The importance of socio-economic variables in cancer screening participation: a comparison between population-based and opportunistic screening in the EU-15.

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Objectives: To investigate differences in participation with breast and cervical cancer screening related to individual socio-economic characteristics, across population-based versus opportunistic screening programmes.

Methods: Data from Eurobarometer 66.2 “Health in the European Union” 2006 on self-reported breast and cervical cancer screening participation in the preceding 12 months within the EU 15 was obtained The sample was restricted to those eligible for screening based on the screening age within each country. Observations for 2214 and 5025 individuals respectively for breast and cervical cancer screening were available. Data on marital status, self-reported health, socio-economic group and years of education were also available. Screening programmes were categorised as population-based or opportunistic and logistic regression analysis used to examine the relationship between participation, individual characteristics and programme type.

Results: Differences in participation related to socio-economic status were observed in opportunistic screening programmes for breast cancer (OR=0.63* and OR=0.51**) and cervical cancer (OR=0.75** and OR=0.64**). Differences related to socio-economic characteristics were not found with respect to participation in population-based programmes.

Conclusions: In opportunistic programmes, differences in participation across socio-economic groups are evident in respect of both breast and cervical cancer screening. These differences may have implications for treatment and outcomes across socio-economic groups. Such differences were not evident in population-based programmes.

Keywords: Socio-economic, education, population-based screening, mammography, cervical screen.

Introduction

In 2008 there were an estimated 3.2 million cases of cancer with over 1.7 million deaths from the illness in the European Union. Almost 500 000 of these cases related to breast or cervical cancer.[1] In recent years there has been both a collective and concerted effort by the European Union to combat cancer beginning with the Europe Against Cancer Action Plan in 1985.[2] More recently recommendations proposed by the European Commission focused upon the importance of early cancer detection through screening. Currently the European Partnership for Action Against Cancer 2010 has emphasised the value of organised population-based screening, aimed at 100% of the target population for use in breast, cervical and colorectal screening.[3] The importance of organised cancer screening has been increasingly recognised in lowering mortality and morbidity in both cervical cancer and breast cancer.[4-6]

Screening programmes differ in terms of their coverage and the manner in which they engage with the public. Programmes that offer universal coverage for eligible groups - where eligibility is based on an objectively assessed population risk – are typically characterised as population-based programmes. Such programmes not only use an objective risk assessment as the basis for eligibility but also adopt a systematic approach to the identification of eligible individuals who are contacted by the programme with invitations to participate. Opportunistic programmes by contrast rely to a greater extent on the subjective assessment of risk by the individual as well as the willingness and ability of the individual to take responsibility to organise a screening test. Differences in the role accorded the individual between the two programmes may contribute to differences in participation with screening as perceptions of risk as well as the willingness and ability of individuals to organise screening will vary with, for

example, socio-economic characteristics. It has been argued by the EU and subsequently found in other studies that population-based programmes are more effective and equitable with respect to different socio-demographic groups.[7-10] In December 2003 the European Council, for example, advocated the development of national screening programmes with regard to a range of cancer screening services including breast, cervical and colorectal cancer.[7]

Only one previous study has investigated differences in participation between programme types across EU countries related to individual characteristics. This used WHO (2002) cross country data from 22 countries within Europe to investigate variations across programme type with respect to educational attainment. It found differences related to education in opportunistic programmes but not in population-based programmes.[11] Limitations exist with this study however. First, while it focuses on education, education is an imperfect indicator of social class and as such differences related to other individual characteristics may be missed.[12] Second, the data used in the study relate to 2002 which precede the EU Council recommendations and may not provide as current a picture of participation as more recent data. While other studies have found evidence of differential participation related to social class these have not examined differences across the types of programme offered or have used area based data and are thus open to accusations of ecological fallacy.[13-15] This study examines differences in participation across socio-economic classification controlling for other individual characteristics between population-based and opportunistic programmes using individual based data collected in 2006. To our knowledge it is the first study to do so using representative samples of individuals from across the EU-15.

