**Educational differences in breast cancer incidence and breast cancer survival. How do they add up?**

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**Background:** Social scientists have devoted much attention to socioeconomic (SE) inequalities in health. For nearly all indicators of morbidity and mortality, they find a persistent negative association with SE position (SEP). In a number of studies, a widening of inequalities has been observed during the last decades. For cancer, the picture is much more heterogeneous. International studies have illustrated a large diversity in the social patterning of cancer. The association between markers of SEP and cancer ranges from negative over non-existent to positive, depending on the site of cancer and the cancer indicator, i.e. occurrence (incidence) or outcome (mortality and survival).

Cancer mortality is a function of both cancer incidence and survival, implying that the chances to die from a disease depend on the chances of getting the disease and then on the chances of surviving the disease. Cancer incidence is defined as the number of new cancer cases in the total population, cancer mortality refers to the number of cancer deaths in the total population, whereas cancer survival is restricted to the population diagnosed with cancer. Each of these indicators has advantages and disadvantages but examining mortality alone can be misleading. Inequalities in cancer mortality arise from inequalities in cancer incidence and cancer survival and should consequently be investigated alongside inequalities in cancer incidence and survival. This study will consider educational differences in breast cancer mortality in Belgium alongside inequalities in breast cancer incidence and breast cancer survival. In addition, it will investigate the impact of fertility variables – number of children and age at first birth – on educational inequalities in breast cancer. Previous research clearly illustrated that both these variables (partly) explain the higher breast cancer among the highest educated.

In Belgium, cancer is a leading cause of death. Belgium has among the highest all-cancer incidence from a European perspective and particularly high incidence rates in breast cancer. Therefore, our country constitutes an interesting setting to investigate social differences in cancer.

**Methods:** Data are derived from record linkage between i) the Belgian censuses of 2001, ii) emigration and all-cause mortality data from the National Register and cause-specific mortality data from the death certificates for the period 2004-2014 and iii) cancer data from the Belgian Cancer Registry (BCR). The BCR collects data on all new cancer diagnoses at the population level and is considered to be complete for more than 95%. The missing cases most often concern neoplasms with very bad prognosis. For the Flemish Region, the BCR-data cover the period 1999-2014; for the Brussels-Capital Region and the Walloon Region data are available for the years 2004-2014. Individually linked data containing site-specific cancer incidence, survival and mortality as well as SE characteristics are quite unique. To our knowledge, only Nordic countries dispose of equally comprehensive data on a nationwide scale. Hence, the mapping exercise proposed in this study cannot be easily replicated in many other European countries.

Firstly, age-specific rates will be calculated for breast cancer incidence, mortality and survival. To quantify inequalities, relative and absolute measures will be calculated because both are important. All measures will be adjusted for age. Relative educational differences will be assessed through two different indicators: the mortality rate ratio (MRR) and the relative index of inequality (RII). These will be estimated through age-adjusted Poisson regression with the observed number of deaths as the dependent variable and person-years of population as the offset variable. To measure absolute educational differences in breast cancer mortality, the slope index of inequality (SII) will be calculated. Both the RII and the SII take into account all education groups (i.e. not just the lowest and highest groups). In addition, both measures adjust the relative position of each group to its share in the population. Analyses will be stratified by age at baseline, as a proxy variable for menopausal status (ages 30-49 for premenopausal women and ages 50+ for postmenopausal women). Studies have indicated that breast cancer among premenopausal women is more strongly related to endogenous factors – age at menarche and family history – and less strongly to traditional risk factors (nulliparity, postponed motherhood, alcohol and smoking behaviour, obesity,… ). These behavioural risk factors seem more important among postmenopausal women. Models will first include age and education. Educational differences will then be controlled for fertility variables, the number of children and age at first child in order to check whether educational differences in breast cancer are related to fertility behaviour.

**Results:** Analyses are still being effectuated and will be finished in the coming months. The results presented below are preliminary and only present part of the analysis.

