

Socioeconomic factors and mortality in urban settings: the case of Barcelona, Spain

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Abstract

Study objective – This study aimed to describe the relationship between health and socioeconomic indicators in the 38 neighbourhoods of the city of Barcelona, Spain.

Design – Mortality data for 1983–89 and socioeconomic data for each of the 38 neighbourhoods of Barcelona were used. Mortality indicators used were the comparative mortality figure, the ratio of potential years of life lost, and life expectancy at birth. Socioeconomic indicators were the percentage of unemployed, the percentage of illiteracy, monthly telephone usage, the average power and age of cars, and the average rateable value of buildings and of land. The statistical correlation between socioeconomic indicators and mortality indicators was studied by Spearman's rank correlation coefficient.

Setting – The 38 neighbourhoods of Barcelona, Spain.

Measurements and main results – The comparative mortality figure ranged from 87.41–152.43 and the ratio of potential years of life lost from 74.94–237.31 in both sexes. Both the absolute difference and the ratio of the value for the neighbourhood with lowest mortality and that with highest mortality were larger when premature mortality was examined. Life expectancy at birth ranged from 64.77–75.32 years in men and 75.04–81.51 in women. All correlations between mortality and socioeconomic indicators were high and statistically significant: the higher the unemployment and illiteracy levels and the older the cars, the greater the comparative mortality figure and ratio of potential years of life lost, and the lower the life expectancy (negative correlations). Conversely, the higher the telephone use, the more powerful the cars, and the greater the rateable value, the lower the mortality (negative correlations) and the greater the life expectancy. These correlations were greater in males than in females. The highest correlations were with illiteracy.

Conclusions – This study has detected significant differences in mortality in a large town in the Mediterranean region of Europe.

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Health inequalities have been the object of considerable interest since the *Report of the Resource Allocation Working Party* in 1976¹ and

the Black report,² both published in the UK. This continued interest in monitoring health inequalities can be explained by the fact that despite improvements in general health indicators at population level, significant differentials continue to be observed in geographical areas and population subgroups.^{3–6} Some recent studies have shown that these differentials, instead of decreasing, are actually widening,⁷ and as a result of this the first aim set by the WHO *Health for All* strategy was a reduction in health inequalities.⁸

Health inequalities have generally been looked at from two different perspectives. The first, ecological perspective, studies the distribution of population data aggregated by geographical areas. This is the approach that we have used here. The second method considers differences between population groups on the basis of individual data, obtained mainly from mortality data and population surveys, defined by some classification of social status.^{9,10}

The relationship between social factors and health in ecological studies has mainly been established by using unemployment data and proxy indicators for income.^{5,6} The present study also looks at the relationship between the level of education and health.

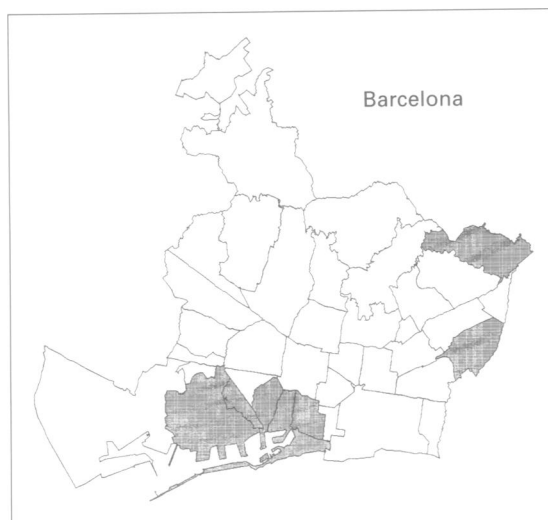
Most published ecological studies on the relationship between social factors and health have used small geographical divisions of countries or regions in which social heterogeneity is assumed. There have been fewer studies of geographical divisions of urban and metropolitan areas. It has become clear that cities are urban nuclei with considerable social heterogeneity. They contain pockets of serious poverty or very substandard living conditions that are associated with disease and substandard levels of health.^{11–13} Published research on health inequalities in urban settings has mainly focussed in northern and central European cities. Since patterns of social support and access to health care may differ between the north and the south of Europe, the social indicators related to health may also be dissimilar, the relationship between social and health indicators may vary in size and explanations for these may be different too.¹⁴ The present study was carried out in an urban setting located in the Mediterranean region of Europe.