Materials and Methods

Data were extracted from a large population-based survey, Eurobarometer 66.2 "Health in the European Union" for analysis. As noted in previous studies, population-based surveys offer the researcher a richer source of individual level data with which to explore differences in screening participation than are typically held in administrative data collected by screening programmes.[15] Data related to countries from the EU-15. While the EU Council has produced recommendations on the appropriate age range for screening, differences nevertheless exist between EU-15 countries (see Table 1 & Table 2). To examine the impact of the programme the sample used for analysis was therefore restricted to individuals in the age ranges screened within each country for the cancer concerned. New accession states to the EU were not included in the study so as to reduce heterogeneity between states with respect to, for example, the maturity of the publicly funded health care system. The type of programme in each country was defined using data from the EU Council's first report on the implementation of the 2003 Council Recommendations.[16]. The data extraction exercise produced 5025 individuals eligible based on age for participation in cervical cancer screening programmes and 2223 individuals eligible for participation in breast cancer screening .

Eurobarometer uses a self-completed survey instrument. With respect to breast and cervical cancer screening respondents were asked:

"*Over the last 12 months, which, if any, of the following tests have you had?*

- *Breast examination by X- ray, that is mammography*
- *Cervical smear test, that is a pap smear"*

Five socio-economic classes were constructed using the individual's current or previous occupation:

1) Socio-economic group 1: Professionals; Business proprietors; High managerial positions.
2) Socio-economic group 2: Intermediate or junior managerial positions; State employees.
3) Socio-economic group 3: Non Professionals; Semi-skilled.
4) Socio-economic group 4: Unskilled; Manual employee.
5) Socio-economic group 5: Individuals who never worked.

Years of schooling was modelled using data on the age an individual finished their schooling. Individuals were only included in the analysis if they completed education after the age of nine and finished their formal education no later than 25 years of age. Five specific categories were created:

1) Individuals who finished their schooling at 22 years or over.
2) Individuals who finished between the ages of 19 and 21.
3) Individuals who finished between the ages of 17 and 18.
4) Individuals who finished between the ages of 15 and 16.
5) Individuals who finished their schooling at 14 years or less.

Other data extracted from the survey (selected based on its potential to impact upon participation in cancer screening) were: age, residence in urban or rural area, country of origin, marital status and self reported health. Dummy variables for each of the EU-15 countries were included to control for differences across states. A multivariate logistic regression of participation as a function of the variables detailed was

undertaken. The analysis compared participation in screening across breast and cervical cancers, controlling for respondent socio-demographic characteristics, country and programme type classified using EU data.[17] (All variables are as defined in appendix 1.)

Descriptive statistics on the samples, differences in participation rates related to socio-demographic variables and by programmes type are reported in Table 1.[1] Z-tests were used to determine the significance or otherwise of individual explanatory variables and WALD tests used to determine the joint significance of socio-economic variables. Regression coefficients are expressed as adjusted odds-rations to facilitate discussion.

Results

Table1(here) and Table2(here) outline the variations evident across the EU-15 countries with regards to the organisation of screening programmes in terms of intervals and eligible ages for screening.[17] While differences in the targeted age range were small with respect to breast screening, as can be seen, larger differences existed with respect to cervical cancer screening. These differences within opportunistic programmes may consequently lead to adverse results regarding the efficacy and cost-effectiveness of the screening programme.

Consistent with EU descriptions eight countries had completed full implementation of population-based breast cancer programmes by 2006. Five more countries had failed

[1] Population-based organised programmes offered screens to all individuals of target age groups within a country using a central cancer registry with adherence to correct interval periods. Opportunistic screening programmes conversely do not invite individuals to attend screening rather it is of the individuals or GPs initiative to attend for screens where correct interval periods may not be adhered to leading to over screening among certain women. Where population-based programmes are being implemented, opportunistic screening may still take place.

to achieve fully implemented population-based programmes but were in the process of doing so. Two countries Austria and Greece had only opportunistic programmes. With respect to cervical cancer screening five countries had implemented population-based programmes, (though the five had already implemented organised programmes prior to the EU recommendations of 2003). All others had yet to implement a population-based programme (though Italy had begun to implement such a programme.)

