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Twenty years of socioeconomic inequalities in premature mortality in Barcelona: The influence of population and neighbourhood changes

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ABSTRACT

The objective of this study was to analyse trends in socioeconomic inequalities in premature mortality in Barcelona from 1992 to 2011, accounting for population changes. We conducted a repeated cross-sectional study of the Barcelona population (25–64 years) using generalized linear mixed models for trend analysis, and found that socioeconomic inequalities in premature mortality persisted between neighbourhoods, but tended to diminish. However, the reduction in inequality was related to an increase in the number of foreign-born individuals mainly in socioeconomic disadvantaged neighbourhoods, in which the decrease in premature mortality was more marked. To study trends in geographical inequalities in mortality, it is essential to understand demographic changes occurred in different places related to local levels of deprivation.

1. Introduction

In urban contexts, it is well known that neighbourhood characteristics, especially the socioeconomic context, have an independent effect on a variety of health outcomes, including mortality (Pickett and Pearl, 2001; Meijer et al., 2012). A common finding is that living in more deprived neighbourhoods is associated with increased mortality, independently of individual socioeconomic characteristics (Van Lenthe et al., 2005), and this effect is stronger among men and in younger age groups (Meijer et al., 2012). In the European context, the INEQ-CITIES project, which used small area analysis, has shown strong evidence of socioeconomic inequalities in mortality in 16 European cities, with mortality increasing in parallel with socioeconomic deprivation. Inequality is greater in eastern and northern European cities and lesser in some western and southern European cities (Borrell et al., 2014).

However, only a few studies have analysed trends in socioeconomic inequalities in mortality among neighbourhoods and small areas at the urban level, and the findings have been inconsistent. Previous studies in the United Kingdom (Norman et al., 2011), Scotland (Leyland et al., 2007; Exeter et al., 2011) and Sydney (Hayes et al., 2002) observed a decreasing trend in mortality, but an increase in socio-spatial inequality in mortality. Stable socio-spatial patterns in mortality have been reported in other cities, such as New York (Karpati et al., 2006), Montreal (Pampalon et al., 2008), Turin (Marinacci, 2004) and Rome (Cesaroni et al., 2006). In Spain, the findings from various cities have been inconsistent in terms of trends in socioeconomic inequalities in mortality observed using small-area analysis: some studies report an increase (Ruiz-Ramos et al., 2014), others a stable trend (Nolasco et al., 2009) and others a decrease (Rodríguez et al., 2014; Rodríguez-Fonseca et al., 2013; Dalmau-Bueno et al., 2010).

From a broad perspective, both places and populations should be regarded as dynamic. Over the last few decades, cities have undergone continuous reurbanisation processes (Haase et al., 2009), leading to substantial changes in population structure as a result of migration, aging, and declining fertility, which affect population health and health inequalities (Lawrence, 2013). At a national level, several studies have found that mortality was inversely related to population growth; mortality rates were higher in areas with decreasing population and lower in those with increasing population as a result of immigration. These differences are probably the result of health selection bias (Smith et al., 1998;

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Molarius and Janson, 2000; Regidor et al., 2002; Boyle et al., 2004). Despite this, recent studies suggest that the negative relationship between population change and mortality in Scotland is an artefact of the relationship between deprivation and mortality, since declining areas tend to be more deprived (Exeter et al., 2005, 2009; Popham et al., 2011). However, longitudinal studies in England and Wales have shown that both deprivation and health-selective migration are responsible for the increased inequality in mortality between the least and most deprived areas (Norman et al., 2005; Connolly et al., 2007). Similarly, a study in France reported a large increase in the population in deprived areas, and found that this was associated with a decrease in relative socioeconomic inequalities in mortality (Ghosn et al., 2013). In this regard, when studying trends in geographical inequalities in mortality, it is important to understand demographic changes in relation to deprivation. However, at urban context few studies have accounted for changes in the composition of the population and its contribution in explaining changes in socioeconomic and mortality inequalities between areas.

Barcelona has undergone continuous changes in both the city and its population. The urban transformation that began in the mid-1980s has combined cultural strategies with urban regeneration (namely, the 1992 Olympic Games and the 2004 Universal Forum of Cultures) (Degen and García, 2012), as well as a series of urban renewal programmes introduced to deal with deprived neighbourhoods and inner-city areas (Arbaci and Tapada-Berteli, 2012). Moreover, while the city's population began to decrease in the 1990s, it rose rapidly again after 2000, mainly due to a large influx of foreigners who migrated to Spain for economic reasons. Since most of this recently arrived immigrant population is young, this influx has had an impact on the age structure of the general population (Domínguez Mújica and Guerra Talavera, 2009). The foreign population in Barcelona represented 3.9% of residents in 2000, growing to 18.9% in 2009, most of which has settled in specific areas of the city centre and the periphery (Bayona and Gay, 2011).

