Social Inequalities and Cancer
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Socioeconomic status and cancer screening

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The only widely applied cancer screening programmes are those for cancers of the cervix and female breast. Participation in breast cancer screening has been shown to depend on income and education, health insurance and type of health service. Women in low social classes tend to have lower screening participation rates than those in higher classes. Socioeconomic differences in screening practices tend to decrease when participation is promoted, cultural and economic barriers are removed, and social support is offered. In both developed and developing countries, women of low socioeconomic status have a higher than average risk of cervical cancer, and a lower than average participation in Pap smear screening.

There is substantial agreement within the scientific community on the efficacy of mammographic screening for breast cancer and of cytological screening for cancer of the cervix uteri. It is usually recommended that mammography is carried out every two years in women of age 50–70 years, and that cytology is performed every three years in women of age 25–64 years, although different policies have been proposed and adopted by scientific societies or national institutions.

The experimental evidence of the efficacy of faecal blood screening (Mandel *et al.*, 1993), as well as the observational evidence of the efficacy of rectosigmoidoscopy and total colonoscopy (Atkin *et al.*, 1992; Newcomb *et al.*, 1992; Selby *et al.*, 1992; Winawer *et al.*, 1993), in reducing colorectal cancer mortality are convincing but there is yet no consensus over efficient screening policies. There is still little evidence of efficacy of screenings for other cancers such as those of the lung, stomach and urinary bladder, and recommendations and policies vary across countries.

In this article I examine the association between socioeconomic status and screening for cancers of the breast and the cervix uteri. Differences in screening by social class have also been reported for other cancers, such as colon cancer and melanomas (Myers *et al.*, 1990; Vernon *et al.*, 1989; Meade *et al.*, 1994; Koh *et al.*, 1991; Anderson *et al.*, 1995).

Systematic comparisons of mortality and use of screening across countries is of limited value, particularly if the national income, health care system, local screening policies and quality of screening are not taken into account. Moreover, participation rates often are not measured uniformly.

The association of socioeconomic status and cancer screening attendance could, theoretically, be estimated by measuring the differences in cancer mortality (or incidence) by socioeconomic status, since variation in disease occurrence could be attributed to differential participation in screening programmes. In fact, it is difficult to provide such an estimate because attendees of screening programmes have different cancer risks compared with non-attendees, and data on both socioeconomic status and cancer risk are rarely available simultaneously for screened and unscreened population groups.

Cancer of the breast

Cancer of the breast is the most frequent tumour in the female population worldwide (Coleman *et al.*, 1993a). The populations at highest risk for breast cancer are those of western Europe and North America, where there is a more than fivefold higher incidence of the disease than in low-risk Asian countries.

Mortality and compliance in randomized trials

In the Health Insurance Plan (HIP) trial for breast cancer screening (Fink & Shapiro, 1990), the incidence in non-compliers of the intervention group after 10 years from entry was 84% of that in compliers (1.89 per 1000 person years versus 2.24 per

1000, respectively) and the mortality in non-compliers was 96% of that in compliers (0.49 per 1000 person years versus 0.51 per 1000, respectively). Women who refused to participate were less educated and older than participants. In the Edinburgh trial (Roberts *et al.*, 1990), breast cancer mortality increased with increasing socioeconomic status in the control population. In the study population, the findings were less clear: mortality was decreased by 44% in women of the highest socioeconomic status, increased by 29% in women of medium status, and decreased by 10% in women in the lowest socioeconomic category. These data are compatible with a differential effect of screening in groups of different socioeconomic status, with most benefit observed for those of the highest socioeconomic status.

Compliance to mammographic screening

In a review of the participation in breast cancer screening programmes in North America (Vernon *et al.*, 1990), socioeconomic status measured through education and through occupation of the head of household were positively associated with participation in mammographic screening. The social class and age distributions of invited attendees and non-attendees were more similar to each other and to census data than to the distributions for women who came as a result of self-referral.

In the United States of America, a survey by the NCI Breast Cancer Screening Consortium (1990) found that women with less than high-school education or an income less than US$ 15 000 had fewer mammograms than their better-educated or wealthier counterparts. In the seven studies examined, the differences ranged between 11% and 18% for education, and 5% and 12% for income.