*Figure 1: Breast cancer in females: comparison of age-standardised incidence rates in selected European countries*

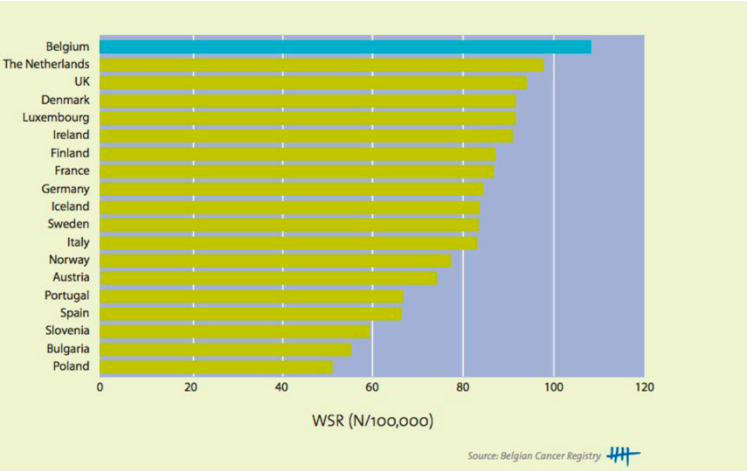



Figure 1 clearly illustrates that Belgium has the highest breast cancer incidence rate of all countries included with an incidence rate higher than 100 per 100,000 in 2008.

Figure 2 clearly shows the age-specific patterns of breast cancer incidence. Post-menopausal women clearly have the highest incidence rates in breast cancer. However, breast cancer also hits younger women.

*Figure 2: Age-specific incidence rates for breast cancer Belgium 2004-2014*

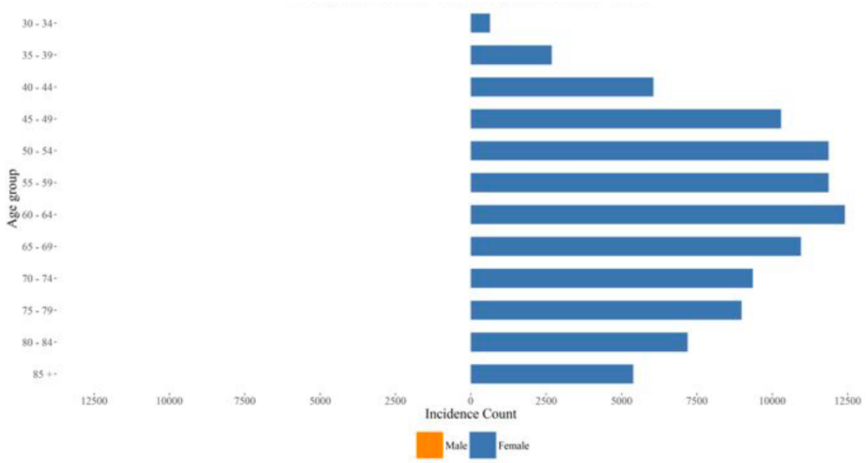
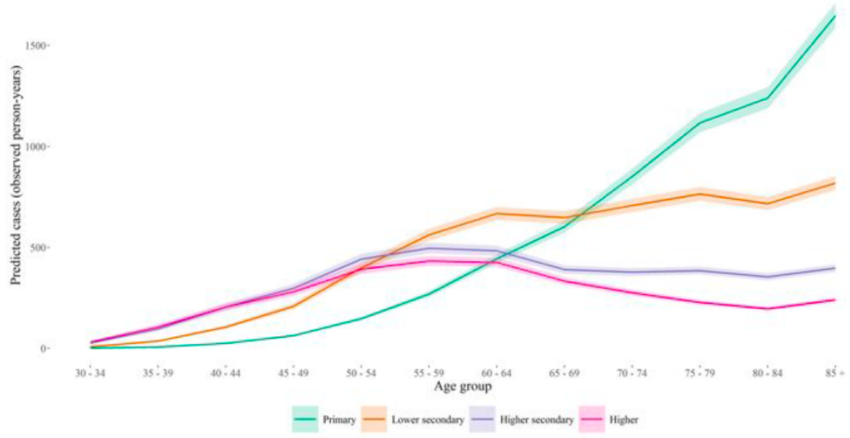



Figure 3 shows breast cancer mortality rates by educational level and age group. In the younger (pre-menopausal) age groups, low educated women clearly have lower breast mortality rates compared to the other educational groups, while high educated women have higher mortality rates. This pattern changes at older ages (among post-menopausal women), lower educated women showing much higher mortality rates than the highest educated. Lower secondary educated women constitute an intermediary group.

*Figure 3: Breast cancer mortality rates by educational level and age group, women, Belgium 2004-2014*




An important question is whether these patterns mainly result from incidence inequalities or from inequalities in survival. Figure 4 shows incidence rates by educational level and age group. We observe the same pattern again, the lowest educated showing the lowest incidence rates at young age and surmounting all other educational groups at older age. Contrastingly, the highest educated women have the highest incidence rates at young age and the lowest at old age.