This study aimed to describe the relationship between health indicators (life expectancy, overall, and premature death rates) and socioeconomic indicators (unemployment, illiteracy, and proxy indicators for income) using mortality data for 1983–89, in the 38 neighbourhoods of the city of Barcelona, Spain.

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Plan of Barcelona, with the boundaries of the 38 neighbourhoods. The shaded area shows neighbourhoods where both socioeconomic and mortality indicators indicate most disadvantage.

Methods

Barcelona is a city of 1 701 812 inhabitants located on the north east coast of Spain. The city is divided into 10 municipal, administrative districts, each made up of various historical neighbourhoods. The figure is a map of Barcelona showing its division into 38 neighbourhoods. The areas examined in this study are these neighbourhoods, which have populations ranging from 1715–113 900.

A summary of socioeconomic and mortality indicators is given in table 1. The data for socioeconomic indicators are taken from the municipal census of 1986,¹⁵ the motor vehicle census of 1987, the rating survey carried out in 1988, and telephone company data for 1989.¹⁶

MORTALITY DATA

Mortality data for 1983–9 were obtained from death certificates. Deaths during this period

totalled 112 817, and the number for each neighbourhood ranged from 152 to 8832.

SOCIOECONOMIC INDICATORS

The socioeconomic indicators used for each of the neighbourhoods were as follows:

- Percentage of unemployment and illiteracy in the population aged 15 to 64 years;
- Mean of monthly telephone expenditure;
- Mean age of cars;
- Mean engine power of cars;
- Mean of rateable values of buildings and land.

All of these, except unemployment and illiteracy, were adjusted by the number of families living in the neighbourhood. The indicators used are described further in table 1.

HEALTH INDICATORS

A comparative mortality figure (CMF) (an index which compares mortality, standardised by the direct method, for each of the 38 neighbourhoods with the rate for the city as a whole) was calculated for each neighbourhood, using the total population of Barcelona in 1986 as a reference¹⁷ (the value of the CMF for the whole of the city was 100).

Potential years of life lost (PYLL) were also calculated for the age interval between 1 and 70 years as proposed by Romeder and McWhinnie.¹⁸ To compare neighbourhoods, the ratio of potential years of life lost (RPYLL) was calculated as an indicator of premature mortality. This ratio compares the PYLL for each neighbourhood with the PYLL that might be expected on the basis of mortality for the Barcelona population as a whole (indirect standardisation method), using as standard rates the specific rates by age and sex for the whole of Barcelona population in 1986¹⁹ (the value of the RPYLL for the whole of the city was 100).

Finally, life expectancy at birth was calculated using the life table method.²⁰

Table 1 Socioeconomic and mortality indicators used in this study

	Source	Year	Sex	Unit of measure
Socioeconomic indicators:				
Unemployment in the active population aged 15–64 y	Municipal census	1986	M, F, T	%
Illiteracy in the population aged 15–64 y	Municipal census	1986	M, F, T	%
Monthly telephone usage weighted by the no of families in neighbourhood	Telefónica España SA	1989	–	Pesetas/mth
Average power of cars weighted by the no of families in neighbourhood	Vehicle census	1987	–	Fiscal horse power (cc)
Average age of cars weighted by the no of families in neighbourhood	Vehicle census	1987	–	Years
Average rateable value of buildings and services (including residential and commercial) weighted by the no of families in neighbourhood	Rating survey	1988	–	Millions of pesetas
Average rateable value of land weighted by the no of families in neighbourhood	Rating survey	1988	–	Millions of pesetas
Mortality indicators:				
Comparative mortality figure	Death certificates	1983–89	M, F, T	–
Ratio of potential years of life lost	Death certificates	1983–89	M, F, T	–
Life expectancy at birth	Death certificates	1983–89	M, F, T	Years

M = males; F = females; T = total.

STATISTICS

To choose measures of statistical correlation, distributions of social and health indicators were tested for normality with the Kolmogorov-Smirnoff test. None of the indicators used showed normal distributions, even after logarithmic transformation. Consequently, the non-parametric Spearman's rank correlation coefficient²¹ was chosen.

