29)	0.99	(0.64, 1.52)	
an	0.54	(0.31, 0.93)*	0.70	(0.38, 1.28)).83	(0.49, 1.41)	0.99	(0.52, 1.86)	0.137
Education level									0.441
Superior BAC	1.00		1.00	1	.00		1.00		
BAC	0.79	(0.50, 1.24)	0.85	(0.53, 1.34)	.21	(0.81, 1.83)	1.25	(0.80, 1.95)	
nferior BAC	0.77	(0.58, 1.04)	0.75	(0.55, 1.02)).99	(0.74, 1.34)	0.94	(0.68, 1.30)	
RII	0.67	(0.41, 1.09)	0.69	(0.42, 1.14) 0).90	(0.56, 1.45)	0.81	(0.48, 1.35)	0.466
Employment					1				0.800
Employed	1.00		1.00	1	.00		1.00		
Unemployed	0.86	(0.40, 1.88)	1.09	(0.49, 2.40) 0).68	(0.37, 1.27)	0.86	(0.45, 1.66)	
nactive	1.45	(1.12, 1.88)*	1.18	(0.83, 1.67) 1	.58	(1.25, 1.99)**	1.14	(0.82, 1.58)	
Complementary health insu	irance								0.485
Yes	1.00		1.00	1	.00		1.00		
No	0.50	(0.25, 0.97)*	0.53	(0.26, 1.05) 0).65	(0.40, 1.05)	0.81	(0.47, 1.38)	
Basic health insurance									0.388
Yes	0.70	(0.43, 1.16)	0.75	(0.47, 1.22) 1	.03	(0.69, 1.54)	1.06	(0.68, 1.65)	
No	1.00		1.00	1	.00		1.00		

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Temporal trend in socio-economic inequalities in the uptake of cancer screening programs in France between 2005 and 2010: Results from the Cancer Barometer Surveys

Journal:	BMJ Open
Manuscript ID	bmjopen-2017-016941.R4
Article Type:	Research
Date Submitted by the Author:	08-Nov-2017
Complete List of Authors:	Kelly, David; Institut National du Cancer, Recherche en Sciences Humaines Sociales, Épidémiologie et Santé Publique Estaquio, Carla; Institut National du Cancer, Recherches en Sciences Humaines et Sociales, Épidémiologie et Santé Publique Leon, Christophe; Sante publique France Arwidson, Pierre; Sante publique France Nabi, Hermann; Institut National du Cancer, Recherche en Sciences Humaines et Sociale, Épidémiologie, Santé Publique
Primary Subject Heading :	Epidemiology
Secondary Subject Heading:	Epidemiology, Public health, Health services research
Keywords:	cancer screening, Social inequalities, cancer epidemiology



Temporal trend in socio-economic inequalities in the uptake of cancer screening programs in France between 2005 and 2010: Results from the Cancer Barometer surveys

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Word count: Abstract = 300; Text = 3784

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ABSTRACT

Objectives: Cancer screening is a form of secondary prevention for a disease which is now the leading cause of death in France. Various socio-economic-indicators have been identified as potential factors for disparities in breast, cervical and colorectal cancer screening uptake. We aimed to identify the socioeconomic inequalities which persisted in screening uptake for these cancers, and to quantify these disparities over a 5-year-period.

Setting: The Cancer Barometer was a population-based-survey carried out in 2005 and 2010 in France.

Participants: A randomly selected sample of participants aged 15 to 85 years (n=3820 in 2005 and n=3727 in 2010) were interviewed on their participation in breast, cervical and colorectal cancerscreening-programs and their socioeconomic profile.

Primary and secondary outcome measures: For each type of screening-program, we calculated participation rates, odds ratios (OR) and relative inequality indices (RII) for participation, derived from logistic regression of the following socioeconomic variables: income, education, occupation, employment and health insurance. Changes in participation between 2005 and 2010 were then analyzed.

Results: Participation rates for breast and colorectal screening increased significantly among the majority of socioeconomic categories, whereas for cervical cancer screening there were no significant changes between 2005 and 2010. RIIs for income remained significant for cervical smear in 2005 (RII=0.25, 95% CI 0.13-0.48) and in 2010 (RII=0.31, 95% CI 0.15-0.64). RIIs for education in mammography (RII=0.43, 95% CI 0.19-0.98) and cervical smear (RII=0.36, 95% CI 0.21-0.64) were significant in 2005 and remained significant for cervical smear (RII=0.40, 95% CI 0.22-0.74) in 2010.

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Conclusions: There was a persistence of socioeconomic inequalities in the uptake of opportunistic cervical cancer screening. Conversely, organized screening-programs for breast and colorectal cancer saw a reduction in relative socioeconomic inequalities, even though the results were not statistically significant. The findings suggest that organized-cancer-screening programs may have the potential to reduce socio-economic disparities in participation.

Key words: cancer screening, breast cancer, cervical cancer, social inequalities, cancer epidemiology

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Strengths and limitations of this study

- First study to examine temporal changes in inequalities for cancer screening uptake in • France using relative inequality index.
- Benefits from datasets of two identical questionnaires on cancer screening uptake, taken 5 years apart, using two comparable population samples, hence minimizing information bias.
- Evolution in the format of colorectal screening program in terms of technique and age limits may have led to measured differences in uptake between 2005 and 2010.
- Residents of nursing homes and other medical institutions without a personal telephone line were excluded from the survey, limiting the generalizability of the findings.
- Relatively small sample for certain socio-economic strata, reducing therefore the precision of some estimates.



INTRODUCTION

Screening for cancer is an important form of secondary prevention for a disease which is now leading cause of death in France and worldwide [1]. The 2008 European report on cancer recommends that health systems focus their resources on cancer prevention and early detection rather than treatment alone, as the global disease burden of cancer threatens to become unsustainable in terms of financial costs, pressure on services, follow-up of patients and delivery of care [2].

To date, many European countries have rolled out screening programs for breast, colorectal and cervical cancer via mammography, faecal occult blood test (FOBT) and cervical smear respectively [3, 4]. However, for these screening programs to have a significant effect on reducing cancer mortality, they require a minimum level of participation among the eligible population; for instance 70% for mammography, and 50% for FOBT [5].

