Mortality and Socioeconomic Deprivation in Census Tracts of an Urban Setting in Southern Europe

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ABSTRACT *In southern European cities, research on deprivation and mortality inequalities using small-area analysis is recent. In many countries, the census tract (CT) is the smallest territorial unit for which population data are available. The aim of this study was to examine the association between mortality from all causes and socioeconomic deprivation in CTs in Barcelona (Spain). A cross-sectional ecologic study was carried out using mortality data for 1987–1995 and 1991 census variables. Mortality data were obtained from death certificates. Socioeconomic deprivation indicators were drawn from the census and included unemployment, inadequate education, and low social class. They were correlated, and a deprivation index was elaborated with them. The analysis was descriptive, and multivariate Poisson regression models were adjusted. The most deprived CTs tend to present higher mortality (49.7% of CT in the quartile associated with greatest deprivation were included in the top male mortality quartile and 40.4% in the top female mortality quartile), whereas the less deprived ones present lower mortality. For male mortality, the risk of dying among those in the quartile representing most deprivation is from 25 to 29% higher (depending on the indicator chosen) than the least deprived quartile, and for women, it is from 12 to 14% higher. We concluded that the mortality from all causes in the CT of a southern European city has shown a clear positive association with a variety of socioeconomic deprivation indicators drawn from the census. Studies of this nature may help to orient more specific studies in which CTs are grouped together as a function of particular population and/or health characteristics.*

KEYWORDS *Census, Health inequalities, Mortality, Small areas, Socioeconomic factors.*

INTRODUCTION

A method frequently used to study socioeconomic inequalities in mortality is the comparison of geographic areas. Strong positive associations between mortality and socioeconomic deprivation at the small-area level have been mostly documented in England, Wales, and Scotland.^{1–4} In contrast, in many other countries, such as those in southern Europe, research on deprivation and mortality inequalities using small-area analysis is more recent.^{5–7}

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In regard to large cities, several studies have analyzed social inequalities in health by analyzing mortality and socioeconomic indicators of small areas, and all found that the areas with the highest mortality presented the worst socioeconomic indicators.⁸ In addition, in some cities such as Barcelona,^{9,10} it has been observed that employing several complementary small-area analysis has advantages. This study of Barcelona is based on this idea, using a smaller area than has been used previously: the census tract (CT). In many countries, the CT is the smallest territorial unit for which population data are available, and socioeconomic data for this level have been mainly used when socioeconomic data on individuals is not available,^{11–14} and the results have been interpreted from an individual-based standpoint.

This study aimed to tackle the association between mortality from all causes and deprivation in CTs in Barcelona, Spain, from an ecologic viewpoint, under the hypothesis that this analysis would provide advances in the study of mortality inequalities within the city.

METHODS

Areas Studied

Barcelona, the second largest city in Spain, with 1,643,542 inhabitants (1991 census data), is located in the northeast of the Iberian Peninsula. In 1991, the city was divided into 1,812 CT, their populations ranging from 253 to 7,396 (median 815).

Sources of Data

Mortality information was obtained from data based on death certificates for the years 1987 to 1995. The population in the 1991 census provided denominators for death rates over the period 1987–1995. Socioeconomic and population data were drawn from the 1991 census.

Indicators

We computed directly age-standardized mortality rates from all causes by sex in each CT. The reference population was that of Barcelona as a whole, according to the 1991 census. On the basis of the information available in the 1991 Spanish census, several deprivation indicators were selected following theoretical criteria^{15,16} and previous experience in Spain^{6,7}: (1) unemployment, as the percentage of unemployed in the population aged 15–64 years; (2) inadequate education, as the percentage of people who were illiterate or had no schooling in the population aged over 10; and (3) low social class, determined as the number of people with unskilled occupations divided by all people who ever worked. The three indicators were correlated, with Spearman correlation coefficients that ranged from 0.72 to 0.86. Using the three indicators and applying principal components analysis,¹⁷ we computed a deprivation index. The first principal component represented an overall measure of the information contained in the three indicators, it accounted for 84.2% of the total variation in the data, and only this factor was extracted. The factor score coefficients of each indicator were 0.35 for unemployment, 0.37 for inadequate education, and 0.37 for social class. These coefficients were used to calculate factor scores for each CT. Increasing scores indicate greater levels of deprivation.

