Trends in differential breast cancer mortality, Belgium 1991-1995 – 2004-2005

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Introduction

Breast cancer is the most common cause of death among women in industrialized countries. In the 2000s, Belgium had among the highest breast cancer incidence and mortality rate in Europe.

Differences in breast cancer are of particular interest. Unlike other causes of death, breast cancer shows a positive association with socio-economic status, especially educational level.[1-6] The picture is becoming more complex however. Recent studies have shown that the gradient in breast cancer mortality is moving from being positive to non-existent.[7-9]

This trend fuels the idea that social conditions are "*fundamental causes*" of health.[10-11]. Fundamental social causes *'embody access to important resources; they affect multiple disease outcomes through multiple mechanisms and consequently maintain an association with disease even when the intervening mechanisms change'* [10]. Individuals and groups faced by health treats use their resources and assets to avoid risks and to adopt protective strategies, no matter what the risk and protective factors are in given circumstances. That is why, whenever technology and knowledge are available to combat a particular disease, mortality from that disease will be lower in the higher socio-economic classes [11]. When technology and knowledge are not available, exceptions to this general pattern may occur. Lung cancer, for instance, used to be more prevalent among rich population groups, but once the health-damaging effects of smoking became clear, the relation reversed as higher classes began to control their smoking behaviour increasingly. Breast cancer may provide another example, the gradient moving from being positive, over non-existent to even negative, depending on the spread and implementation of effective treatments and screening programs.

The aim of this study is to investigate i) whether the social patterning of breast cancer in Belgium has changed direction between 1991-1995 and 2004-2005 and ii) the role of reproductive factors herein.

Our dataset is exhaustive and includes all cases of breast cancer mortality during the observation period in Belgium. To our knowledge only Nordic countries dispose of individual-linked data on breast cancer mortality, education and reproductive factors on a nationwide scale. The data for this analysis are thus quite exceptional outside the Nordic context.

Materials and methods
The data consist of (i) a linkage between the 1991 census and register information on survival status, emigration status and cause of death for the period 01/03/1991 - 31/12/1995 and (ii) a linkage between the 2001 census and register information on survival status, emigration and cause of death for the period 1/1/2004 – 31/12/2005.

The research population comprises all women aged 35 to 79. Each woman is classified by attained educational level and by fertility history (number of children and age at first birth). Education is categorized according to the International Standard Classification of Education (ISCED): pre-primary and primary education (ISCED 0-1); lower secondary education (ISCED 2); upper secondary education (ISCED 3) and tertiary education (ISCED 4-6). Educational differences in breast cancer mortality are controlled for two reproductive factors, number of children and age at first birth. Each variable is categorized into 6 groups (no children, 1 child, 2 children, 3 children, 4 children and 5 or more children and <20 years, 20-24 years, 25-29 years, 30-34 years, 35-39 years, >40 years). The effect of both reproductive variables is estimated through a combined indicator, allowing for the inclusion of all women whether they have children or not.

Mortality rates in breast cancer are estimated for each educational group as a function of age, number of children and age at first birth. The association between these variables is measured in terms of rate ratios estimated using a Poisson model. Women's age is introduced as a control factor and is a continuous variable. The association between breast cancer and education is controlled for number of children and for age at first birth. In addition, analyses are stratified according to nulliparity. For parous women, number of children and age of first birth are introduced separately. For nulliparous women, educational differences in breast cancer are controlled for age only. Analyses are also stratified by age, distinguishing pre- and postmenopausal women (women aged 35 to 49 and women aged 50 to 79).

Results
In 1991-1995, the association between education and breast cancer is significant among postmenopausal women. Women aged 50-79 with higher education have a 16% higher mortality risk due to breast cancer, women with upper secondary have a 14% higher mortality risk compared to women with lower education. Control for parity and especially for parity in combination with age at first birth explains much of the excess mortality observed among tertiary educated women. The stratified analyses confirm that there is no significant association between education and breast cancer mortality among premenopausal women, neither for parous nor for nulliparous women. Among postmenopausal women, differences are smaller than before and only significant among parous women, not among nulliparous women. Controlling for number of children and for age at first birth eliminates the differences, except for women with upper secondary

education. These results suggest that reproductive factors play a considerable role in explaining the educational gradient in breast cancer mortality in Belgium.