In addition, although the indicators were not normally distributed, multiple linear regression models were used to ascertain whether social variables were acting independently of each other. Weighted multiple regression was modelled using the stepwise approach. The neighbourhood population size was used as the weight. The CMF was used as the dependent variable and all the socioeconomic indicators as independent variables. As an approximation to adjustment by age, the percentage of each neighbourhood population aged 65 and over was entered into the model.

Table 2 Description of socioeconomic and mortality indicators in the neighbourhoods of Barcelona

	Most favourable value			Least favourable value			Difference			Ratio			Median		
	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T
Socioeconomic indicators:															
Unemployment	9.1	17.4	12.5	33.8	44.9	36.4	24.7	27.5	23.9	3.7	2.6	2.9	18.1	26.3	20.6
Illiteracy	0.3	0.5	0.4	9.7	11.9	10.8	9.4	11.4	10.4	32.3	23.8	27.0	1.4	2.5	2.0
Telephone usage			6833			987			-5846			0.14			2439.5
Power of car			22.1			6.3			-15.7			0.29			10.4
Age of car			8.1			12.0			3.9			1.49			10.0
Rateable value buildings			4.2			0.6			-3.6			0.14			1.3
Rateable value land			5.6			0.3			-5.3			0.06			1.0
Mortality indicators:															
CMF	84.47	85.22	87.41	152.99	157.15	152.43	68.52	71.93	65.02	1.81	1.84	1.74	96.3	98.0	97.3
RPYLL	72.75	75.91	74.94	251.35	243.22	237.31	178.60	167.31	162.37	3.45	3.20	3.17	92.5	95.7	92.7
Life expectancy	75.32	81.51	78.64	64.77	75.04	69.94	-10.55	-6.47	-8.70	0.86	0.92	0.89	73.6	80.1	77.2

Difference = least favourable value - most favourable value; ratio = least favourable value / most favourable value; CMF = comparative mortality figure; RPYLL = ratio of potential years of life lost; M = males; F = females; T = total.

Results

The CMF ranged from 87.41-152.43 in the 38 neighbourhoods and the RPYLL from 74.94-237.31 in both sexes. Both the absolute difference and the ratio between the value for the neighbourhood with the lowest mortality and that with the highest mortality were wider when premature mortality was examined (the absolute differences were 65.02 for CMF and 162.37 for RPYLL, and the ratios were 1.74 for CMF and 3.17 for RPYLL). This result was also obtained when males and females were examined separately (table 2).

Life expectancy at birth ranged from 64.77-75.32 years in men and 75.04-81.51 in women (representing a difference between affluent and deprived neighbourhoods of 10.55 years for men and 6.47 years for women). Both the absolute difference and the ratio of most to least affluent neighbourhoods were greater in men (table 2).

Table 2 also shows the variations in socioeconomic indicators among neighbourhoods. Both unemployment and illiteracy were more

frequent in women: there were important differences between the most and least affluent neighbourhoods. There were also large relative differences in average telephone use and average rateable value.

The neighbourhoods in which mortality and socioeconomic indicators showed the most deprivation were in the centre of Barcelona (the historic centre of the city) as well as in the newer neighbourhoods on the edge of the city (the neighbourhoods marked in the figure).

The correlations between mortality indicators and socioeconomic indicators are shown in table 3. As can be observed, all except one of these were high and statistically significant: the higher the rate of unemployment, the greater the amount of illiteracy, and the older the cars, the greater the CMF and the RPYLL, and the lower the life expectancy (negative correlations). Conversely, the higher the telephone use, the more powerful the cars, and the greater the rateable value, the lower the mortality (negative correlations) and the greater the life expectancy. These cor-

Table 3 Spearman correlation coefficients between socioeconomic and mortality indicators for males, females, and both sexes in the 38 neighbourhoods of Barcelona

