Social inequalities in breast cancer mortality among French women: disappearing educational disparities from 1968 to 1996.

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Running title: Time trends in social inequalities in breast cancer mortality

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Abstract

The aim of this study was to investigate time trends in social inequalities in breast cancer mortality with an analysis by age at death and birth cohort. We used a representative sample of 1% of the French population and studied four subcohorts (1968-74, 1975-81, 1982-88, 1990-96). Causes of death were obtained by direct linkage with the French national death registry. Education was measured at the beginning of each period, and educational disparities in breast cancer mortality were studied among women aged 35-74 at the beginning of each period. In the 1970s higher breast cancer mortality was found among higher educated women. This positive association progressively weakened and no association remained in the 1990s. This association disappeared earlier among younger women. When the analysis was conducted according to birth cohort, the same pattern was found among women born before 1925 whereas no association between education and mortality was observed among women born after 1925. Educational disparities in breast cancer mortality are currently changing. The positive gradient observed in the past is disappearing. An important question is whether this signals the first phase of a reversing from positive to negative association between education and breast cancer.

Key words: Breast cancer, mortality, age at death, birth cohort, education, time trends

Introduction

Breast cancer is the leading cause of cancer mortality among women in most industrialized countries (Ferlay et al., 2004). Contrary to most causes of death, higher breast cancer mortality risks are often observed among women with the highest socioeconomic status (Dano et al., 2003;Dano et al., 2004;Faggiano et al., 1997;Heck et al., 1997); however, some studies find no association between socioeconomic status and breast cancer mortality (Faggiano et al., 1997;Lund and Jacobsen, 1991).

Most breast cancer risk factors (reproductive behaviour, diet or physical activity) (Dos Santos Silva and Beral, 1997;Potter, 1997) and factors related to cancer survival (screening, treatment) (Auvinen and Karjalainen, 1997;Segnan, 1997) are associated with socioeconomic status and their social distribution may have changed over time. These changes may have induced changes in social inequalities in breast cancer mortality. However, the few studies investigating time trends in social inequalities in breast cancer mortality showed a decrease in socioeconomic disparities (Martikainen and Valkonen, 2000;Wagener and Schatzkin, 1994). Investigating time trends in social inequalities is important to improve our knowledge of social inequalities in breast cancer mortality and to adapt prevention policies to the target population.

The aim of this study was to investigate time trends in social inequalities in breast cancer mortality among women in France during the period 1968-1996, with analyses by age at death and birth cohort.

Materials and methods

In 1968, the French National Statistics Institute (INSEE) created a longitudinal population study (the "permanent demographic sample" or EDP), which represented roughly 1% of the French population. The sample includes all persons born on one of four specific calendar dates every year and is regularly updated to include new subjects with these birthdays (births and immigration). Data are updated at each successive census (1968, 1975, 1982, 1990). INSEE supervises the keeping of vital records thus vital status is also systematically monitored for EDP subjects (Rouault, 1994). Causes of death were obtained by linkage with the French national death registry (INSERM-CepiDc).

Four subcohorts, each covering a 7-year period, were studied (1968-74, 1975-81, 1982-88, 1990-96). Each subcohort began the year of a census and included all deaths during the following 7 years.

Women eligible for each subcohort were those who responded to the census marking the beginning of the period and were aged 35-74 at that time. Women born outside metropolitan France (around 15% at each census) were excluded because their vital status was not adequately recorded, especially for foreigners who died abroad. Women for whom data were inconsistent (less than 50 at each census) were also excluded. The cause of death was identified for 95% of those who died in the 1968-74 period and 98% of those who died in later time periods. Analysis focused on breast cancer mortality (International Classification of Diseases 8-9 174). In the end, the analysis included 94 734 women in 1968, 99 737 women in 1975, 100 898 women in 1982 and 112 066 women in 1990.