We reviewed several publications from France, United Kingdom (UK), United States of American (USA), Italy, Denmark, Korea and Argentina, which identified variables shown to have a significant effect on cancer screening uptake [6-19]. For breast cancer screening, various different social and economic variables were found to have a positive effect on uptake, including employment, higher occupation class, higher education level, income, private health insurance and car/home ownership. However, no single variable was consistently observed across the studies except for participation in other screening programs [7, 18]. For cervical cancer screening, the variables identified as having a significant positive effect on uptake were more numerous, and notably consistent for income [7, 11, 17], higher education level [10-12, 17, 18], employment[6, 12, 18, 19] and private health insurance [6, 7, 18]. For colorectal screening, income was consistently shown to have a significant positive effect on uptake of screening across the studies [14, 16, 18].

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Nevertheless, it remains unclear as to whether the effect of these socio-economic variables on participation rates in screening programs persists over time.

Only one study to date, drawn from the 2006, 2008 and 2010 French Healthcare and Health Insurance surveys, has examined the temporal evolution in breast, cervical and colorectal cancer screening uptake in France [6]. This study conducted among 10 000 participants found that those classified as unskilled workers were more likely to not have undergone cervical cancer screening (OR = 1.64, 95% CI 1.38-1.95) when compared to those with an intermediate profession. The results also showed that women without (OR = 2.05, 95% CI 1.68-2.51) or receiving free complementary health insurance (OR = 1.79, 95% CI 1.36-2.37) were more likely to not have undergone breast cancer screening when compared to those with a private complementary health insurance. In this study, the authors found that inequalities for participation in breast and colorectal cancer screening persisted over the study period from 2006 to 2010 [6]. Thus, we believe there is a need to re-examine how these trends may have evolved with respect to expansion in the coverage and awareness of organized cancer screening programs. The third French National Cancer Plan for the 2014-2019 period has identified early detection of cancers as a primary priority [20]. Included within this priority is the reduction of inequalities associated with cancer diagnosis, in the hope of subsequently reducing mortality rates. Any widening or reduction in socio-economic inequalities in the uptake of screening programs that are identified may then be used to direct future policy of the French national cancer control plan, which specifically seeks to address this issue [20]. We aim therefore in the present study to identify the socio-economic inequalities which persist for uptake of breast, cervical and colorectal cancer screening, and to quantify these disparities over a 5-year period in France.

MATERIALS AND METHODS

Study population

We used data, obtained with formal permission, from the Cancer Barometer surveys, two telephone surveys on cancer-related knowledge, attitudes and practices conducted by the French National Institute for Prevention and Health (now part of Santé Publique France). Both surveys were carried out on a representative random sample of the general French population aged over 16 years old for the 2005 survey and aged 15–85 years old for the 2010 survey. A two-stage random sampling design was used. Residents of nursing homes or other medical institutions who did not possess a personal telephone line were not included in the samples. Private households with telephones were included in the sample. The first sampling step was household selection (by phone number). Within each selected household, one French-speaking person aged 15–85 was randomly selected using the "next birthday" method. The study protocol included a formal request to participate, which explained the objectives of the study that was delivered by mail before the first telephone call. Informed consent was obtained at the start of the telephone interview, in accordance with the guidelines of the French Data Protection Authority (CNIL). The interviews were conducted using a computer-assisted telephone interview (CATI) system.

In order to obtain adequate statistical power for measuring associations between variables and changes in participation rates at smaller levels, a sample size of between 3500 and 4000 was deemed appropriate. The 2005 Cancer Barometer sample consisted of 4046 participants aged over 16 years interviewed between April and June 2005 [18]. There were 226 individuals with missing observations in the 2005 Cancer Barometer sample, notably for all 3 of the dependent variables, and 7 out of 10 covariates and independent variables. These individuals terminated the survey

prematurely, and were thus removed from the analysis as their data was not contributive, leaving 3820 participants in the sample population. Females (51.5%) responded more often than males (48.5%) and mean age of interviewees was 46.7 years. The 2010 Cancer Barometer sample consisted of 3727 participants aged 15 to 85 interviewed during the first semester of 2010[19]. The mean age was 44.6 years and the majority of participants were also female (52.0% vs. 48.0%). The response rates for the 2005 and 2010 Cancer Barometers were 51.2% and 47.0%, respectively.

Measures

Demonstrates and the second of the second Socio-economic indicators (independent variables) were as follows: education level (inferior, equal to or superior to the baccalauréat [high-school diploma]), employment status (employed, unemployed, and inactive), occupational class (farmer, self-employed, manager, professional, employee, manual worker, other), monthly income (below $\in 1000, \in 1000-1500$, above $\in 1500$) and health insurance (private complementary vs. basic insurance coverage). The outcome variables were participation in breast, cervical and colorectal cancer screening programs (dependent variables). For breast cancer screening, participants aged over 40 years were asked if they had undergone mammography within the previous 2 years. For cervical cancer screening, participants aged over 20 vears were asked if they had undergone a cervical smear within the previous 3 years. For colorectal cancer screening, participants aged 50-74 years were asked if they had undergone a faecal occult blood test (FOBT) within their lifetime. Covariates included gender, age, smoking status, alcohol consumption, region, living as a couple and having a close relative with cancer. For the calculation of screening participation rates, we added filters to select the target population eligible for each of the 3 different screening programs. Breast screening by mammography (n=1546): female gender and 49 < age < 75. Cervical screening by cervical smear (n=3085): female gender and 24 < age < 66. Colorectal screening by FOBT (n=2647): both genders where 49<age<75.

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The weighting was based on the data of the 1999 and 2008 Employment Survey of the French population [21], taking into account age, gender, region, education level and number of persons per household [18]. This allowed us to effectively calculate age-adjusted standardized rates for screening participation, in addition to later adjusting the regression models for the covariates mentioned.

Statistical analysis

We created a pooled dataset of the two surveys conducted in 2005 and 2010.We calculated age-adjusted screening rates (AAR) for each stratum using the weighting provided by the INPES. The temporal evolution in the participation rate within each stratum between 2005 and 2010 was examined by adding an interaction term for the year of the survey. The disparity within each socio-economic variable was calculated as the absolute difference between the AAR for the highest and lowest group within an ordinal or binary variable for the given year.