In two other studies in the USA, adherence to screening guidelines was found to vary with income: it was increased significantly among women with an annual household income between US$ 25 000 and US$ 49 000 and equal to or over US$ 50 000 (Romans, 1993), or over US$ 15 000 (Zapka *et al.*, 1989), compared with women of lower income.

In Quebec, Canada in 1987, income was not associated with the recency of mammography, but education above high-school level was a significant predisposing factor [odds ratio (OR) = 1.6; 98% confidence interval (CI) = 1.1–2.4] (Potvin *et al.*, 1995). The absence of an association by income is, in part, explained by the universal third-party payer health care system adopted in Quebec. However, despite a similar health care system in Ontario, Canada, the OR for mammographic screening within the previous two years in the higher-income (at least US$ 45 600) group was 1.8 (95% CI = 1.3–2.6) in 1990 compared with the lower-income group In the USA in the same year and for the same income the OR was 2.8 (95% CI = 2.3–3.2).

In the USA, cost is an important barrier for the use of mammography. Uninsured women, smokers, and women who do not visit a physician regularly may have relatively low rates of use of mammography (Urban *et al.*, 1994), even in the presence of mandatory coverage of screening.

In a study carried out in Northern Ireland (Kee *et al.*, 1992), a higher proportion of attendees (53%) than non-attendees (39%) of mammographic screening used a private car.

Data from a population-based case–control study in Costa Rica (Irwin *et al.*, 1991) indicate that 59% of the most educated or 25% of wealthy women underwent physical examination of the breast compared with 21% of illiterate and 35% of poor women.

In Canada, women living in rural areas had the same basic knowledge of breast cancer screening and similar access to physician care as women in urban areas. Despite this, the prevalence rate ratio, adjusted for age, education, income and marital status, was 0.47 (95% CI = 0.37–0.62) among rural women for having had a mammographic examination in the past two years, compared with urban women (Bryant & Mah, 1992).

The opposite pattern is seen in Europe. In rural areas of Italy, the participation in organized screening programmes is over 70% compared with around 50% in cities (Giordano *et al.*, 1996). In the United Kingdom, participation in the National Breast Screening Programme is lower in urban areas. In a population sample of inner London, the compliance was 42% versus more than 70% in the country (Sutton *et al.*, 1994).

In the USA, findings of the National Health Interview Surveys indicate that race does not seem to be associated with the use of mammography (Breen & Kessler, 1994): 33% of White women reported being screened in 1990 versus 32% of Black and 31% of Hispanic women. In contrast, highest

educational and income levels are significantly associated with mammographic screening as well as urban area of residence compared with rural area of residence: the differences are 18% between more than 12 years of schooling and less than 12 years of schooling, 15% between an income of more than US$ 20 000 and an income of less than this amount, and 9% between urban and rural residence.

Reported breast cancer screening in the USA increased between 1987 and 1992 from 23% to 49% (Anderson *et al.*, 1995). The difference in reported mammography between Black and White women disappeared (50.4% versus 48.8% in 1992, and 19% versus 23.2% in 1987, respectively), but participation in mammography by educational levels still ranged in 1992 from 61% for more than 12 years of schooling, to 52% for 12 years of schooling, and to 35.5% for less than 12 years of schooling (Anderson *et al.*, 1995).

In Arizona, where a Medicaid-type programme was proposed to poor women, 54% of such women had had a mammogram within the last two years, compared with 50% of women with other types of health insurance and 9% of women with no insurance (Kirkman-Liff & Kronenfeld, 1992). Differences by level of education and ethnicity were still important, with the less educated and Hispanic women being less screened. Similar results were obtained in New York, USA among women users of county-funded health centres: the screening rates of such women were not lower than those in the community sample, despite the significantly lower socioeconomic level of the former group (Lane *et al.*, 1992).

No differences in mammographic screening have been detected for education and race among a random sample of working women who were members of a health maintenance organization (HMO) (Glanz *et al.*, 1992). Overall, 85% had had a mammogram.