Socioeconomic status was measured by educational level, as reported at the time of the census. Educational level was defined as the highest level achieved, according to the CASMIN classification grid, which is designed to provide a scale for international comparisons (Brauns and Steinmann, 1999). We used the following categories: incomplete elementary education (CASMIN level 1a), completed elementary education (CASMIN level 1b), secondary and intermediate general and vocational qualifications (CASMIN level 1c, 2a, 2b) and high school and higher education (CASMIN level 2c, 3a and 3b).

Relative risks (RR) were computed with Cox proportional hazards models for each period, using women with the highest educational level as the reference category. Whereas RR are easy to interpret, comparisons of RR over time are complicated by the possibility that the distribution of educational level in the population may change over time, that is, that some groups may grow larger while others become more marginal. The use of the Relative Index of Inequality (RII) as a measure of social inequalities overcomes this problem. This index provides a continuous measure of social inequalities that simultaneously takes into account the size and relative position of social groups. The RII measures the degree of inequality across the socioeconomic hierarchy. The RII can be interpreted as the change in mortality when moving from the top to the bottom of the social scale (Davey Smith et al., 1998;Mackenbach and Kunst, 1997;Pamuk, 1985). It differs from the relative risk, which only gives the ratio between two groups at either end of the socio-economic range, without taking into account what occurs between these two groups. RIIs were calculated using the following analytic procedures. A new socioeconomic index was assigned to each individual, equal to the proportion of the population

with an educational level higher than that of the subject. This is therefore a continuous index, with a value of 0 for someone at the top of the social scale and 1 for a person at the bottom. To obtain the RII, a Cox regression model was then used to regress mortality on this new socioeconomic index. In all Cox regression models, age was used as the time scale variable.

We first studied social inequalities in breast cancer deaths among all women. Additional analyses were conducted: 1) an analysis according to age at death, categorized into three categories (less than 50 years old, 50-64, 65 and more); 2) an analysis according to birth cohort, considering two birth cohorts (born before or in 1925 and born after 1925). The cut point for birth cohort was the midpoint in years of birth for all women included in the analyses (when the four periods were considered).

For each period, we calculated mortality rates among all women adjusted for age by direct standardization, using the total female person-years for the period 1968 to 1996 as the standard. Mortality rates were also calculated among women with the highest and the lowest education level, according to age at death (less than 50 years old, 50-64, 65 and more). Given the small number of deaths in some groups, only crude mortality rates were computed in these analyses.

Results

The educational level of French women strongly increased throughout the study period (Table 1): the proportion of women who completed high school or higher education increased from 6.5% to 18.2%, while the proportion of those who did not complete elementary school was halved. The changes were particularly pronounced between the third (1982-1988) and the fourth period (1990-1996). The proportion of women with only general elementary education decreased slightly throughout the study period. The proportion of women with a vocational education increased regularly between 1968 and 1990.

Among all women, changes in social inequalities were observed throughout the study period (Table 2). During the first period (1968-1974), RRs were significantly lower than 1 for all educational levels when compared with women with the highest education level. This positive gradient progressively weakened and no association between education and mortality was found during the last period (1990-1996). The RII moved toward 1 throughout the study period. It was statistically significantly lower

than 1 (or borderline significant) during the three first periods, and did not significantly differ from 1 during the last period (1990-1996). Age-adjusted mortality rates increased throughout the study period.

A similar pattern was observed when analyses were conducted according to age at death (Table 3): there was a positive association between education and mortality at the beginning of the study period and that association progressively disappeared. Among women aged 35-49, this positive association was observed only during the first period (1968-1974); the RIIs were around 1 for the following 3 periods. However, analyses were conducted on relatively small samples, especially for the first period (1968-1974). This positive association was observed until 1988 among women aged over 65. Among women aged 50-64 it was found only in the first two periods, although it was not significant in the second one (1975-1981).

The situation differed according to birth cohort (Table 3). Among women born before 1925, a positive association between education and mortality was found during the first three periods. No association remained in the last period (1990-1996). Among women born after 1925, no association was seen whatever the period considered. The analysis could not be conducted for the first period because of the small number of deaths.