Table 3 (here) provides descriptive statistics and illustrates the participation rates across the EU-15. The table details participation across programme type for both cancers.

Table 4 (here) presents the results of the multivariate analyses. These demonstrate that, with regards to breast cancer screening, there is a socio-economic gradient evident within the EU-15 countries that have not yet fully implemented organised programmes. With the highest socio-economic group operating as a base, those in socio-economic group 3 (OR=0.63*) and socio-economic group 5 (OR=0.51**) were significantly less likely to have had a mammogram in preceding 12 months compared to the most affluent group. (The Wald test for the socio-economic groups achieved borderline significance here also.) Education was found not to be a significant factor for either programme type. With regard to cervical cancer the results indicate that in countries with opportunistic programmes in place, those within the two lowest socio-economic groups, are less likely to have had a screen compared to the most affluent group (OR=0.75**; OR=0.64**). (The Wald test was also significant for socio-economic groups (P>chi=0.011)). Individuals with greater years of schooling had higher participation rates compared to individuals who finished formal education at 18

years or younger (OR=0.66***; OR=0.62***; OR=0.60***). (The Wald test was significant for age finished schooling groups (P>chi=0.000)). This suggests that years of schooling and socio-economic status play an important role in participation in cervical cancer screening in countries with opportunistic programmes. There are no such differences in countries with population-based screening programmes. Marital status was significant across both cancers and programme types.

Discussion

This study, demonstrates that a socio-economic gradient is evident in participation in both breast and cervical cancer screening in opportunistic programmes within EU-15 countries but interestingly not in population-based programmes. Unlike the previous study which focused only on educational attainment, this study demonstrated the existence of such a gradient whilst controlling for years of schooling.[12] This measure of socio-economic status may be superior to education alone which may exhibit significant heterogeneity between countries and over time. (For example, what a given number of years of education or level of educational attainment means in terms of social class may vary between countries and overtime.) In opportunistic cervical screening programmes, socio-economic status and years of schooling were found to be highly significant factors in determining participation. This socio-economic variation was not as evident in respect of breast cancer but was nevertheless present. In those countries with population-based screening programmes socio-economic differences were not evident.

For cervical cancer in particular, this is noteworthy given that those from lower socio-economic groups exhibit a higher incidence of HPV infection, the major cause of

cervical cancer.[18] The EU Commission has issued recommendations that population-based programmes be implemented across the EU in accordance with IARC guidelines for breast, cervical as well as colorectal cancer screening. These programmes are more easily monitored; systematically evaluated and more cost effective.[8,19] Recent evidence suggests that that those countries that introduced organised nationwide screening programmes earliest are also those that have witnessed the largest declines in mortality over time.[20] This study demonstrates that population-based programmes may also avoid variations in participation related to socio-economic variables, an additional desirable outcome. While, as is evident from Table 3, a higher uptake of cervical screening services may occur in opportunistic programmes, this may reflect over use among those in higher social classes. Those from higher social classes may not only be more likely to use the service but use it with greater frequency. This may serve to compromise the cost effectiveness of the programme in the sense that screening may take place at shorter than appropriate intervals while presenting a headline use figure that conceals low uptake among particular groups. The data available in the survey did not allow us to pursue this issue as it did not detail the interval since the last screen, merely whether there had been one in the preceding twelve months.

The results for both breast and cervical cancer screening support the hypothesis that there are variations in participation related to socio-economic characteristics in opportunistic programmes. Between 2003 and the beginning of 2007, only three countries, in addition to those with existing programmes had completed the full implementation of organised screening for breast cancer whilst no country, without an existing programme had implemented organised screening for cervical cancer. This

suggests differences in participation related to social class are likely to persist at least in the short term and be reflected in differences in experience of morbidity and mortality across social classes.