In Italy, the compliance to mammographic screening by socioeconomic status and educational level tended to be similar in women who were actively invited by organized screening programmes (Ciatto *et al.*, 1992). Compliance may sometimes be higher in less-educated women: Donato *et al.* (1991) reported that the proportion of women with only an elementary-school level of education was 60% among attendees and 49% among non-attendees. In contrast, the higher the education, the higher is self-referral to mammographic screening: 19% of women with high-school education or a university degree came to screening without invitation versus 11% of women with less than a high-school education (Segnan *et al.*, 1990).

Increasing the participation

Many projects have been promoted with the aim of increasing participation in breast screening programmes. The targets have been African-American women (Kang *et al.*, 1994), rural Black women (Eng, 1993), Hispanic American women (Zapka *et al.*, 1993), poor elderly Black women (Mandelblatt *et al.*, 1993a, 1993b), and entire communities (Fletcher *et al.*, 1993). Generally, all these intervention studies were successful in increasing participation in breast cancer screening, although the coverage was lower than the 80% objective set by the United States National Cancer Institute for breast cancer screening. However, in the Florida project, sponsored by the American Cancer Society for breast cancer detection, promotion through the media and provision of low-cost mammograms missed members of minority groups and the socioeconomically disadvantaged, who have a higher incidence of late-stage disease at diagnosis (Roetzheim *et al.*, 1992). These groups were underrepresented, and a significantly higher proportion of White, high-school- or college-educated, higher-income women had a mammography for the first time.

Preventable breast cancer deaths

An estimate of the effect of breast cancer screening participation in reducing socioeconomic status differences in breast cancer mortality can be only empirical. Data on compliance to breast cancer screening by socioeconomic status could be used for estimating the risk of breast cancer that can be attributed to lack of participation in screening across different socioeconomic status categories. We would have to consider, however, that the risk for breast cancer and the stage at diagnosis are different by socioeconomic status, and that increases of breast cancer incidence due to screening have been observed. Moreover, it is likely that the values of these factors are not constant within risk and socioeconomic status strata. Assuming a potential 30% mortality reduction in a population that is fully screened, we can estimate that out of every

Table 1. Preventable fraction of invasive cervical cancer cases by different screening policies and by compliance

Screening interval	Age cycles	Preventable fraction[a]	Compliance						
		1.00	0.30	0.40	0.50	0.60	0.70	0.80	0.90
1 year	20–64	0.93	0.28	0.37	0.47	0.56	0.65	0.75	0.90
3 years	20–64	0.91	0.27	0.36	0.46	0.55	0.64	0.73	0.82
3 years	25–64	0.90	0.27	0.36	0.45	0.54	0.63	0.72	0.81
5 years	25–64	0.82	0.25	0.33	0.41	0.49	0.57	0.65	0.74

[a]From Day, 1996.

1000 deaths from breast cancer among women aged 50 or over at diagnosis, 300 would be preventable. Therefore, every 1% of compliance would prevent three deaths. This empirical estimate indicates that the differences in breast cancer screening compliance observed between women of different socioeconomic status can have an appreciable effect on socioeconomic status differences in breast cancer mortality.

Cancer of the cervix uteri

Cervical cancer is the second most common cancer in females, representing 15% of all cancers. However, 80% of cervical cancers are diagnosed in developing countries (Coleman *et al.*, 1993b). The risk of cervical cancer varies by a factor of 20, the cumulative 30–74 years risk ranging from 7% in Cali, Colombia to 0.35% in the non-Jewish population of Israel. In 1986, it was estimated that in developing countries less than 5% of women, mainly women under 35 years of age, had been screened within the previous five years (WHO, 1986). In industrialized and developing countries, an inverse correlation exists between socioeconomic status and the incidence of cervical cancer (see the chapter by Faggiano *et al.* in this book).

