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Trends in socio-economic inequalities in injury mortality among men in small areas of 26 Spanish cities, 1996–2007

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ABSTRACT

Objective: To analyse trends in socio-economic inequalities in mortality due to all injuries, as well as, suicide and motor vehicle injuries, in men in the census tracts of 26 Spanish cities for the periods 1996–2001 and 2002–2007.
Methods: Ecological study of trends based on two periods (1996–2001 and 2002–2007). The study population consisted of male residents in each city during the period 1996–2007. We fitted a hierarchical Bayesian model which takes into account the spatial structure of the data in order to obtain relative risks (RRs), and their 95% credible intervals (CIs), between mortality and a socio-economic deprivation index, in each period.
Results: In most of the cities, mortality due to total injuries presents the same geographical pattern as the deprivation index in the two periods. Moreover, inequalities remained stable. In contrast, socio-economic inequalities in mortality due to motor vehicle injuries tended to diminish in the second period in the majority of the cities, particularly Castellón (first period: $RR_1 = 2.56$; 95%CI: 1.19–4.84; second period: $RR_2 = 1.06$; 95%CI: 0.45–2.12), whereas in the case of suicides, the inequalities remain stable but are only significant in large cities.
Conclusion: This study has demonstrated that socio-economic inequalities in mortality due to all injuries in small areas of 26 Spanish cities remain stable over time. These results highlight the importance of intra-urban inequalities in mortality due to injuries and their evolution over time.

1. Introduction

Injuries due to external causes constitute an important public health problem. In Europe they are responsible for 800,000 deaths every year, and for 14% of ill health in terms of Disability Adjusted Life Years (DALYs) (Sethi et al., 2006). Since the middle of 1990s in Spain approximately 70% of these deaths occurred in men with the leading causes of death due to injuries being traffic injuries and suicides (INE, 2010). Moreover, in the last decade the mortality rates for these causes present a declining trend, above all in the case of traffic injuries in men, where the mortality rate per 100,000 inhabitants fell from 23.5 in 1999 to 8.9 in 2009 (INE, 2010).

On the other hand, some studies have shown that individuals with worse socio-economic indicators have a higher risk of dying due to injuries (Cubbin and Smith, 2002; Laflamme et al., 2009) and, in addition, these inequalities have tended to remain stable in men and to rise among women (Borrell et al., 2008; Menvielle et al., 2007; Strand et al., 2010). In the case of suicides, studies conducted in Europe, New Zealand and Korea have found an increase in socio-economic inequalities among men, whereas these inequalities tend to fall for traffic injuries. Socio-economic inequalities, for these causes, have not been found among women (Blakely et al., 2008; Borrell et al., 2008; Lee et al., 2009; Strand et al., 2010).

There has been an increase in recent years of studies of mortality inequalities based on geographical areas, since area of residence is recognised as a factor affecting health, independently of individual determinants (Diez Roux, 2001). In the case of deaths due to injuries, some studies have found that areas with worse socio-economic indicators present higher mortality risk, particularly among men (Borrell et al., 1997; Chang et al., 2011; Gotsens

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et al., 2011a; Michelozzi et al., 1999; Middleton et al., 2006; Nolasco et al., 2009; Singh and Kogan, 2007; Windenberger et al., 2011). However, only a few studies have analysed trends in these inequalities at small area level, finding that the inequalities tend to remain constant or even increase, especially among men (Michelozzi et al., 1999; Nolasco et al., 2009; Windenberger et al., 2011).

Although there are some studies which have analysed trends in inequalities for injury-related mortality by socio-economic level at both individual and area level, hardly any studies have done so in an urban context, using small areas as the unit of analysis (Michelozzi et al., 1999; Nolasco et al., 2009). It is important to note that currently 75% of the Spanish population live in urban areas (United Nations, 2011) and it is in these areas where certain injuries due to external causes, such as traffic injuries in pedestrians, homicides and substance abuse are more common (Vlahov and Galea, 2002). Thus, the aim of the present study was to analyse trends in socio-economic inequalities in mortality due to all injuries, as well as suicide and motor vehicle injuries, among men within the census tracts of 26 Spanish cities during the periods of 1996–2001 and 2002–2007.