Barriers to the uptake of screening services may be financial or non-financial in nature. While opportunistic programmes may be more likely to have financial barriers associated with them (in that individuals may be more likely to pay for access) they may also have larger non-financial barriers in the sense that more of the burden of arranging a screen falls on the individual. The nature and impact of these barriers may differ between programmes. While the Eurobarometer provides a rich source of individual level characteristics it contains a relatively small number of observations for each country and a limited range of variables. This limits the extent to which analysis within and between countries including the nature and impact of particular barriers can be pursued. While the data source was rich the fact that household income was not, for example. collected limited our ability to ascertain the extent to which income played a role in screening uptake within systems where charges may have been levied.. That there is heterogeneity between programmes classed here as either population-based or opportunistic is also conceded. Programmes will exist on a continuum in relation to their ability to overcome barriers to participation. The classification of programmes into population-based and opportunistic is recognised as being somewhat crude.

Conclusion

This study found that organised population-based screening programmes within the EU do not exhibit significant differences in screening participation across socio-

economic groups. Moreover these differences are evident in opportunistic programmes. Population-based programmes may therefore allow for greater equality in respect of screening and associated benefits compared with opportunistic programmes. Further research on the nature of barriers to screening uptake and how best these might be overcome may facilitate the development of appropriate policy responses within programmes to address the socio-economic gradient evidenced here. Whether uptake from those in lower socio-economic classes would be better encouraged through education, financial incentives or greater persistence on the part of programmes when inviting individuals to screens is beyond the scope of this paper. However that compliance with EU recommendations in regard to population-based screening in breast and cervical may help reduce or eliminate socio-economic inequalities in participation and thereby reduce inequalities in morbidity and mortality does seem clear.

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Table 1: Breast Cancer screening Programmes in the EU-15

Breast Cancer Screening Programmes:				
Country	**Programme Type**	**Rollout Status**	**Eligible age**	**Interval Period**
Austria	Opportunistic	-	40+	2
Belgium	Organised	Complete	50-69	2
Denmark	Organised	Ongoing	50-69	2
Finland*	Organised	Complete	50-(59)69	2
France	Organised	Complete	50-74	2
Germany	Organised	Ongoing	50-69	2
Greece	Opportunistic	-	40+	(1)2
Republic of Ireland	Organised	Ongoing	50-64	2
Italy	Organised	Ongoing	50-69	2
Luxembourg	Organised	Complete	50-69	2
Netherlands	Organised	Complete	50-75	2
Portugal	Organised	Ongoing	45-69	2
Spain*	Organised	Complete	(45)50-64(70)	2
Sweden*	Organised	Complete	40(50)-(69)70	2
UK (Great Britain)	Organised	Complete	50-70	3
UK (Northern Ireland)	Organised	Complete	50-64	3

† Data acquired from von Karsa et al (2008) Cancer screening in the European Union. Report on the implementation of the Council Recommendation on cancer screening – First Report. European Commission, 2008. http://ec.europa.eu (date last accessed 26 March 2010).
*In Finland, Spain and Sweden variations in eligible ages groups between regions within the country.
- The EU recommends targeting of women aged 50-69

Table 2: Cervical Cancer Screening Programmes in the EU-15

	Cervical Cancer Screening Programmes:			
Country	**Programme Type**	**Rollout Status**	**Eligible age**	**Interval Period**
Austria	Opportunistic	-	18+	1
Belgium	Opportunistic	-	25-64	3
Denmark	Organised	Complete	23-59	3&5
Finland*	Organised	Complete	(25)30-60(65)	5
France*	Opportunistic	-	(20)25-65	3
Germany	Opportunistic	-	20+	1
Greece	Opportunistic	-	20+	1
Republic of Ireland	Opportunistic	-	25-60	3&5
Italy	Organised	Ongoing	25-64	3
Luxembourg	Opportunistic	-	15+	1
Netherlands	Organised	Complete	30-60	5
Portugal	Opportunistic	-	25-64	3
Spain*	Opportunistic	-	(18)30(35)-59(65)	3 or 5
Sweden	Organised	Complete	23-60	3&5
UK (Great Britain)	Organised	Complete	25-70	3&5
UK (Northern Ireland)	Organised	Complete	20-64	3&5

† Data acquired from von Karsa et al (2008) Cancer screening in the European Union. Report on the implementation of the Council Recommendation on cancer screening – First Report. European Commission, 2008. http://ec.europa.eu (date last accessed 26 March 2010).
*In Finland, France and Spain, variations in eligible ages groups between regions within the country.
- The EU recommends targeting of women not before the age of 20, and not after the age of 30.