Odds ratios (OR), derived from multiple logistic regression of screening participation on each socio-economic variable were used as a measure of participation likelihood for each stratum of the 6 socio-economic variables. The model was adjusted for the covariates: age, gender (colorectal screening only), region, alcohol, smoking, living as a couple and close relative with cancer. For categorical variables, the higher socio-economic position was used as the reference group. The trend for disparities within each socioeconomic variable for each survey was then estimated and compared using a two way interaction term composed of the socioeconomic variable of interest and a survey year dummy variable (2010 vs. 2005), consistent with the methodology of previous studies on the topic[22, 23].

For the ordinal variables of income and education level, we calculated the Relative Inequality Index (RII) as a measure of health inequality as described by Mackenbach and Kunst [24]. Previous studies on health inequalities, including breast cancer screening uptake [4, 9], employed a similar

Page 10-1136/bmjopen-2017-016941 on 14 December 2017. Downloaded from http://bmjopen.bmj.com/ on June 8, 2025 at Department GEZ-LTA Erasmushogeschool he n, s. vo ch le on in nd is ic ip ng nd dy nd on or ic ic es on 10 methodology for examining temporal evolutions within ordered socio-economic strata [23, 25]. The trend in RII for each survey was estimated and compared using a two way interaction term, composed of the socioeconomic variable of interest and a survey year dummy variable (2010 vs. 2005). The RII is a regression-based measure that summarizes the association between two variables. It is computed by ranking income and education values on a scale from the lowest, which is 0, to the highest, which is 1. Each income or education level value covers a range on this scale that is proportional to the number of participants who held that value and is given a new value on the scale corresponding to the cumulative midpoint of its range. The RII resembles relative risk in that it compares the probability of cancer screening uptake at the extremes of income and educational levels, but is estimated using the data on all income and education values and is weighted to account for the distribution of these values. Here the RII was fitted using logistic regression models. An RII of 0.5 for example implies that participants in the most deprived group (those with lower incomes and educations levels) had a 50% lower probability of cancer screening uptake when compared to those in the least deprived group (those with higher incomes and education levels). All statistical analysis was performed using SAS version 9.2. **RESULTS**

Table 1 presents the demographic and socio-economic characteristics of the study populations. The overall participation rates among the eligible populations for breast, cervical and colorectal cancer screening are shown in Table 2. Chi-squared tests for the change in participation rates within each socio-economic stratum between 2005 and 2010 are also included. For mammography, participation rates increased significantly (p<0.05) among all socio-economic strata, with the exception of farmers, managers, manual workers, unemployed, those with basic health insurance and education level superior to the baccalauréat. For FOBT, participation rates increased significantly among all socio-economic strata between 2005 and 2010, with the exception

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of the unemployed or those with an occupation classified as other. For cervical smear participation rates, there were no significant changes in participation rates among any of the socio-economic strata, except for those without complementary health insurance, which increased significantly from 52.5% to 71.0% (p=0.017).

Table 3 shows the results of the logistic regression models for mammography participation on each socio-economic variable separately, adjusted for covariates. In 2005, farmers, self-employed, employees and manual workers showed significantly reduced participation compared to managers, whereas in 2010 the association remained significant only for manual workers. In 2005, those with an education level inferior to the baccalauréat (OR=0.57, 95% CI 0.35-0.95) showed significantly reduced participation compared to those with an education level superior to the baccalauréat, which became non-significant in 2010 (OR=1.04, 95% CI 0.53-2.05).

Table 4 shows the results of the regression model for cervical smear participation for each socio-economic variable. In 2005, significantly reduced participation was observed for self-employed and manual workers, which became non-significant for both in 2010. In 2005, there was significantly reduced participation for those earning <£1000 and £1000-£1500, which remained significant in 2010 for those earning <£1000 (OR=0.47, 95% CI 0.29-0.76). An education level inferior to the baccalauréat showed significantly lower participation in both 2005 and in 2010. In 2005, being unemployed or inactive significantly reduced participation, and remained significant for both in 2010. The odds ratio for cervical smear participation changed significantly (p=0.014) for those without complementary health insurance from 0.29 (95% CI 0.17-0.49) in 2005 to 0.64 (95% CI 0.38-1.08) in 2010. Having only basic health insurance was significantly associated with reduced participation in both periods.

Table 5 shows the logistic regression results for FOBT participation for each socio-economic variable. Concerning occupation, manual workers (OR=0.63, 95% CI 0.42-0.96) showed

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significantly reduced participation in 2010. Odds ratios for all other occupations showed reduced participation compared to managers, but at a non-significant level in 2005 and 2010. Those earning \leq 1000 showed reduced participation in 2005 (OR=0.62, 95% CI 0.32-0.97), which became non-significant in 2010. There were no significant temporal changes in any of the odds ratios for participation in breast or colorectal cancer screening between 2005 and 2010.

The regression of screening participation on income distribution produced RIIs which can be found in Tables 3-5. The results showed significant inequalities for cervical smear (RII=0.25, 95% CI 0.13-0.48) in 2005, but not for mammography (RII=0.47, 95% CI 0.19-1.29) or FOBT (RII= 0.70, 95% CI 0.38-1.28). In 2010, the income-based RII remained significant for cervical smear (RII=0.31, 95% CI 0.15-0.64). For education, mammography (RII=0.43, 95% CI 0.19-0.98) and cervical smear (RII=0.36, 95% CI 0.21-0.64) showed significant inequalities in 2005, whereas the RII for FOBT was non-significant (RII=0.69, 95% CI 0.42-1.14). In 2010, the education-based RII for mammography became non-significant (RII=0.80, 95% CI 0.26-2.50), whereas the RII for cervical smear remained significant (RII=0.40, 95% CI 0.22-0.74). The p-trend for the temporal change in the RIIs (adjusted model), measured by interaction term between 2005 and 2010, was non-significant for all 3 screening programs for income and education level.

