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Patterns of breast cancer mortality trends in Europe

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ABSTRACT

Objectives: To identify patterns of variation in breast cancer mortality in Europe (1980–2010), using a model-based approach.
Methods: Mortality data were obtained from the World Health Organization database and mixed models were used to describe the time trends in the age-standardized mortality rates (ASMR). Model-based clustering was used to identify clusters of countries with homogeneous variation in ASMR.
Results: Three patterns were identified. Patterns 1 and 2 are characterized by stable or slightly increasing trends in ASMR in the first half of the period analysed, and a clear decline is observed thereafter; in pattern 1 the median of the ASMR is higher, and the highest rates were achieved sooner. Pattern 3 is characterised by a rapid increase in mortality until 1999, declining slowly thereafter.
Conclusion: This study provides a general model for the description and interpretation of the variation in breast cancer mortality in Europe, based in three main patterns.

Introduction

Breast cancer is the leading cause of oncological death among women, in both economically developed and developing settings.[1] In Europe, in the last decades the mortality decreased in most countries,[2] along with rising incidence rates.[3]

An increasing incidence may be explained by trends towards a more frequent exposure to factors that contribute to a higher risk of breast cancer (e.g.: delayed childbearing, lower parity, use of postmenopausal hormone therapy, obesity, physical inactivity),[4,5] while the widespread use of mammographic screening further contributes to higher incidence rates.[5,6]

The decline in mortality rates has been attributed both to an increasing frequency of early diagnosis through mammography screening and access to more efficient treatments, including adjuvant chemotherapy or tamoxifen, besides improved radiotherapy and surgery.[7–11] The identification of clusters of countries with similar trends in breast cancer mortality may contribute to understand the impact, at a population level, of early detection and improved disease management. Previous attempts to describe breast cancer mortality patterns relied on criteria related to geographical,[12] social, economic or cultural[13–15] characteristics. Model-based clustering may allow a more meaningful grouping of the different settings with no *a priori* constraints, according to the magnitude of the mortality rates at onset of the observation period, as well as its trends.

Therefore, we aimed to identify patterns of variation in breast cancer mortality, using a model-based approach.

Methods

Breast cancer mortality data were obtained for 40 countries from the World Health Organization (WHO) database updated in November 24, 2011.[16] Albania, Bosnia and Herzegovina, Cyprus, Montenegro, The Former Yugoslav Republic of Macedonia, Serbia and Slovakia had data available for less than 20 calendar years between 1980 and 2010, and were excluded from our analyses (Fig. 1). In this period, different revisions of the International Classification of Diseases (ICD) were used; we extracted the number of deaths, corresponding to the codes A054 (ICD-8), B113 (ICD-9), C50 (ICD-10).

Mid-year estimates of the resident population were obtained from the 2010 revision of United Nations World Population