Socioeconomic indicators	Mortality indicators								
	CMF			RPYLL			Life expectancy		
	M	F	T	M	F	T	M	F	T
Illiteracy	0.824**	0.750**	0.859**	0.591**	0.547**	0.655**	-0.762**	-0.721**	-0.820**
Unemployment	0.754**	0.610**	0.768**	0.580**	0.404*	0.581**	-0.704**	-0.572**	-0.725**
Telephone usage	-0.647**	-0.598**	-0.687**	-0.482*	-0.456*	-0.531**	0.585**	0.603**	0.662**
Power of car	-0.581**	-0.471*	-0.582**	-0.410*	-0.369	-0.466*	0.523**	0.442*	0.549**
Age of car	0.606**	0.484*	0.592**	0.593**	0.437*	0.568**	-0.577**	-0.513**	-0.605**
Rateable value buildings	-0.655**	-0.538**	-0.641**	-0.569**	-0.456*	-0.574**	0.612**	0.526**	0.645**
Rateable value land	-0.650**	-0.590**	-0.690**	-0.377*	-0.383*	-0.453*	0.554**	0.544**	0.629**

CMF = comparative mortality figure; RPYLL = ratio of potential years of life lost; M = males; F = females; T = total.
* p < 0.01; ** p < 0.001.

Table 4 Spearman correlation coefficients between socioeconomic indicators for men and women in the neighbourhoods of Barcelona

	Illiteracy	Unemployment	Telephone usage	Power of car	Age of car	Rateable value buildings	Rateable value land
Illiteracy	1.0**						
Unemployment		0.959**					
Telephone usage			1.0**				
Power of car				1.0**			
Age of car					1.0**		
Rateable value buildings						1.0**	
Rateable value land							1.0**

** p < 0.001.

relations were higher in men than in women. For both sexes, all three mortality indicators showed the highest correlations with illiteracy (Spearman's correlation coefficient = 0.859 for CMF, 0.655 for RPYLL, and -0.820 for life expectancy; $p < 0.001$), followed in magnitude by the correlation with unemployment (Spearman = 0.768 for CMF, 0.581 for RPYLL, and -0.725 for life expectancy; $p < 0.001$).

Both the mortality and socioeconomic indicators were highly intercorrelated: Pearson's correlation coefficient showed similar results. Of the socioeconomic indicators, illiteracy and unemployment showed the highest correlation (Spearman = 0.959, $p < 0.001$; Pearson = 0.941, $p < 0.001$) (table 4). CMF was positively correlated with RPYLL, but both indicators were negatively correlated with life expectancy, with coefficients higher than 0.9 ($p < 0.001$).

Stepwise multiple linear regression was performed with CMF as the dependent variable. Illiteracy and the percentage of the neighbourhood population aged ≥ 65 were retained in the model ($R^2 = 0.77$, F significance = 0.0000; illiteracy slope coefficient = 4.94).

Discussion

Considerable differences in the CMF, RPYLL, and life expectancy were found for both men and women in the 38 districts of Barcelona. For RPYLL, a measure of premature death, both the differences between and ratios of the values of the most and least affluent neighbourhoods were wider. Several authors have already described how differences in mortality are greater when younger subpopulations are taken into account.^{6,22,23}

The differences in mortality indicators observed between neighbourhoods show a geographical distribution of the population related to social and economic factors. The correlations between the CMF, RPYLL, and life expectancy at birth and socioeconomic indicators indicate that the greater the disadvantage in terms of social and economic indicators, the worse the health indicators. The relationship between unemployment and mortality has been investigated extensively, both in ecological studies and studies based on individual data, and unemployment has been related to health inequalities, even independently of social class.^{5,6,24-28}

Illiteracy is an index of the standard of education while the amount of telephone usage and the power and age of cars are indirect measures of income. The rateable value represents the value of the buildings (including residential and commercial property) and the value of land, which have not always been related with income.²⁹ Other studies have used the fact of having a car or not as an indicator of income. Carstairs and Morris⁶ and Townsend⁵ used this to construct their poverty indices and found a relationship between the fact of not having a car and the existence of a high mortality rate. Other authors have also used it as an indirect indicator of socioeconomic level.³⁰ We had the average car statistics (engine power and age)

for all neighbourhoods, variables which are correlated with the other indicators and which may also provide a good indication of poverty or affluence.

We used both positive (life expectancy) and negative (premature death) measures, that have not been used frequently in health inequalities research. Life expectancy is especially important as an overall measure of population health and development, and the measure of premature death (RPYLL) is regarded as an approach to quantifying avoidable mortality in the population.