2. Methods

2.1. Design, unit of analysis and study population

This is an ecological study of trends based on two periods (1996–2001 and 2002–2007), which forms part of the MEDEA project (Socio-economic and environmental inequalities in mortality in small areas of Spanish cities: http://www.proyectomedea.org/). The units of analysis are the census tracts of 26 Spanish cities as defined in the 2001 Spanish Population and Housing Census. These cities (Fig. 1), which accounted for 28.4% of the population of Spain in 2001, vary in size and are located in different geographical regions of Spain (autonomous communities, which are the first-level political division of Spain). The study population consists of the male residents in the 26 cities during the period 1996–2007, except in the cases of Coruña and Vigo where the study population consists of male residents there during the period 1998–2007. Consequently, in these cities the periods of study are 1998–2001 and 2002–2007.

2.2. Information sources

Male mortality data grouped by census tract and period were obtained from the mortality registers of the corresponding autonomous communities. Census tract was obtained from the postal address of the deceased provided on the Death Certificate or from the Register of Inhabitants of each city. The proportions of deaths which could not be geographically referenced due to problems in geocoding place of residence varied from 0.02% in Pamplona to 5.0% in Cartagena-La Unión. The male population data stratified by age (in 5-year groups), census tract and period were obtained from the Register of Inhabitants for each city or from the National Institute of Statistics (Instituto Nacional de Estadística). Moreover, the 2001 Population and Housing Census was used to obtain the information necessary to elaborate the index of socio-economic deprivation for each city (INE, 2010).

2.3. Mortality

The present study has analysed deaths due to all injuries (including drug overdose) and from two specific causes of death: motor vehicle injuries and suicide, these being the leading causes of deaths due to injury. Deaths occurring between 1996 and 1998 were coded using the ninth revision of the International Classification of Diseases (ICD-9), while those occurring between 1999 and 2007 were coded using the tenth revision (ICD-10) (see footnote, Table 1).

2.4. Socio-economic deprivation index

We included as a covariate an index of socio-economic deprivation, which was calculated for each city through a Principal Components Analysis of five socio-economic indicators corresponding to 2001, available for each census tract, based on the methodology described by Domínguez-Berjón et al. (2008). The indicators included in the index were percentages of: (a) unemployment; (b) low educational level; (c) low educational level in young people (16–29 years); (d) manual workers; (e) temporary workers. The index was normalised to achieve a mean of 0 and standard deviation of 1. In all cities, the index accounted for over 75% of the variability of the indicators which it includes.

2.5. Data analysis

Age standardised mortality rates (ASMRs) were calculated by the direct method using the Spanish population for the year 2001 as the reference population. ASMR were calculated for each cause of death, each period and each city.

The mortality indicator used for the analysis is the Standardised Mortality Ratio (SMR). The SMR is dependent on population size since its variance is inversely proportional to the expected values, thus areas with low population tend to present very variable estimates. In order to smooth the SMR we used the hierarchical Bayesian model proposed by Besag, York and Mollié (BYM) (Besag et al., 1991). This model takes two types of random effects into account, spatial and heterogeneous: the former takes account of the spatial structure of the data while the latter deals with non-structural (non-spatial) variability. Smoothed SMR (sSMR) were estimated for each cause of death and period with the following model:

$$\begin{aligned} &O_i \sim \text{Poisson}\,(E_i\theta_i) \\ &\log\,(\theta_i) = \alpha + S_i + H_i \end{aligned} \qquad \text{(model 1)}$$

where, for each area i, O_i is the number of observed cases, E_i is the expected cases, θ_i is the relative risk with respect to the whole city, S_i is the spatial effect, and H_i is the heterogeneous effect. The expected cases were calculated by indirect standardisation taking as reference the male mortality rates of each city, by age (in 5-year groups), cause of death and period.

The geographical distribution of the sSMR has been represented using maps of septiles. Moreover, the deprivation index results have also been represented as septile maps. All maps were generated using the R statistical package (R Development Core Team, 2008).

In order to analyse the relationship between mortality and socio-economic deprivation in the two periods, we have fitted an ecological regression model which takes into account the deprivation index (D), the period (P) and their interaction:

$$\begin{aligned} &O_{it} \sim \text{Poisson}\,(E_{it}\theta_{it}) \\ &\log\,(\theta_{it}) = \alpha + \beta_1 P_t + \beta_2 D_i + \beta_3 P_t D_i + S_{it} + H_{it} \end{aligned} \qquad \text{(model 2)}$$

where, for each area i and period t (t = 1 for period 1996–2001 and t = 2 for period 2002–2007), O_{it} is the number of observed cases, E_{it} is the expected cases, θ_{it} is the relative risk with respect to the whole city, S_{it} is the spatial effect, and H_{it} is the heterogeneous effect. Finally, P is a dummy variable taking values, $P_t = 0$ for t = 1 and $P_t = 1$ for t = 2. In this case, the expected cases were calculated taking as reference the male mortality rates of the first period (1996–2001).