Analysis

In the analysis of the association between mortality and socioeconomic measures, we used exploratory tools—maps and figures where the gradient of the association was assessed by comparing quartiles of all mortality rates with quartiles of the socioeconomic measures. After these exploratory steps, we analyzed the relationship between mortality and deprivation indicators through Poisson regression models.¹⁷ The dependent variable was the death rate (in men and in women), and the independent variables were each one of the socioeconomic indicators taken separately, with age as an adjustment variable (a series of terms representing three age groups: 0–34, 35–64, and >64 years). The least deprived quartile of each indicator was taken as the reference category, and rate ratios (RR) with 95% confidence intervals (CI) were thus obtained for the other quartiles.

RESULTS

Table 1 summarizes population, mortality, and deprivation indicators of CT in Barcelona. Indicators for both deprivation and mortality have fairly symmetric distributions, despite their wide ranges. The death rate in men is slightly higher than that in women (in men the average is 1,133.2 per 100,000 inhabitants, whereas in women it is 956.5). The socioeconomic indicator presenting the highest values is the percentage of low social class (mean 24.4), whereas that with the lowest values is unemployment (mean 15.1).

The maps (Figs 1, 2, 3, and 4) show that when representing the socioeconomic status of the CT, some CTs stand out because of their poor status and correspond to the oldest and most central part of the city and to several areas in the north and east that were built rapidly in the 1960s and 1970s to accommodate the boom of immigration arriving from regions of Spain poorer than Barcelona. Also of note is another group of CT with better socioeconomic status situated in the west of the city. The distribution of CT by mortality reveals a more heterogeneous pattern, although it may be observed that mortality is high in the central city (particularly among men).

Joint analysis of socioeconomic status and mortality in CT shows that the most socioeconomically deprived (by unemployment, inadequate education, manual workers or the deprivation index) CTs tend to present greater mortality, whereas the less deprived present lower mortality. For example, by the deprivation index (Fig. 5), the CTs included in the quartile of greatest deprivation (quartile 4) are in general the same ones that appear in the quartile with highest mortality (49.7% of the CT in quartile 4 of deprivation are also included in quartile 4 of male mortality; for female mortality, this figure is 40.4%). Similarly, the CTs in quartiles representing less deprivation tend to belong to the quartiles of lower mortality (40.3% of CT in quartile 1 of the deprivation index are included in quartile 1 of male mortality; in the case of women, the corresponding figure is 30.8%).

Analysis of mortality risks by deprivation indicators (Table 2) shows that they are all fairly similar, risks being higher among men than among women. Regarding male mortality, the risk of dying in the most deprived quartile is, depending on the indicator, from 25 to 29% higher than in the least deprived quartile, and in the case of women, it is from 12 to 14% higher.

TABLE 1. Population, mortality, and deprivation indicators in the census tracts (N = 1812) in Barcelona city

	Least	Greatest	Range	25%	50%	75%	Mean	Standard deviation
Population (N)								
Men	113	3,688	3,575	298	382	494	428.2	210.1
Women	135	3,708	3,573	340	435	560.8	478.8	215.9
Total	253	7,396	7,143	643	815.5	1,050.0	907.0	424.1
Mortality (directly standardized rates per 10 ⁵ inhabitants)								
Men	391.9	5,417.1	5,025.2	939.3	1,084.0	1,265.1	1,133.2	324.4
Women	357.1	5,628.8	5,271.7	805.9	934.9	1,085.8	965.5	265.0
Total	528.6	4,662.6	4,134.0	891.8	998.7	1,132.1	1,034.6	238.5
Deprivation indicators								
Unemployment (%)	0.0	44.7	44.7	11.9	14.3	17.5	15.1	5.0
Inadequate education (%)	2.3	61.3	59.0	11.9	17.4	24.8	18.7	9.0
Low social class (%)	0.0	75.9	75.9	14.1	21.8	32.1	24.4	13.3
Deprivation index	-1.891	4.864	6.755	-0.734	-0.175	0.625	0	1

1991 census and 1987–1995 mortality.