DISCUSSION

Our objective was to identify the socio-economic inequalities which persisted in uptake of breast, cervical and colorectal cancer screening, and to quantify the disparities between socioeconomic groups between 2005 and 2010. In absolute terms, a significant increase in participation rates was observed for most socio-economic strata for mammography and for FOBT between 2005 and 2010. Cervical cancer screening, however, saw no significant change in participation rates between 2005 and 2010 (except for those without complementary health insurance). A similar trend was observed when relative inequalities were considered. It should be

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noted that some of these inequalities persisted between 2005 and 2010, even though formal statistical tests for trends were generally not significant.

Findings in the context of the literature

We found only one study to date that has examined the temporal evolution in breast, cervical and colorectal cancer screening uptake in France [6]. Our objectives and methods, however, constitute a major difference between our study and the one conducted by Sicsic and Franc. The latter aimed to analyze the obstacles to and levers for breast, cervical, and colorectal cancer screening uptake and their trends over time, whereas the aim of our study was to identify the socio-economic inequalities which persist in the uptake of breast, cervical and colorectal cancer screening, and to quantify these disparities over a 5-year period. Thus, Sicsic and Franc pooled their three samples but did not conduct direct comparisons of associations between indicators of socioeconomic position and uptake of cancer screenings between periods.

The sole point of comparison between the two studies concerns the overall participation in screening programs. Sicsic and Franc found that the screening rate for breast cancer decreased between 2006 and 2010, from 77.6% in 2006 to 74.0% in 2010, but that the difference was not statistically significant. Although our study found an increase in participation rates for breast cancer screening, this was not statistically significant at the 5% level. They also found that colorectal cancer screening uptake increased significantly between 2006 and 2010, from 18.2% in 2006 to 38.9% in 2010. This is consistent with our result showing that colorectal cancer screening uptake significantly decreased from 75.3% in 2006 to 71.9% in 2010. For cervical cancer, we found that the rate was stable between 2006 (79.7%) and 2010 (81.4%). In the end, differences in sampling, sample sizes, number of data collection phases, and in desirability bias may explain these differences in participation rates. It should also be noted that the study by Sicsic and

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Page 14 Protected by copyright, including for uses related to text and data mining, Al training, and similar technologies. ar d d ng on ist ed d on ed in ur er 1., he se ng ng nt in ic 14 Franc was based on three surveys carried out in 2006, 2008 and 2010, with therefore a two-year interval, whereas the Cancer Barometer survey was conducted at two points in time in 2005 and 2010. Our study confirmed significantly reduced participation for manual workers in breast and colorectal screening and for those with only basic health insurance in breast and cervical screening in 2010. This is consistent with the study by Sicsic and Franc which showed reduced participation in all 3 screening programs for manual workers and those with only basic health insurance. Breast and colorectal cancer screening programs saw the absolute differences in participation rates reduced over time for all socio-economic variables in our study, with the exception of employment and basic health insurance. A study by Kim et al. showed the disparity in mammography participation based on income remained unchanged among the American population, while the disparity based on education decreased from 2000 to 2005[9]. There remains, however, a persistent disparity in participation rates in cervical cancer screening for the majority of socio-economic variables in our study, consistent with the results of De Maio et al. and Sicsic and Franc[6, 17].

The relative inequalities for income and education decreased for breast and colorectal cancer screening in our study, albeit non-significantly. This is somewhat consistent with De Maio et al., which showed a reduction in the RII for breast cancer screening from 2005 to 2009[17]. In the study by Kim et al., the income-based relative inequalities tended to decrease slightly, while those for education remained constant over time[9]. The relative inequalities for cervical cancer screening persisted according to both income and education from 2005 to 2010 in our study, both remaining statistically significant. This is partially consistent with De Maio et al., where the social gradient decreased for income and increased for education between 2005 and 2010[17].

Interpretation of results

Breast and colorectal screening programs are organized at a national level and differences in absolute participation rates and relative inequalities decreased over time for all socio-economic

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variables. For both breast and colorectal screening, the odds ratios for manual workers showed reduced participation compared to managers in 2010. Education and occupation are strongly correlated, with manual workers having a higher proportion of participants with an educational level inferior to the baccalauréat (85%) than any other occupational category in 2010. Thus they may have been less aware of the health marketing campaigns for colorectal cancer screening and the recommendation for FOBT, due to the negative effect of lower education on health literacy[14, 26, 27].

Cervical cancer remains without a nationally organized screening program in France. It is the duty of doctors to organize and falls to the individual to pay for opportunistic screening via a cervical smear test. The lack of a nationally organized screening program may impose significant financial, educational and cultural barriers to screening uptake among certain sections of the French population. The financial costs for a consultation and laboratory processing of the screening test may deter those with only basic health insurance, as public reimbursement covers only 70% of the cost[28]. This may account for the persistence of the observed differences in participation rates and large RIIs. Improving the awareness, affordability and access to cervical cancer screening should be prioritized in order to increase participation rates and reduce socio-economic disparities.

Limitations and strengths of the study

Our study used two almost identical datasets to construct a temporal analysis of participation in screening programs in France between 2005 and 2010. The use of relative inequality indices in our study has never before been employed as a measure of the evolution of socio-economic inequalities in cancer screening in the French population. The comparability of the study populations minimized selection bias and the conservation of the questionnaire format minimized information bias.

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The study still retains several limitations however. It shares the usual shortcomings of telephone surveys. There is a potential selection bias, as residents of nursing homes or other medical institutions who did not possess a personal telephone line were not included in the samples. The study includes only those who are French-speakers, excluding individuals unable to answer fluently in French. There was no available data on the ethnicity or nationality of participants in the study, which may have been an important source of confounding or effect modification. The exclusion of the above subpopulations, which are likely to be more socio-economically disadvantaged, may have overestimated the screening participation rates in our study.

Our study used two separate sample populations, whose distributions in Table 2 differed significantly for all of the socio-economic indicators and several covariates. The difference in sample distributions may have accounted for the observed differences in screening participation rates. Thus, we cannot rule out that reductions observed in inequalities over time are not simply due to changes in socioeconomic distributions rather than an actual reduction in social inequalities in screening participation.