*Figure 4: Breast cancer incidence rates by educational level and age group, women, Belgium 2004-2014*

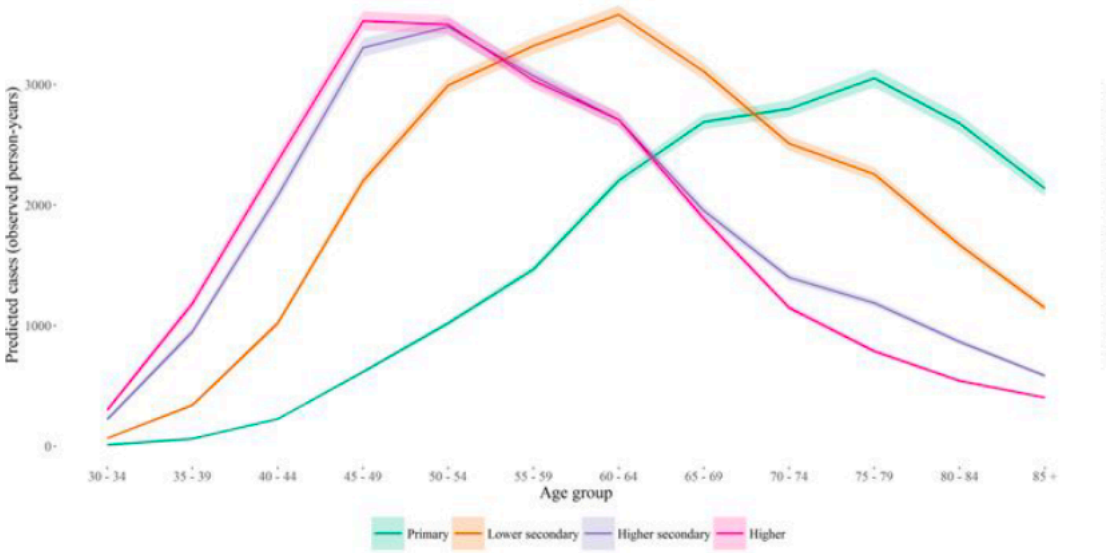
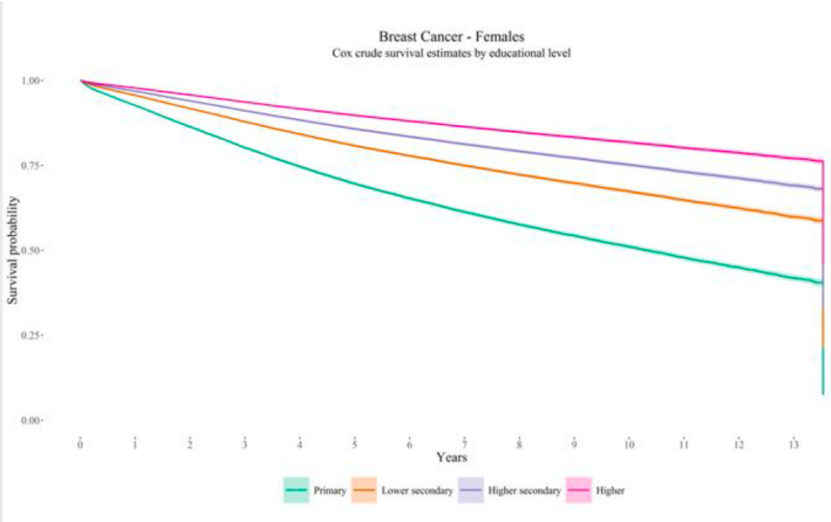



Figure 5 shows the survival rates by educational level and duration since diagnosis. Survival rates are systematically lower for the lowest educated and highest for the highest educated. Additional analysis will further finetune these results and also include fertility variables into the models.

*Figure 5: Breast cancer survival rates by educational level and age group, women, Belgium 2004-2014*




**Conclusions:** This study clearly shows that the relation between education and breast cancer depends upon the age group and the indicator considered (mortality, incidence or survival). At younger age, lower educated women show lower breast cancer incidence rates as well as lower breast cancer mortality rates compared to the higher educated. At older age, this pattern reverses, lower educated women having higher breast cancer incidence and mortality rates. In survival however, lower educated have lower chances to survive from breast cancer independently of duration since diagnosis. These results will be further finetuned in the coming months.