Crude mortality rates among women with the lowest and the highest education levels (incomplete elementary education and high school and higher education) are presented according to age at death (Figure 1). Over the study period, rates increased among women with a lower education level in all age groups. The pattern is less clear among women with a high education level but a sharp decrease in mortality rates is noted between the first (1968-1974) and the second period (1975-1981). Even if confidence intervals overlap, the association reversed throughout the study period. During the first period (1968-1974), the highest rates were observed among highly educated women. Then the rates intersected. This occurred in the 1970s among women aged 35-49, in the early 1980s among women aged 50-64 and in the 1990s among women aged 65 and more. At the end of the study period, rates among women with high and low education levels were close, although they were slightly higher among less educated women.

Discussion

This study provided a unique opportunity to investigate time trends in educational disparities in breast cancer mortality: the study population is a large, representative sample and individual date on socioeconomic status and specific cause of death was obtained from the same source for all subjects, irrespective of their vital status. Thus these results are not affected by the numerator/denominator bias inherent to studies in which information on education is obtained from different sources for the deceased and for the living population (Kunst et al., 1998).

Coding for educational level in the census changed slightly in 1990. Some degrees classified as professional education until 1982 were grouped with high school and higher education in 1990. This may lead to a slight underestimation of the inequalities associated with educational level for the last period. This change in classification occurs for only a small proportion of degrees and consequently probably does not substantially bias the results.

This study gives new insights into both social inequalities in breast cancer mortality and into time trends in breast cancer inequalities in France. We computed RRs, RIIs and mortality rates and conducted analyses among all women, according to age at death, and according to birth cohort. All the analyses gave consistent results. We found that educational differences in breast cancer mortality decreased in France between 1968 and 1996. A positive association was observed in the 1970s that progressively weakened and no association remained in the 1990s. This association disappeared earlier among younger women. This pattern was found among women born before 1925 whereas no association between education and mortality was observed among women born after 1925.

Some studies investigating time trends in social inequalities reported results on breast cancer. These studies conducted relatively crude analyses and found that the positive association between socioeconomic status and breast cancer mortality appeared between 1981 and 1991 (McLoone and Boddy, 1994) or remained between 1959-72 and 1982-96 (Steenland et al., 2002). Two studies conducted in Finland and in the US focused on time trends in social inequalities in breast cancer mortality (Martikainen and Valkonen, 2000;Wagener and Schatzkin, 1994). Although the Finnish

study used individual data on education whereas the American study used an ecological measure, both studies showed a decrease in social disparities . Our results are in agreement with these findings. During the last decades, educational level among women strongly increased in all industrialized countries (Martikainen and Valkonen, 2000). The two studies just mentioned computed mortality rates without controlling for this change. Our results show that even when this phenomenon is taken into account (by the use of RII as the measure of social inequalities), social disparities decreased over time.

There are several possible explanations for our findings. Changes in the social distribution of risk factors and in the association between education and risk factors may have occurred throughout the study period . Breast cancer is a multifactorial disease. Reproductive factors, diet, alcohol consumption, excess weight, physical activity and genetic factors (family history of breast cancer) are all associated with breast cancer incidence (Hankinson et al., 2004;Hulka and Stark, 1995). Data on risk factors were not available in our study; therefore no firm conclusion can be drawn on their contribution to the observed time trends. Nevertheless, a study among French women suggests that changes in the distribution of reproductive factors by educational level may partly explain the decrease over time of educational disparities for breast cancer (Daguet, 2000). This study showed that parity decreased with the yezr of birth for women born between 1917 and 1949, and that the decrease in parity was more pronounced among women with lower education levels (Daguet, 2000).. Factors associated with cancer survival may also explain part of the time trends. We observed that, within each age group, educational disparities diminished over time. It may be a consequence of better prevention and treatment in recent years, which mostly benefited women with higher education levels. Indeed, studies found that women with higher education levels had better access to health care and prevention, as evidenced by the higher screening rates (use of mammography and breast examination) observed among highly educated women (Gupta et al., 2003;Heck et al., 1997;Katz et al., 2000;Remontet et al., 2003). This improves the relative position of these highly educated women in terms of mortality and thereby diminishes the social disparities in breast cancer mortality. In France, systematic screening with mammography began in 1990. Although it has not yet been evaluated in France until now, the

introduction of systematic screening is probably too recent to have had an impact on educational disparities during the last period (1990-1996).