Preventable invasive cervical cancers

Data from eight screening programmes in developed countries indicate that the relative protection provided in women with two or more negative tests at three to five years of follow-up is a three to five times lower risk than in unscreened women (Day, 1986). An overall estimate of the preventable fraction of invasive cervical cancer in developed countries (Day, 1986) ranges from 82% for screening eight times every five years between the ages of 25 and 64 years to 93% for screening every year between the ages of 20 and 64 years (Table 1). Yearly testing increases the percentage of preventable invasive cancers only marginally, and much less so than an increase in compliance does. The percentage of preventable invasive cancer cases is a third lower (47% versus 73%) with yearly testing and 50% compliance compared with testing every three years with 80% compliance. In the latter scenario, the number of tests are almost half (80 versus 150 per 100 women per three years) that in the former (Table 1).

The effect of different screening policies on the cumulative incidence of cervical cancer at ages 20–64 years was estimated using data from 30 cancer registries with the world's highest rates (Parkin *et al.*, 1992) and the estimates of rate reductions of the IARC Working Group (Day, 1986) (Table 2). Even very low-intensity programmes with two to four tests per lifetime every 10 years can reduce the incidence of cervical cancer by 40–60%, if compliance is 100%. Some European countries or regions and North American subpopulations show a high cumulative incidence, suggesting low coverage and/or ineffective screening policies.

Cervical screening availability and attendance

A survey undertaken in 1991 indicated that the number of Papanicolaou (Pap) tests in European Community countries was sufficient to screen all women of age 25–64 years (Coleman *et al.*, 1993a). Despite this, 22 000 new cancer cases are diagnosed

Table 2. Effects of different screening policies on the 20–64 years cumulative incidence (CI) of cervical cancer per 10^5 women in the areas of 30 cancer registries with the highest world rates

Interval	–	10 years		10 years		5 years	
Age (years)	–	45-64		25-64		20-64	
No. of tests per lifetime	None	2		4		9	
Reduction in rate (%)		43[a]		61[a]		84[a]	
Registry	CI[b] 20–64 per 10^5	CI 20–64 per 10^5	No. of cases prevented by 10^5 Pap tests	CI 20–64 per 10^5	No. of cases prevented by 10^5 Pap tests	CI 20–64 per 10^5	No. of cases prevented by 10^5 Pap tests
India, Madras	4050	2309	871	1580	618	648	378
Peru, Trujillo	3900	2223	839	1521	595	624	364
Paraguay, Asuncion	3860	2200	830	1505	589	618	360
Brazil, Goiania	3350	1910	720	1307	511	536	313
Colombia, Cali	3110	1773	669	1213	474	498	290
Ecuador, Quito	2630	1499	565	1026	401	421	245
India, Bangalore	2540	1448	546	991	387	406	237
Thailand, Chiang Mai	2400	1368	516	936	366	384	224
Brazil, Porto Alegre	2310	1317	497	901	352	370	216
New Zealand: Maori	2190	1248	471	854	334	350	204
Canada, Manitoba	2140	1220	460	835	326	342	200
Philippines, Manila	2030	1157	436	792	310	325	189
Mali, Bamako	2000	1140	430	780	305	320	187
Thailand, Khon Kaen	1969	1122	423	768	300	315	184
Costa Rica	1900	1083	409	741	290	304	177
France, Martinique	1880	1072	404	733	287	301	175
Poland, Lower Silesia	1860	1060	400	725	284	298	174
India, Ahmedabad	1790	1020	385	698	273	286	167
Bermuda: Black	1770	1009	381	690	270	283	165
East Germany	1740	992	374	679	265	278	162
India, Bombay	1580	901	340	616	241	253	147
Cuba	1570	895	338	612	239	251	147
Philippines, Rizal	1550	884	333	605	236	248	145
Poland, Cracow City	1550	884	333	605	236	248	145
Hong Kong	1550	884	333	605	236	248	145
Portugal, V N de Gaia	1470	838	316	573	224	235	137
USA, Los Angeles	1460	832	314	569	223	234	136
Singapore: Chinese	1410	804	303	550	215	226	132
Japan, Hiroshima	1390	792	299	542	212	222	130
Canada, Newfoundland	1380	787	297	538	210	221	129
Czech., Boh. & Morav.	1370	781	295	534	209	219	128

[a]From Day, 1986.