Page of er s. er he he ly ed in on ut in ss in he of ts, ch al to ng 16 Changes in screening policies concerning age limits, screening techniques and regional access meant that the 2005 and 2010 Cancer Barometers were not directly comparable for certain programs. The question of screening participation for colorectal cancer was therefore limited to the lifetime use of FOBT. Organized cervical screening was available in 13 regions in 2009, a source of regional variation not present in 2005. Some screening techniques are more memorable for patients, due to the invasiveness of the screening technique or the duration of the screening interval, which may have led to recall bias.

The respective analytical sample sizes in 2005 and 2010 for breast (n=742, n=804), cervical (n=1571, n=1514) and colorectal (n=1222, n=1425) cancer screening may have been too small to capture disparities among socio-economic strata, leading to a low precision of estimates. Missing

observations for each variable accounted for less than 5% of the total population, except for the variable income (16.3% missing in 2005 and 9.3% in 2010). This may have limited the precision of certain estimates, producing participation rates with large standard errors and odds ratios with large confidence intervals. We undertook multiple comparisons in our study. Thus, we cannot exclude that some of the results we have observed are due to chance.

Conclusion

The findings suggest that organized cancer screening programs may have the potential to reduce socio-economic disparities in participation.

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Acknowledgements

This article uses data collected from the 2005 and 2010 Barometre cancer studies, provided by the National Institute for prevention and health education, INPES (now Santé Publique France). Special thanks to the department of screening at the Institut National du Cancer (INCA).

Funding statement

This research received no specific grant from any funding agency in the public, commercial or notfor-profit sectors. The data collection was funded by the National Institute for prevention and health education, INPES (now Santé Publique France) in association with the French National Cancer Institute (INCa). The authors declare no external or private sources of funding.

Competing interest statement

All authors have completed the ICMJE uniform disclosure form at <u>www.icmje.org/coi_disclosure.pdf</u> and declare: no support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous three years; no other relationships or activities that could appear to have influenced the submitted work.

Contributors

HN conceived the study, advised on methodology, reviewed the results of statistical analyses and supervised the final edit of the manuscript. DK reviewed the background literature, run statistical analyses and drafted the manuscript. CE, CL, PA provided advice on methodology and statistical analyses. CL & PA directed the data collection. All authors contributed to the final draft of this manuscript.

Data sharing statement

All data presented in this manuscript came from 2 original datasets of the 2005 and 2010 Cancer Barometer surveys. The original files can be requested by contacting Santé Publique France (formerly INVS and INPES) via Pierre Arvidson (pierre.arwidson@santepubliquefrance.fr) or Christophe Léon (christophe.leon@santepubliquefrance.fr).

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ariables	Barometer	: 2005 (n=3820)	Barometer	: 2010 (n=3727)	p-value
	n	%	n	%	P
ender					0.660
ale	1854	48,5	1790	48,0	
egion	1900	51,5	1937	52,0	0.976
-de-France	701	18,4	696	18,7	
est Paris basin	380	10,0	348	9,3	
orth	257	<u> </u>	290	6,4	
est	508	13,3	504	13,5	
ust West	334	8,8	321	8,6	
uth East	455	12,0	447	12,0	
editerranean	457	12,0	471	12,6	~0.001
rmer	117	31	81	2.2	<0.001
lf-employed/craftsman	220	5,8	270	7,2	
anager/executive	589	15,4	595	16,0	
ofessional nployee/office worker	970	20,3	914 829	24,5	
anual worker	642	16,8	839	22,5	
her	506	13,3	199	5,3	<0.001
ducation level	1946	52.0	2270	61.2	<0.001
AC	651	17,4	635	17,1	
perior BAC	1146	30,6	803	21,7	-0.001
onthly Income	414	12.2	200	12.1	<0.001
000-1500	663	21.0	499	12,1	
21500	2075	65,8	2401	72,8	
mployment					< 0.001
nployed	2146	56,2	1851	49,7	
active	1497	39,2	1615	43,3	
lcohol consumption					< 0.001
25	3430	89,8	3195	85,7	
) nakina status	389	10,2	532	14,3	< 0.001
	964	25,2	1195	32,1	
)	2856	74,8	2532	67,9	
lose Relative with cancer	22(((2.1	2102	(21	0.950
25	2366	62,1	1339	62,1	
ving in couple		,,			0.071
es l	2465	64,6	2333	62,6	
) omnlomontom, Ucolth Insurance	1351	35,4	1394	37,4	<0.001
	3518	92.6	3210	89.6	-0.001
)	282	7,4	375	10,5	
asic Health Insurance		10.2	4.4.1	10.4	0.003
)	361	10,2	441 3109	87.6	
BAC = Baccalauréat (high-school di Veighted by age, gender, region and nployment Surveys (INSEE)	ploma) educational level	according to stand	dard populatio	on of the 1999 and 20	008

Table 2.Standardized[†] participation rates for eligible participants in 3 screening programs, Chisquared test for 2005-2010, *p*-trend