Table 3: Descriptive Statistic of cancer screening participation in the previous 12 months

	Breast		Cervical	
	Opportunistic or not fully rolled out organised	**Organised & fully rolled out**	**Opportunistic**	**Organised & fully rolled out**
Overall %	53%	58%	55%	41%
Age group				
20-29	-	-	55%	46%
30-39	-	-	57%	48%
40-49	74%	-	60%	45%
50-59	58%	65%	59%	34%
60-69	45%	59%	48%	26%
70-74	29%	47%	-	-
Socio-economic group				
Professionals; Business owners; Higher managers	64%	55%	61%	41%
Intermediate managerial; junior non-manual	52%	63%	60%	44%
Non Professionals, Service job; State job	51%	53%	59%	36%
Semi-skilled	53%	58%	48%	38%
Never worked	48%	57%	44%	38%
Age finished schooling				
Ages 22-25	44%	60%	63%	45%
Ages 19-21	57%	66%	62%	44%
Ages 17-18	57%	56%	56%	38%
Ages 15-16	51%	52%	54%	36%
Ages 10-14	53%	59%	42%	26%
Marital Status				
Married	57%	65%	59%	43%
Single, divorced or widowed	47%	48%	48%	37%

Table 4: Multivariate Analysis using Logistic Odds Ratios and Wald joint significance statistic

	Breast		Cervical	
	Opportunistic or not fully rolled out organised	**Organised & fully rolled out**	**Opportunistic**	**Organised & fully rolled out**
	1196	**1027**	**3689**	**1336**
Age group				
20-29	-	-	0.73**	2.00**
			(0.10)	(0.48)
30-39	-	-	0.86	1.97***
			(0.09)	(0.32)
40-49	0.89	-	1.01	1.76***
	(0.27)		(0.10)	(0.28)
50-59	1	1	1	1
60-69	0.61***	0.77*	0.54***	0.88
	(0.08)	(0.11)	(0.07)	(0.21)
70-75	0.14***	0.32***	0.18***	-
	(0.07)	(0.10)	(0.07)	
Socio-economic group				
Professionals; Business owners; Higher managers.	1	1	1	1
Intermediate managerial; junior non-manual.	0.69	1.12	0.91	1.11
	(0.16)	(0.26)	(0.11)	(0.22)
Non Professionals, Service job; State job.	0.63*	0.75	0.95	0.81
	(0.15)	(0.18)	(0.12)	(0.17)
Semi-skilled.	0.73	0.90	0.75**	0.94
	(0.17)	(0.22)	(0.09)	(0.21)
Have never worked.	0.51**	1.03	0.64***	0.86
	(0.14)	(0.34)	(0.09)	(0.40)
Health				
Fair or poor	1	1	1	1
Good or excellent	1.02	1.01	1.19**	1.13
	(0.14)	(0.15)	(0.11)	(0.17)
Age finished schooling				
22-25	1	1	1	1
19-21	1.18	1.36	0.87	1.11
	(0.32)	(0.37)	(0.11)	(0.18)
17-18	0.91	1.06	0.66***	0.87
	(0.22)	(0.27)	(0.08)	(0.16)
15-16	0.71	1.04	0.62***	0.90
	(0.18)	(0.28)	(0.08)	(0.17)
10-14	0.86	1.61	0.60***	0.70
	(0.23)	(0.47)	(0.08)	(0.27)
Marital Status				
Single, divorced or widowed.	1	1	1	1
Married.	1.35**	1.61***	1.42**	1.42**
	(0.16)	(0.23)	(0.10)	(0.1442)
Wald Test Statistic socio-economic group.	chi2(4) = 6.90 P>chi2 = 0.141	chi2(4) = 5.11 P> chi2 = 0.270	chi2(4) = 12.90 P> chi2= 0.011	chi2(4) = 4.82 P> chi2 = 0.306
Wald Test Statistic f age finished schooling.	chi2(4) = 4.16 P>chi2 = 0.384	chi2(4) = 6.46 P> chi2 = 0.167	chi2(4) = 18.33 P> chi2= 0.000	chi2(4) = 2.07 P> chi2 = 0.557

Standard errors in brackets.