Besides, there is some evidence that risk factors for breast cancer may differ for premenopausal and postmenopausal cancers (Hulka and Stark, 1995). Family history of breast cancer is particularly relevant for premenopausal cancers, whereas reproductive and behavioural risk factors are generally more important for postmenopausal cancers. Breast cancer mortality before the age of 50 may be considered as mortality due to premenopausal cancers. Differences in risk factors according to menopausal status could partly explain why we did not find any association between education and mortality among women aged less than 50 after 1975, whereas we observed more pronounced educational disparities among older women. The literature on educational disparities according to menopausal status is particularly scarce, but one study found a slightly steeper gradient among postmenopausal women (Braaten et al., 2004). We found no association between education and breast cancer mortality among women born after 1925. These women were aged 35-50 in 1975, 35-57 in 1982 and 35-65 in 1990. Breast cancer deaths occurring among this birth cohort were probably not all premenopausal cancers. Thus we can not attribute this lack of social inequalities among women born after 1925 to the lack of an association between socioeconomic status and premenopausal breast cancer mortality. Only one study investigated time trends in social inequalities according to birth cohort. It also found small educational differences in breast cancer mortality among women born after 1935 (Martikainen and Valkonen, 2000).

This study investigated time trends in social inequalities in breast cancer mortality. Results show that the positive association between education and breast cancer mortality progressively disappeared between 1968 and 1996, and was not observed among women born after 1925. It seems that women with lower education levels have now lost the more privileged position with regards to breast cancer mortality that they occupied in the past. An important question is whether this observed lack of an association will remain, or whether it signals the first phase of a reversing from positive to negative

association between education and breast cancer mortality in the future. More recent data are needed to investigate these questions.

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References

Auvinen A, Karjalainen S (1997) Possible explanations for social class differences in cancer patient survival. *IARC Sci Publ* **138**: 377-397

Braaten T, Weiderpass E, Kumle M, Adami HO, Lund E (2004) Education and risk of breast cancer in the Norwegian-Swedish women's lifestyle and health cohort study. *Int J Cancer* **110**: 579-583, doi: 10.1002/ijc.20141

Brauns H, Steinmann S (1999) Educational reform in France, West-Germany and the United Kingdom: updating the CASMIN educational classification. *ZUMA-Nachrichten* **23**: 7-44

Daguet F (2000) L'évolution de la fécondité des générations nées de 1917 à 1949: analyse par rang de naissance et niveau de diplôme. *Population* **55**: 1021-1034

Dano H, Andersen O, Ewertz M, Petersen JH, Lynge E (2003) Socioeconomic status and breast cancer in Denmark. *Int J Epidemiol* **32**: 218-224, doi: 10.1093/ije/dyg049

Dano H, Hansen KD, Jensen P, Petersen JH, Jacobsen R, Ewertz M, Lynge E (2004) Fertility pattern does not explain social gradient in breast cancer in denmark. *Int J Cancer* **111**: 451-456, doi:10.1002/ijc.20203

Davey Smith G, Hart C, Hole D, MacKinnon P, Gillis C, Watt G, Blane D, Hawthorne V (1998) Education and occupational social class: which is the more important indicator of mortality risk? *J Epidemiol Community Health* **52**: 153-160

Dos Santos Silva I, Beral V (1997) Socioeconomic differences in reproductive behaviour. *IARC Sci Publ* **138**: 285-308

Faggiano F, Partanen T, Kogevinas M, Boffetta P (1997) Socioeconomic differences in cancer incidence and mortality. *IARC Sci Publ* **138**: 65-176

Ferlay, J, Bray, F, Pisani, P, and Parkin, DM. GLOBOCAN 2002: Cancer Incidence, Mortality and Prevalence Worldwide IARC CancerBase No. 5. 2004. Lyon, IARCPress.