Socio oconomic		Mammography		(Cervical smear			FOBT	
variable	p	articipation rate (‰) ± SE	partic	ipation rate (%) \pm	SE	partic	ipation rate (%) \pm	SE
variable	2005	2010	Chi2	2005	2010	Chi2	2005	2010	Chi2
	(n=742)	(n=804)	<i>p</i> -value	(n=1571)	(n=1514)	<i>p</i> -value	(n=1222)	(n=1425)	<i>p</i> -value
Overall	72.1	88.3		79.7	81.4		34.0	51.6	
Occupation									
Farmer	62.49 ±8.24	87.64 ±8.81	0.148	75.61 ±7.28	80.39 ±11.63	0.739	26.97 ±6.69	$56.50\pm\!10.82$	0.006
Self-employed	63.70 ±9.46	85.96 ±5.37	0.027	71.02 ± 7.00	$77.92 \pm \! 6.89$	0.438	33.47 ±5.61	$52.30\pm\!\!5.75$	0.009
Manager	85.50 ± 4.04	91.45 ±2.50	0.262	85.15 ±2.51	83.88 ± 3.05	0.740	39.33 ±3.89	57.33 ±3.31	0.0003
Professional	74.87 ± 3.74	87.82 ±2.95	0.004	84.31 ±1.95	88.17 ± 1.68	0.153	35.04 ±3.21	53.32 ±2.79	<0,000
Employee	68.76 ± 3.00	90.58 ±1.98	<0.0001	78.05 ± 1.81	81.52 ±2.06	0.170	29.92 ±2.63	51.07 ±3.54	<0,000
Manual worker	64.52 ± 6.01	76.02 ±5.29	0.161	74.70 ± 3.96	75.00 ±4.22	0.956	30.29 ±3.74	46.95 ±4,23	0.001
Other	69.37 ±6.19	83.70 ±5.28	0.097	81.14 ±4.21	62.94 ±6.53	0.010	32.87 ±6.20	43.84 ±6.92	0.204
Education level									
inferior BAC	67.80 ±2.29	86.26 ±1.79	<0.0001	75.20 ±1.77	76.88 ±1.97	0.484	31.55 ±1.82	51.06 ±2.06	0
BAC	71.86 ±5.71	93.63 ±2.15	0.0003	83.59 ±2.47	86.42 ±2.03	0.385	32.07 ±4.46	56.06 ±3.58	<0,000
Superior BAC	80.17 ±3.49	87.34 ±2.56	0.153	84.27 ±1.65	86.81 ±1.67	0.318	37.39 ±3.27	51.23 ±2.92	0.002
Difference	12.37	1.08		9.07	9.93		5.84	0.17	
Income									
<€1000	58.45 ±4.48	82.62 ±3.92	0.001	64.78 ±4.01	64.81 ±4.70	1	27.02 ±3.55	49.40 ±4.79	0.0001
E1000-1500	68.62 ±4.19	84.95 ±3.57	0.006	72.43 ±2.96	78.81 ±3.49	0.161	33.29 ±3.35	50.61 ±4.33	0.001
>€1500	76.21 ±2.65	89.57 ±1.59	< 0.0001	85.21 ±1.25	84.96 ±1.36	0.885	37.07 ±2.23	52.29 ±1.96	<0,000
lifference	17.76	6.95		20.43	20.15		10.05	2.89	
Complementary l	health								
insurance									
Yes	72.09 ± 1.84	88.08 ±1.38	< 0.0001	81.77 ±1.08	81.83 ±1.29	0.964	33.63 ±1.53	52.31 ± 1.64	<0,000
No	48.35 ±9.53	78.06 ± 7.49	0.013	52.51 ±6.04	71.00 ±5.67	0.017	20.10 ±5.58	41.51 ±7.71	0.011
lifference	23.76	10.02		29.26	10.83		13.53	10.80	
Basic health insu	rance								
Yes	66.12 ±7.38	69.98 ± 8.60	0.694	67.20 ±4.70	67.22 ±5.47	1	26.23 ±4.56	52.75 ±6.93	0.0001
No	70.99 ± 1.93	88.72 ±1.28	< 0.0001	81.52 ±1.12	82.87 ±1.24	0.399	33.83 ±1.60	52.06 ±1.64	<0,000
lifference	4.87	18.74		14.32	15.65		7.60	0.69	
Employment									
Employed	76.23 ±3.07	89.0 ±2.21	0.001	83.75 ±1.21	86.56 ±1.34	0.097	28.37 ±2.42	45.11 ±2.56	<0,000
Unemployed	66.26 ±9.44	84.1 ±8.73	0.176	66.00 ±5.25	72.88 ±5.23	0.304	25.48 ±6.60	35.91 ± 9.21	0.308
Inactive	68.58 ±2.32	86.79 ±1.75	< 0.0001	72.72 ±2.51	71.15 ±2.73	0.665	36.51 ±1.93	56.48 ±2.03	<0.000

[†]Weighted by age, gender, region and educational level according to standard population of the 1999 and 2008 Employment Surveys (INSEE)

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		Mammography (n=742)	y 2005			Mammograph (n=804)	y 2010		_
Socio-economic	Unadjusted	(11-742)	Adjusted		Unadjusted	(11-004)	Adjusted		<i>p</i> -trend ⁺
variable	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)	OR	(95 % CI)	2005-201
Occupation									0.521
Manager	1.00		1.0		1.00		1.0		
Farmer	0.28	(0.10, 0.77)*	0.33	(0.12, 0.92)*	0.66	(0.08, 5.45)	0.64	(0.07, 5.54)	
Self-employed	0.30	(0.11, 0.81)*	0.33	(0.12, 0.93)*	0.57	(0.18, 1.86)	0.60	(0.18, 2.00)	
Professional	0.51	(0.23, 1.10)	0.53	(0.24, 1.18)	0.67	(0.26, 1.72)	0.66	(0.25, 1.74)	
Employee	0.37	(0.18, 0.77)*	0.39	(0.19, 0.82)*	0.90	(0.36, 2.26)	1.13	(0.43, 2.95)	
Manual worker	0.31	(0.13, 0.74)*	0.34	(0.14, 0.84)*	0.30	(0.11, 0.78)*	0.34	(0.12, 0.94)*	
Other	0.38	(0.16, 0.95)*	0.45	(0.17, 1.14)	0.48	(0.16, 1.47)	0.59	(0.18, 1.95)	
Income									0.775
>€1500	1.00		1.00		1.00		1.00		
€1000-€1500	0.68	(0.42, 1.11)	0.83	(0.50, 1.39)	0.66	(0.34, 1.27)	1.04	(0.49, 2.20)	
<€1000	0.44	(0.26, 0.73)*	0.57	(0.32, 1.03)	0.55	(0.29, 1.06)	0.80	(0.38, 1.68)	
RII	0.29	(0.14, 0.64)*	0.47	(0.19, 1.29)	0.37	(0.13, 1.00)	0.78	(0.23, 2.64)	0.781
Education level									0.403
Superior BAC	1.00		1.00		1.00		1.00		
BAC	0.63	(0.32, 1.26)	0.61	(0.30, 1.23)	2.13	(0.73, 6.18)	2.09	(0.70, 6.22)	
nferior BAC	0.52	(0.32, 0.86)*	0.57	(0.35, 0.95)*	0.91	(0.48, 1.73)	1.04	(0.53, 2.05)	
RII	0.36	(0.16, 0.79)*	0.43	(0.19, 0.98)*	0.62	(0.21, 1.81)	0.80	(0.26, 2.50)	0.450
Employment									0.786
Employed	1.00		1.00		1.00		1.00		
Unemployed	0.61	(0.23, 1.62)	0.60	(0.23, 1.61)	0.65	(0.19, 2.20)	0.74	(0.21, 2.68)	
nactive	0.68	(0.46, 1.01)	0.93	(0.57, 1.54)	0.81	(0.49, 1.36)	1.30	(0.65, 2.60)	
Complementary heal	lth insurance								0.859
Yes	1.00		1.00		1.00		1.00		
No	0.36	(0.16, 0.81)*	0.41	(0.18, 0.95)*	0.48	(0.22, 1.06)	0.60	(0.26, 1.42)	
Basic health insuran	ce								0.121
Yes	0.80	(0.41, 1.54)*	0.83	(0.43, 1.61)	0.30	(0.15, 0.58)*	0.41	(0.20, 0.85)*	
No	1.00		1.00		1.00		1.00		