In 2004-2005, the situation has changed considerably. Educational differences in breast cancer mortality are no longer significant neither for premenopausal nor for postmenopausal women and control for reproductive factors does not change these conclusions. Moreover, there is a trend among premenopausal women for an inversion of the 1991-1995 pattern. Among women aged 35-49, breast cancer mortality is no longer higher, but lower among highly educated women, a trend that becomes more pronounced after controlling for reproductive factors. These differences are not significant, but indicate nevertheless that there is a shift going on in the pattern of breast cancer inequalities. In 1991-95, breast cancer mortality was higher among the highly educated; in 2004-2005, this is no longer the case.

Conclusion

The positive association between breast cancer mortality and education observed for postmenopausal women in 1991-1995 has disappeared in 2004-2005. Several countries have witnessed such a change of patterns. (Martikainen and Valkonen 2000; Menvielle, Leclerc et al. 2006). This may be explained through the inverse equity theory: inequality will increase if individuals within higher socio-economic groups access new technologies such as improved breast cancer treatments, prior to those within lower groups. Comparing post- and premenopausal women in 2004-2005, shows that there might be a trend towards inversing inequalities.

References
1. Wagener DK, Schatzkin A. Temporal trends in the socio-economic gradient for breast cancer mortality among US women. *Am J Public Health* 1994; **84**: 1003-1006.

2. Heck KE, Pamuk ER. Explaining the relation between education and postmenopausal breast cancer. *Am J Epidemiol* 1997; **145**: 366-371.

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

4. Danø H, Andersen O, Ewertz M, Petersen JH, Lynge E. Socioeconomic status and breast cancer in Denmark. *Int J Epidemiol* 2003; **32**: 218-224.

5. Robert SA, Strombom I, Trentham-Dietz A, Hampton JM, McElroy JA, Newcomb PA, Remington PL. Socioeconomic risk factors for breast cancer – Distinguishing individual- and community-level effects. *Epidemiology* 2004; **15**: 442-450.

6. Strand BH, Kunst A, Huisman M, Menvielle G, Glickman M, Bopp M, Borell C, Borgan JK, Costa G, Deboosere P, Regidor E, Valkonen T, Mackenbach JP, EU Working Group on Socioeconomic Inequalities in Health. The reversed social gradient: higher breast cancer mortality in the higher educated compared to lower educated. A comparison of 11 European populations during the 1990s. *Eur J Cancer* 2007; **43**: 1200-7.

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

8. Menvielle, G, Leclerc A, Chastang J-F, Luce D. Social inequalities in breast cancer mortality among Frenchwomen: disappearing educational disparities from 1968 to 1996. *Br J Cancer* 2006; **94**: 152-155.

9. Sarfati D, Blakely T, Shaw C, Cormack D, Atkinson J. Patterns of disparity: ethnic and socio-economic trends in breast cancer mortality in New Zealand. *Cancer Causes Control* 2006; **17**: 671-678.

10. Link B.G., Phelan J. Evaluating the fundamental cause explanation for social disparities in health, in C.E. Bird, P. Conrad and A. Fremont (eds.) *The Handbook of Medical Sociology (5th edition)*, 2000, Upper Saddle River (N.J.): Prentice Hall, pp. 33-46.

11. Link B.G., Phelan J. Social conditions and fundamental causes of disease. *Journal of Health and Social Behaviour* 1995, **35**, pp. 80-94.

12. Phelan J.C., Link B.G. et al. Social Conditions as Fundamental Causes of Health Inequalities: Theory, Evidence, and Policy Implications. *Journal of Health and Social Behavior* 2010, **51**, pp. 28-40.