* significant to the 90 percentile; ** significant to the 95 percentile; *** significant to the 99 percentile

Appendix

The variables presented in this study were based upon data from the EU-15 member states in the large population-based survey Eurobarometer "Health in the European Union" 66.2 (2006). This Eurobarometer was carried out at the end of 2006 and surveyed participants on whether they had a breast or cervical cancer test in the previous 12 months. Data was restricted to individuals in the age range screened within each individual country as these ages varied within the EU-15 countries.

Table A1: Variable Definition and sources

Variable	Definition
Socio-economic groups	Within the Eurobarometer "Health in the European Union" 66.2 (2006) dataset, individuals were categorised into 19 distinctive occupations. Five socio-economic groups were constructed using an individual's current or previous occupation from this occupation scale.
1) Socio-economic group 1	Professional (lawyer, medical practitioner, accountant, architect); Business proprietors, owner (full or partner) of a company; Owner of a shop, craftsmen; Employed professional (employed doctor, lawyer, accountant, architect); General management, director or top management (managing directors, director general, other director).
2) Socio-economic group 2	Middle management, other management (department head, junior manager, teacher, technician); Employed position, in a service job (hospital, restaurant, police, fireman).
3) Socio-economic group 3	Employed position at a desk; Employed position, not at travelling (salesmen, driver).
4) Socio-economic group 4	Agriculture worker; Lower supervisor; Manual worker; Unskilled worker.
5) Socio-economic group 5	Never did any paid work.
Years of schooling	The survey questioned an individual about the year they left full time education. Individuals who left before the age of ten and those who continued after the age of 25 were excluded from analysis.
1) Age 10-14	Finished schooling aged 14 or less.
2) Age 15-16	Finished schooling between the ages of 15 and 16.
3) Age 17-18	Finished schooling between the ages of 17 and 18.

4) Age 19-21	Finished schooling between the ages of 19 and 21.
5) Age 22-25	Finished schooling aged 22 or more.
Age group of individual	Using the exact age, Individuals were categorised into 5 yearly age groups. 20-24; 25-29; 30-34; 35-39; 40-44; 45-49; 50-54; 55-59; 60-64; 65-69 and 70-74
Marital status	A dichotomous variable was constructed for marital status. If the individual was married a value of 1 was assigned. If the individual was single, divorced or widowed a value of 0 was assigned.
1) Married	An individual is married.
2) Single, divorced or widowed	An individual is single, divorced or widowed
Self reported health	Eurobarometer enquired about the self reported health of the individual. A dichotomous variable was constructed. If the individual reported very good or good general health a value of 1 was assigned. If the individual reported fair, bad or very bad a value of 0 was assigned.
1) Very good or good	An individual reports general health to be very good or good
2) Neither good nor bad, bad or very bad	An individual reports general health to be neither good nor bad, bad or very bad
Urban or rural	Eurobarometer asked whether the individual lived in a rural area or village, small town or large town. A dichotomous variable was constructed. If an individual lived in a small town or large town a value of 1 was assigned. If an individual lived in a rural area or village a value of 0 was assigned
1) Urban	An individual lives in a small or large town
2) Rural	An individual lives in a rural area or village
Country of residence	Individuals were questioned with regards to whether they were born in the country in which they currently lived. A dichotomous variable was constructed. If an individual was born within the country of residence a value of 1 was assigned. If an individual was born outside the country of residence a value of 0 was assigned.
1) Born in resident country	An individual was born within the country of residence
2) Immigrant	An individual was born outside the country of residence