FIGURE 1. Map of the census tracts of Barcelona.

DISCUSSION

In several countries, the availability of geocoding health and population data has paved the way for exploring small-area health statistics based on routine data.¹⁸ The study of mortality inequalities in small units of urban territory permits the detection of those areas where there are greatest risks of dying, which often pass unnoticed when larger analysis areas are employed. In Barcelona, the mortality register and the local census are linked, and this permits assigning an area of residence, available in the census, to each death. Mortality had been previously analyzed in Barcelona by using a variety of small areas.^{9,10,19,20} The analysis at CT level may be considered an important quantitative step, because it implies moving from using 66 primary health care areas (the greatest number used to date) to using the 1,812 CT. At this level of disaggregation, the important association between mortality and socioeconomic characteristics continues to be observable: the risk of dying is higher in CTs with greater socioeconomic deprivation. Using smaller areas has allowed us to corroborate once more that the central city is more deprived, although certain CTs are more deprived than others, whereas mortality is homogeneously high in all of them. Additionally, in peripheral areas of the city (north and east), a concentration of deprived CT has been observed, although here the distribution of mortality is much more heterogeneous. Therefore, it has once again been observed that through

FIGURE 2. Distribution of the census tracts of Barcelona by deprivation index quartiles. ■, 0.626 to 4.864; ■, -0.174 to 0.625; ■, -0.733 to -0.175; □, -1.891 to -0.734.

the complementary use of various small areas, as well as by the disaggregation by CT, it is possible to detect differences in deprivation in the inner city and differences in mortality in more deprived peripheral areas, which had not been detected in the analysis based on primary health care areas.^{10,23}

These findings are consistent with those obtained in previous studies, in that in Barcelona, the inner city area, as has been reported in other cities,^{21,22} is the one presenting the worst health indicators, in this case higher mortality. In the inner city in the period analyzed, mortality related to intravenous drug use was particularly significant, as also were acute adverse reaction to drugs, AIDS, and tuberculosis.^{20,23} In regard to mortality due to these causes, several authors^{20,24,25} have described the importance of mediating factors related to the community, such as social cohesion, family and community structure, and immigration, and consequently, the situation

FIGURE 3. Distribution of the census tracts of Barcelona by male mortality quartiles. ■, 1,265.2 to 5,417.1; ■, 1,084.1 to 1,265.1; ■, 939.4 to 1,084.0; ■, 391.9 to 939.3.

of socioeconomic deprivation presents as a necessary, but not sufficient, factor. However, for other causes of death, related to tobacco and alcohol consumption, a linear increase in mortality has been reported when socioeconomic status worsens.¹⁰

With the different socioeconomic indicators (simple and deprivation index) elaborated from the census, the results were similar. In other studies,²⁶ similar results have also been observed by using simple indicators and indices of deprivation (those of Carstairs and Morrison, and that of Townsend, among others) and mortality. The census is the single source of reliable and comparable socioeconomic data with a complete coverage of Spain's population at the small-area level, just as in other countries. However, census data have certain limitations, such as not being able to fully characterize the social context because of infraregistration of the population, mainly corresponding to the homeless, those with no fixed residence, foreign

FIGURE 4. Distribution of the census tracts of Barcelona by female mortality quartiles. ■, 1,085.9 to 5,628.8; ■, 935.0 to 1,085.8; ■, 806.0 to 934.9; □, 357.1 to 805.9.

immigrants not included in the census, and certain other marginal groups. Although the census data, conditioned in part by their universal nature, are restricted to the principal demographic characteristics and socioeconomic information, in this study, the utility of this information in the study of social inequalities in health has once again been observed.