Table 4. Association between socio-economic variables and the probability of cervical smear participation in 2005 and 2010: unadjusted[†] and adjusted odds ratios

		Cervical smo	ear 2005			Cervical smea	ır 2010		
		(n=157	/1)			(n=1514)		
Socio-economic	Unadjusted		Adjusted		Unadjusted		Adjusted		<i>p</i> -tren
variable	OR	(95% CI)	OR	(95 % CI)	OR	(95% CI)	OR	(95% CI)	2005-20
Occupation									0.483
Manager	1.00		1.0		1.00		1.0		
Farmer	0.54	(0.20, 1.45)	0.59	(0.21, 1.65)	0.79	(0.19, 3.29)	0.79	(0.18, 3.44)	
Self-employed	0.43	(0.20, 0.90)*	0.43	(0.20, 0.92)*	0.68	(0.31, 1.50)	0.78	(0.35, 1.75)	
Professional	0.94	(0.57, 1.54)	0.98	(0.59, 1.61)	1.43	(0.89, 2.45)	1.50	(0.87, 2.61)	
Employee	0.62	(0.40, 0.96)*	0.66	(0.42, 1.03)	0.85	(0.52, 1.37)	0.89	(0.54, 1.46)	
Manual worker	0.52	(0.29, 0.92)*	0.51	(0.28, 0.92)*	0.58	(0.33, 1.01)	0.67	(0.37, 1.21)	
Other	0.75	(0.38, 1.49)	0.81	(0.40, 1.62)	0.33	(0.18, 0.60)*	0.51	(0.26, 1.00)	
Income									0.36
>€1500	1.00		1.00		1.00		1.0		
€1000-1500	0.46	(0.32, 0.65)**	0.54	(0.37, 0.79)**	0.66	(0.43, 1.01)	0.79	(0.50, 1.25)	
<€1000	0.32	(0.21, 0.49)**	0.44	(0.28, 0.70)**	0.33	(0.22, 0.49)**	0.47	(0.29, 0.76)**	
RII	0.16	(0.09, 0.28)**	0.25	(0.13, 0.48)**	0.20	(0.11, 0.37)**	0.31	(0.15, 0.64)*	0.29
Education level									0.82
Superior BAC	1.00		1.00		1.00		1.0		
BAC	0.95	(0.63, 1.45)	1.01	(0.66, 1.55)	0.97	(0.59, 1.58)	0.99	(0.60, 1.63)	
Inferior BAC	0.57	(0.41, 0.77)**	0.57	(0.41, 0.80)**	0.51	$(0.35, 0.73)^{**}$	0.63	$(0.43, 0.94)^*$	
RII	0.36	$(0.21, 0.61)^{**}$	0.36	(0.21, 0.64)**	0.28	(0.16, 0.51)**	0.40	$(0.22, 0.74)^*$	0.88
Employment	0.50	(0.21, 0.01)	0.50	(0.21, 0.04)	0.20	(0.10, 0.51)	0.40	(0.22, 0.74)	0.00
Employment	1.00		1.00		1.00		1.0		0.59
	1.00	(0.22, 0, (1)**	1.00	(0.20, 0.75)*	1.00	(0.26.0.67)**	1.0	(0.20, 0.01)*	
Unemployed	0.38	(0.23, 0.61)	0.46	(0.28, 0.75)	0.42	(0.26, 0.67)	0.49	(0.30, 0.81)	
Inactive	0.52	(0.38, 0.71)	0.50	(0.36, 0.71)	0.38	(0.28, 0.52)	0.50	(0.35, 0.73)**	
Complementary he	ealth insurance								0.01
Yes	1.00		1.00		1.00		1.0		
No	0.25	(0.15, 0.40)**	0.29	(0.17, 0.49)**	0.54	(0.34, 0.88)*	0.64	(0.38, 1.08)	
Basic health insura	nce								0.67
Yes	0.46	(0.29, 0.74)*	0.57	(0.35, 0.92)*	0.42	(0.28, 0.65)**	0.52	(0.32, 0.85)*	
No	1.00		1.00		1.00		1.00		

*p<0.05, **p<0.001.

[†]Adjusted on the covariates: age, region, alcohol consumption, smoking status, close relative with cancer & living in couple [†]Calculated using a two way interaction term composed of socioeconomic variable of interest and survey year dummy variable (2010 vs. 2006 pen: first published as 10.1136/bmjopen-2017-016941 on 14 December 2017. Downloaded from http://bmjopen.bmj.com/ on June 8, 2025 at Department GEZ-LTA Erasmushogeschool