[b]From Parkin *et al.*, 1992.

every year in these countries. It has been estimated that in a Danish county, 42% of the screening resources are not used in accordance with the national recommendations, indicating a waste of resources (Coleman *et al.*, 1993a). It is estimated that over 80% of patients with invasive cervical cancer in northern England have never been screened (Gillam, 1991).

In the USA, the proportion of women older than 17 years who self-reported having had a Pap smear within the last 12 months was two-thirds, with an additional 10% reporting a Pap smear within the last 13–24 months. A higher proportion of Blacks than Whites had had the test in the previous year, as well as younger women and women with higher household income (Ackermann *et al.*, 1992). In the National Health Interview Surveys in 1987 and 1992 (Anderson *et al.*, 1995), women with more than high-school education, women living above the poverty level, and women residing in urban areas reported more cervical cancer screening in the last three years than did their counterparts. In 1987, screening was reported by 47% of women with less than 12 years of education, compared with 74% of women with more than 12 years education. In 1992 these percentages were 49% and 76%, respectively.

Among a random sample of women from an area in North America with 20% higher mortality rates of cervical cancer, 44.1% reported not having received adequate Pap testing during the previous four years. These women were more likely to be old, to be without medical insurance, to have never been to an obstetrician/gynaecologist and to have less knowledge of risk factors for cervical cancer (Mamon *et al.*, 1990).

In Arizona, where a Medicaid-type programme was proposed to poor women, 73% of such women had had a Pap smear within the last two years, compared with 70% of women with other types of health insurance and 44% of women with no insurance (Kirkman-Liff & Kronenfeld, 1992). However, Latino women, of age 60–70 years, had made significantly lower use of Pap smear tests (OR = 0.56).

In a random sample of women of age 18–69 years in Turin, Italy, the ORs for having ever had a Pap test, adjusted for marital status, age and place of birth, were 7.6, 6.0 and 2.6 ($P < 0.05$) for different levels of education, ranked from high to low (Ronco *et al.*, 1991). In the area of Milan, Italy, the proportion of hospital controls who had had more than three Pap tests during their life was 12% higher in the highest social class ($P = 0.05$) compared with the lowest (Parazzini *et al.*, 1990).

In Costa Rica (Irwin *et al.*, 1991), 77% of educated women had had at least one Pap smear taken in their life compared with 54% of illiterate women. In four different Latin American countries in a case–control study on screening effectiveness for cervical cancer (Herrero *et al.*, 1992), the proportion of hospital controls never screened ranged from 45% in illiterate women to 15% in women with 10 years of school education or more.

A proportion of women as high as 32% are lost to follow-up before assessment of a detected cytological abnormality (Robertson, 1988). In an observational study in Victoria, Australia two groups of women were advised to have a repeat smear after three or six months (Mitchell & Medley, 1989). The non-compliers were 10% and 18%, respectively. In the three-month group, 17% of women of lowest social class did not comply, versus 7–8% of women in other social classes. No difference with social class was detected in the six-month group.

Conclusions

Differences by socioeconomic status in breast cancer screening practices tend to disappear or to decrease when participation is promoted, cultural and economic barriers are removed, and social support is offered. Organized screening programmes, adopting personal invitation instead of self-referral are more successful in this regard and are more cost-effective. Increased participation in breast cancer screening by women of low socioeconomic status in developed countries can be partly achieved by removing economic barriers (that is, the need for women to pay totally or partially for mammography), and in all countries by tailored programmes that promote knowledge and awareness of potential benefits and disadvantages of breast cancer mammographic screening. A high priority in developing countries seems to be to reduce the proportion of late-stage breast cancers at diagnosis and to offer adequate care to symptomatic cases: without an effective therapy, mammographic screening not only would add extra costs but also would be ineffective.

For cervical cancer, women of low socioeconomic status have a higher than average risk and a lower than average participation in screening. Increasing universal coverage is not sufficient to overcome the large disparities in the use of cancer screening procedures. Nevertheless, increasing attendance, and introducing rational screening policies, will help to reduce health inequalities. In developing countries, low-intensity, highly effective screening policies should be introduced before spontaneous – and usually irrational and frequent – cervical

screenings become rooted; such screening practices already exist in richer areas and reproduce discrimination by socioeconomic status as well as waste resources.

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