With ecologic studies, it is not possible to determine whether inequalities in health between areas are caused by their own specific characteristics (context effect) or by differences between the individuals living in them (composition effect). Nor is it possible to evaluate the role of individual factors as confounders, mediators, or modifiers of the area effect. This would require a multilevel analysis.²⁷

FIGURE 5. Census tracts by mortality quartiles (Q1: lowest mortality, Q4: highest mortality) and deprivation index quartiles (Q1: least deprived, Q4: most deprived). Barcelona, 1991 census and 1987–1995 mortality.

TABLE 2. Mortality in quartiles of different deprivation indicators (Q1 least deprived, Q4 most deprived)

	Male mortality		Female mortality	
	Rate*	Rate ratio (95% CI)†	Rate*	Rate ratio (95% CI)†
Unemployment				
Quartile 1	1,039.6	1	927.7	1
Quartile 2	1,056.8	1.00 (0.98–1.02)	925.4	0.96 (0.94–0.98)
Quartile 3	1,115.5	1.04 (1.02–1.06)	949.3	0.96 (0.94–0.98)
Quartile 4	1,326.3	1.22 (1.20–1.25)	1,062.0	1.03 (1.01–1.06)
Inadequate education				
Quartile 1	1,002.9	1	907.3	1
Quartile 2	1,078.9	1.07 (1.05–1.10)	942.7	1.01 (0.99–1.03)
Quartile 3	1,129.3	1.11 (1.09–1.13)	957.6	1.02 (1.00–1.05)
Quartile 4	1,325.1	1.27 (1.24–1.30)	1,055.8	1.09 (1.06–1.11)
Low social class				
Quartile 1	1,008.6	1	906.7	1
Quartile 2	1,106.9	1.08 (1.06–1.11)	953.4	1.02 (1.00–1.04)
Quartile 3	1,140.1	1.10 (1.07–1.12)	980.9	1.02 (1.00–1.04)
Quartile 4	1,280.0	1.18 (1.15–1.20)	1,021.8	1.01 (0.99–1.03)
Deprivation index				
Quartile 1	1,014.0	1	917.6	1
Quartile 2	1,072.9	1.05 (1.03–1.08)	930.8	0.99 (0.97–1.01)
Quartile 3	1,126.7	1.09 (1.07–1.11)	961.1	1.01 (0.99–1.03)
Quartile 4	1,319.4	1.24 (1.22–1.27)	1,052.3	1.05 (1.03–1.07)

Barcelona census tracts. 1991 census and 1987–1995 mortality. CI, confidence interval.

*Directly standardized rates per 10⁵ inhabitants.

†Adjusted for age.

IMPLICATIONS

Despite the limitations of this study, the description of inequalities between areas of a city takes on considerable importance, not only for political agents and planners but also for researchers. Hence, those small urban territorial areas where material deprivation and poor health indicators are concentrated can become the target population for a variety of interventions that follow models employed in previous experiences, with demonstrated efficiencies.²⁸ Furthermore, in considering smaller areas, this study has allowed us to appreciate more clearly how areas with similar socioeconomic characteristics can present different mortality—a fact that should serve to orient subsequent more specific studies on social inequalities in health in which CTs may be grouped as a function of particular population and/or health characteristics.

In choosing small areas to be studied, a variety of aspects must be taken into account,²⁹ and analyzing a small number of health variables in very small areas, such as CTs, can guide to other studies with larger areas and more detailed health variables. It could therefore be a first step towards the comparison of a small number of well-defined and purposely selected contrasting areas, which, according to Diez-Roux,²⁹ is a method suitable for investigating area effects. It has the advantage of using locally based definitions of areas and direct collection of data on area characteristics. This may help provide an understanding of the processes through which area environments can affect health.

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