		1001 2003	FOBT 2005				FOBT 2010			
<u></u>	(n=1222)				(n=1425)					
ocio-economic ariable	Unadjusted	Adj (95% CI)	OR	(95% CI)	Unadjusted OR	Adj (95% CI)	OR	95% CI	<i>p</i> -trend 2005-2010	
	-	()	-		-	()	-		0.372	
lanager	1.00		1.0		1.00		1.0			
armer	0.57	(0.29, 1.10)	0.61	(0.31, 1.21)	0.97	(0.46, 2.05)	0.72	(0.32, 1.61)		
elf-employed	0.78	(0.46, 1.31)	0.70	(0.41, 1.20)	0.82	(0.51, 1.31)	0.80	(0.48, 1.32)		
Professional	0.83	(0.57, 1.23)	0.90	(0.60, 1.34)	0.85	(0.60, 1.20)	0.94	(0.65, 1.37)		
Employee	0.66	(0.45, 0.96)*	0.83	(0.60, 1.24)	0.78	(0.54, 1.12)	0.99	(0.66, 1.50)		
Ianual worker	0.67	(0.44, 1.03)	0.69	(0.44, 1.07)	0.66	(0.45, 0.96)*	0.63	(0.42, 0.96)*		
ther	0.76	(0.39, 1.46)	0.85	(0.42, 1.73)	0.58	(0.36, 0.95)*	0.71	(0.41, 1.23)		
icome									0.114	
≽€1500	1.00		1.00		1.00		1.00			
1000-1500	0.85	(0.61, 1.18)	0.93	(0.66, 1.31)	0.94	(0.67, 1.31)	1.00	(0.68, 1.46)		
€1000	0.63	(0.42, 0.94)*	0.62	(0.39, 0.97)*	0.89	(0.62, 1.29)	0.99	(0.64, 1.52)		
П	0.54	(0.31, 0.93)*	0.70	(0.38, 1.28)	0.83	(0.49, 1.41)	0.99	(0.52, 1.86)	0.137	
ducation level									0.441	
uperior BAC	1.00		1.00		1.00		1.00			
AC	0.79	(0.50, 1.24)	0.85	(0.53, 1.34)	1.21	(0.81, 1.83)	1.25	(0.80, 1.95)		
nferior BAC	0.77	(0.58, 1.04)	0.75	(0.55, 1.02)	0.99	(0.74, 1.34)	0.94	(0.68, 1.30)		
II	0.67	(0.41, 1.09)	0.69	(0.42, 1.14)	0.90	(0.56, 1.45)	0.81	(0.48, 1.35)	0.466	
mployment					1				0.800	
Employed	1.00		1.00		1.00		1.00			
Inemployed	0.86	(0.40, 1.88)	1.09	(0.49, 2.40)	0.68	(0.37, 1.27)	0.86	(0.45, 1.66)		
nactive	1.45	(1.12, 1.88)*	1.18	(0.83, 1.67)	1.58	(1.25, 1.99)**	1.14	(0.82, 1.58)		
Complementary health	insurance								0.485	
/es	1.00		1.00		1.00		1.00			
lo	0.50	(0.25, 0.97)*	0.53	(0.26, 1.05)	0.65	(0.40, 1.05)	0.81	(0.47, 1.38)		
Basic health insurance									0.388	
les	0.70	(0.43, 1.16)	0.75	(0.47, 1.22)	1.03	(0.69, 1.54)	1.06	(0.68, 1.65)		
			1.00		1.00		1.00			

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STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract
		(b) Provide in the abstract an informative and balanced summary of what was done
		and what was found: Included, please see page 1 and 2.
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported
C		Included, please see 5 and 6
Objectives	3	State specific objectives, including any prespecified hypotheses. Included please see
		page 6, last sentence.
Methods		
Study design	4	Present key elements of study design early in the paper. Included, please see page 7,
		study population section, first paragraph.
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment,
		exposure, follow-up, and data collection. Included, please see page 7, study
		population section, second paragraph.
Participants	6	(a) Cohort study—Give the eligibility criteria, and the sources and methods of
		selection of participants. Describe methods of follow-up
		Case-control study—Give the eligibility criteria, and the sources and methods of
		case ascertainment and control selection. Give the rationale for the choice of cases
		and controls
		Cross-sectional study—Give the eligibility criteria, and the sources and methods of
		selection of participants. Included, please see page 7, study population section,
		first paragraph.
		(b) Cohort study—For matched studies, give matching criteria and number of
		exposed and unexposed
		Case-control study—For matched studies, give matching criteria and the number of
		controls per case
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect
		modifiers. Give diagnostic criteria, if applicable. Included, please see page 8,
		Measures section.
Data sources/	8*	For each variable of interest, give sources of data and details of methods of
measurement		assessment (measurement). Describe comparability of assessment methods if there is
		more than one group. Included, please see page 8, Measures section.
Bias	9	Describe any efforts to address potential sources of bias. Included, please see page
		7, second sentence, study population section, and page 8, last paragraph,
		Measures section.
Study size	10	Explain how the study size was arrived at. Included, please page 7, second
		paragraph, study population section.
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable,
		describe which groupings were chosen and why. Included, please page 8, Measures
		sections.
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding
		Included, please page Statistical Analysis section pages 9-10
		(b) Describe any methods used to examine subgroups and interactions Included,

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please statistical analysis section, second and third paragraphs.

(c) Explain how missing data were addressed. Included, please see page 7, study population section, second paragraph.

erant for study—1, i.e. or not study—1, inging strategy. Included, () Describe any sensitivity mate.

Continued on next page

Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and
		analysed YES
		(b) Give reasons for non-participation at each stage YES
		(c) Consider use of a flow diagram
Descriptive	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information
data		on exposures and potential confounders YES
		(b) Indicate number of participants with missing data for each variable of interest YES
		(c) Cohort study—Summarise follow-up time (eg, average and total amount)
Outcome data	15*	Cohort study-Report numbers of outcome events or summary measures over time
		Case-control study-Report numbers in each exposure category, or summary measures of
		exposure
		Cross-sectional study—Report numbers of outcome events or summary measures YES
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their
		precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and
		why they were included YES
		(b) Report category boundaries when continuous variables were categorized
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful
		time period YES
Other analyses	17	Report other analyses done-eg analyses of subgroups and interactions, and sensitivity
		analyses
Discussion		
Key results	18	Summarise key results with reference to study objectives YES
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision.
		Discuss both direction and magnitude of any potential bias YES
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity
		of analyses, results from similar studies, and other relevant evidence YES
Generalisability	21	Discuss the generalisability (external validity) of the study results YES
Other informati	on	
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable,
-		for the original study on which the present article is based YES

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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