In this context, the objectives of this study were two-fold: first, to describe the population changes that occurred in neighbourhoods of Barcelona over the past two decades; and second, to analyse trends, between 1992 and 2011, in socioeconomic inequalities in premature mortality between neighbourhoods while taking population changes into account.

2. Methods

2.1. Population and study design

The study was conducted in Barcelona, Spain's second largest city, located in the north-east (1.6 million inhabitants). The study population consisted of residents aged 25–64 years in the city's 38 neighbourhoods. We conducted a time trend analysis of repeat cross-sectional data for each year from 1992 to 2011, thereby capturing the complexity of the data (individuals, neighbourhoods, years). In 1984, Barcelona was divided into 10 municipal districts and 38 neighbourhoods, with a further subdivision into 73 neighbourhoods in 2004. However, this study was based on the 38 neighbourhoods, in order to take advantage of historical information about their characteristics. During the study period, the neighbourhoods' populations varied between approximately 500 and 100,000 inhabitants, with a median of ~35,000.

2.2. Sources of information

Data on all deaths in persons aged 25–64 years were obtained from the Barcelona mortality register, which includes geocoded data for each residential address (99% of deaths), and the educational level of the deceased (93% of deaths) obtained via record linkage with the local population register. Also, the population at risk was obtained trough the local population register. On the other hand, we used local statistics to characterize each neighbourhood's population and socioeconomic context (Department of Statistics, Barcelona City Council).

2.3. Variables and indicators

Individual characteristics: for each death, we analysed information on age (5-year groups), sex, education (pre-primary, primary, lower secondary, upper secondary, or university), neighbourhood of residence, and year of death.

Neighbourhood characteristics: from the population censuses for 1991 and 2001, we obtained data on the socioeconomic context of each neighbourhood, estimated from the unemployment rate as the proportion of unemployed persons in the active population. The unemployment rate is a common simple measure of area-based socioeconomic context that is widely used in research on geographical inequalities in mortality (Domínguez-Berjón et al., 2014; Van Lenthe et al., 2005). Using data from the local population register, specifically relative changes between 1991, 2001 and 2011, we studied immigration as a percentage of the foreign-born and Spanish-born populations, the population's age-structure as a percentage of adults under 65 years and those aged 65 and older, and the total population size. We analysed both continuous and categorical (quartiles) variables for all indicators. Therefore, neighbourhoods were grouped into 4 categories: low unemployment and low immigration (12 neighbourhoods below the median of both indicators), low unemployment and high immigration (7 neighbourhoods below the median for unemployment and above the median for immigration), high unemployment and low immigration (7 neighbourhoods above the median for unemployment and below the median for immigration), and high unemployment and high immigration (12 neighbourhoods above the median for both indicators).

2.4. Analysis

To characterize the neighbourhoods, we constructed quartile maps of the unemployment rate in 1991 and relative changes in the population between 1991 and 2011 (total, foreign and under 65 years) (Fig. 1), and computed Spearman correlations coefficients. We then described the relative population changes between 1991, 2001 and 2011 by stratifying by quartiles of neighbourhood unemployment in 1991 (Fig. 2).

We used quartile maps to describe 5-year age-standardized mortality rates (ASMR) in neighbourhoods (using the direct method, and with the population of Barcelona in 2001 as the reference) using time-varying ranks in men and women (Fig. 3). We also described 5-year ASMR for each educational level and neighbourhood group (supplementary Table A1).

We fit generalized linear mixed models (Bolker et al. 2009) for each sex, using Poisson family and log link, to analyse the relationship between mortality and the covariates ('fixed parameters' or mortality relative risks [RR]), with both year and neighbourhood as independent sources of variability ('random parameters'), by means of the maximum likelihood estimation based on Laplace approximation. In the final models (Table 1), the covariates were age, education and neighbourhood characteristics (unemployment in 1991 and increase in the foreign population between 1991 and 2011), including the 5-year period as an interaction with the covariates. Note that educational level was expressed as a continuous variable, taking into account both the population size and the relative position of groups, to obtain the