Gupta S, Roos LL, Walld R, Traverse D, Dahl M (2003) Delivering equitable care: comparing preventive services in Manitoba. *Am J Public Health* **93**: 2086-2092

Hankinson SE, Colditz GA, Willett WC (2004) Towards an integrated model for breast cancer etiology: the lifelong interplay of genes, lifestyle, and hormones. *Breast Cancer Res* **6**: 213-218, doi: 10.1186/bcr921

Heck KE, Wagener DK, Schatzkin A, Devesa SS, Breen N (1997) Socioeconomic status and breast cancer mortality, 1989 through 1993: an analysis of education data from death certificates. *Am J Public Health* **87**: 1218-1222

Hulka BS, Stark AT (1995) Breast cancer: cause and prevention. *Lancet* **346**: 883-887

Katz SJ, Zemencuk JK, Hofer TP (2000) Breast cancer screening in the United States and Canada, 1994: socioeconomic gradients persist. *Am J Public Health* **90**: 799-803

Kunst AE, Groenhof F, Borgan JK, Costa G, Desplanques G, Faggiano F, Hemstrom O, Martikainen P, Vagero D, Valkonen T, Mackenbach JP (1998) Socio-economic inequalities in mortality. Methodological problems illustrated with three examples from Europe. *Rev Epidemiol Sante Publique* **46**: 467-479

Lund E, Jacobsen BK (1991) Education and breast cancer mortality: experience from a large Norwegian cohort study. *Cancer Causes Control* **2**: 235-238

Mackenbach JP, Kunst AE (1997) Measuring the magnitude of socio-economic inequalities in health: an overview of available measures illustrated with two examples from Europe. *Soc Sci Med* **44**: 757-771

Martikainen P, Valkonen T (2000) Diminishing educational differences in breast cancer mortality among Finnish women: a register-based 25-year follow-up. *Am J Public Health* **90**: 277-280

McLoone P, Boddy FA (1994) Deprivation and mortality in Scotland, 1981 and 1991. *BMJ* **309**: 1465-1470

Pamuk E (1985) Social class inequality in mortality from 1921 to 1972 in England and Wales. *Population Studies* **39**: 17-31

Potter J (1997) Diet and cancer: possible explanations for the higher risk of cancer in the poor. *IARC Sci Publ* **138**: 265-283

Remontet L, Esteve J, Bouvier AM, Grosclaude P, Launoy G, Menegoz F, Exbrayat C, Tretare B, Carli PM, Guizard AV, Troussard X, Bercelli P, Colonna M, Halna JM, Hedelin G, Mace-Lesec'h J, Peng J, Buemi A, Velten M, Jougla E, Arveux P, Le Bodic L, Michel E, Sauvage M, Schvartz C, Faivre J (2003) Cancer incidence and mortality in France over the period 1978-2000. *Rev Epidemiol Sante Publique* **51**: 3-30

Rouault D (1994) The Echantillon Démograhique Permanent: a French equivalent to the Longitudinal Study. *Update - News from the LS User Group* **January 1994**: 5-13

Segnan N (1997) Socioeconomic status and cancer screening. *IARC Sci Publ* **138**: 369-376

Steenland K, Henley J, Thun M (2002) All-cause and cause-specific death rates by educational status for two million people in two American Cancer Society cohorts, 1959-1996. *Am J Epidemiol* **156**: 11-21, doi: 10.1093/aje/kwf001

Wagener DK, Schatzkin A (1994) Temporal trends in the socioeconomic gradient for breast cancer mortality among US women. *Am J Public Health* **84**: 1003-1006