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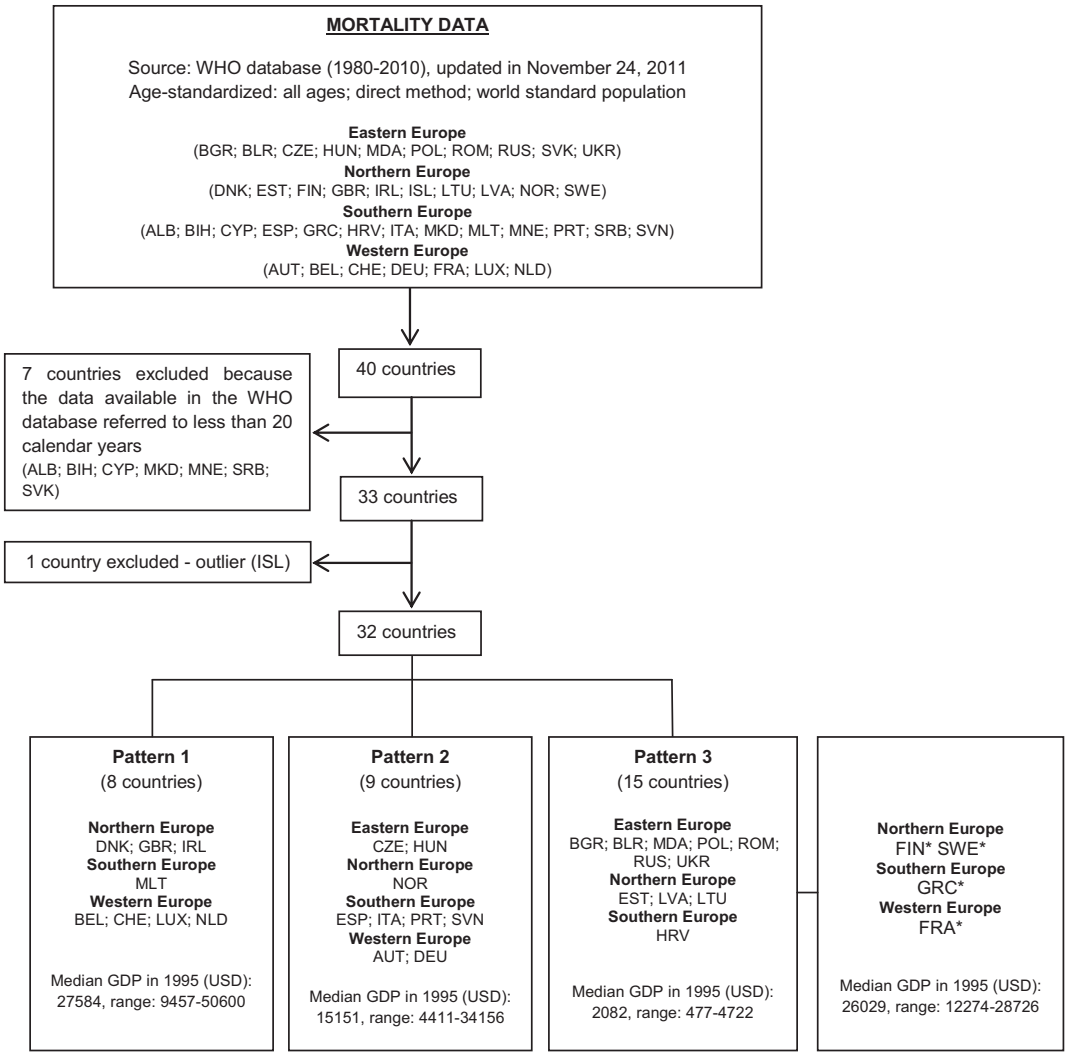

*Finland, France, Greece and Sweden had substantially higher GDP than the other countries included in pattern 3, and were treated separately to increase the homogeneity of this cluster

ALB=Albania; AUT=Austria; BEL=Belgium; BIH=Bosnia and Herzegovina; BGR=Bulgaria; BLR=Belarus; CHE=Switzerland; CYP=Cyprus; CZE=Czech Republic; DEU=Germany; DNK=Denmark; ESP=Spain; EST=Estonia; FIN=Finland; FRA=France; GBR=United Kingdom; GRC=Greece; HRV=Croatia; HUN=Hungary; IRL=Ireland; ISL=Island; ITA=Italy; LTU=Lithuania; LUX=Luxembourg; LVA=Latvia; MDA=Republic of Moldova; MKD=The Former Yugoslav Republic of Macedonia; MLT=Malta; MNE=Montenegro; NLD=The Netherlands; NOR=Norway; POL=Poland; PRT=Portugal; ROM=Romania; RUS=Russian Federation; SRB=Serbia; SVN=Slovenia; SVK=Slovakia; SWE=Sweden; UKR=Ukraine.

Fig. 1. Flowchart of the model-based approach used to identify breast cancer mortality patterns.

Prospects.[17] We computed age-standardized mortality rates (ASMR) for all ages, by the direct method, using the world standard population[18] as reference.

Mixed models[19] were used to describe the time trends in the ASMR, including random terms by country, for the intercept and for slope, quadratic and cubic terms. Iceland presented values three times the interquartile range above or below the median for at least one of the above coefficients and was excluded from further analyses (Fig. 1). These models were used to estimate the ASMR for the years with missing data, between 1980 and 2010 (Appendix 1).

Model-based clustering[20] was used to identify groups of countries that share similar time trends in the ASMR, while distinguishing them from other homogeneous groups of countries regarding the variation in mortality rates. According to this method, the data (intercept, slope, quadratic and cubic terms) are assumed to have a multivariate normal distribution, parameterized by their means and covariances, generated by clusters. The geometric features (orientation, volume and shape) of the distributions are estimated from the data, and can be allowed to vary between clusters, or constrained to be the same for all clusters.[21]