The most relevant finding is the strong correlation between health indicators and illiteracy - this was even stronger than the correlation found between unemployment rates and mortality. Although ecological data have been used and potential bias (ecological fallacy) does exist, illiteracy is a variable which, at the individual level, is usually determined early in life and does not change thereafter. On the other hand, unemployment and income are not such stable concepts at the individual level, since these can vary through an individual's lifetime. Moreover, the high correlations found in illiteracy, unemployment, and income indicators probably reflect different and partial approaches to the definition of socioeconomic level. Furthermore, using illiteracy or the level of education to classify people into socioeconomic levels has the advantage of yielding a value for *each* adult, whereas occupation is useful only for *employed* people, and has the added drawback of using the occupation based social class of the husband for married women. Given the stronger correlation found in our study between illiteracy and mortality indicators compared with the other socioeconomic indicators, and the fact that illiteracy does not usually change over time, we conclude that illiteracy is a good indicator to use in ecological studies of health and social class.

The level of education and duration of schooling are indicators that have been related to health inequalities, and it is always found that the shorter the period of schooling the poorer the health.^{9,31,32} Kitagawa described how lower mortality was associated with more years of education in the United States.³³ Rogot *et al* found important differences in life expectancy according to the level of education, as well as to family income and occupation. In their study, the lower the socioeconomic level, the lower the life expectancy.³⁴

Several studies have been carried out in cities in the UK, The Netherlands, and the USA showing that there are important inequalities between different districts. Townsend *et al* describe the inequalities found in Bristol.³⁵ They related mortality and morbidity indicators (deaths between 15 and 64 years, deaths over 65 years, stillborn and infant mortality, low birth weight) to socioeconomic indicators (households with fewer rooms than persons, households with no car, economically active persons seeking work, children receiving free school meals, households experiencing disconnection of electricity).³⁵ A study carried out in Rotterdam also found a relationship between

the standardised mortality ratio and socioeconomic indicators (unemployment, persons receiving benefit, 17–18 year olds still in education, and income level) at a neighbourhood level.³⁶ Dayal *et al* described the variations in nine causes of mortality in the city of Philadelphia and related these to a socioeconomic score. They found that the neighbourhoods with a higher mortality (which were central neighbourhoods with a predominantly black population) were those with the lowest socioeconomic scores.³⁷

In Spain, there have been studies on health inequalities associated with socioeconomic factors in towns that have related standardised mortality rates and PYLL to composite socioeconomic indicators.^{38,39} In the city of Barcelona, preliminary studies found differences in mortality between the most deprived neighbourhoods and the rest of the city.^{40–42} Our research group found a correlation between a composite health and deprivation index, similar to that proposed by Townsend *et al*, at neighbourhood level in Barcelona and Valencia.⁴³ No previous research has been undertaken in either Barcelona or in Spain that relates life expectancy and RPYLL to the socioeconomic indicators used in the present study.

We have used both direct and indirect standardisation to calculate the CMF and RPYLL, respectively. The indicators standardised by the indirect method are not strictly comparable between two neighbourhoods; however, direct and indirect standardisation give different results only if the three assumptions proposed by Silcock are violated (population structures of the neighbourhoods must differ, the variation of mortality with age must differ, and both differences must be strongly correlated).⁴⁴ In this study the three assumptions were not violated and, moreover, the CMF and SMR for each neighbourhood showed very similar results.⁴⁵

Unemployment and illiteracy were greater in women and large differences were seen between the various neighbourhoods. These indicators are not standardised by age, and although age limits have been used when measuring them (15 and 64 years), age may be a confounding factor, since both unemployment and illiteracy vary according to age group. However, the percentage of the population aged ≥ 65 was entered into the weighted multiple regression model as an approach to age adjustment. It must be pointed out that only illiteracy and the percentage of the neighbourhood population aged ≥ 65 were entered into the regression model, and not the other variables; this was probably because of the low tolerance and high correlations that exist in the socioeconomic indicators.

The socioeconomic indicators used in this study are those available at neighbourhood level. It would have been interesting to have included other indicators such as occupation or level of income but these data were not available. Furthermore, it is very difficult in Spain to study individual mortality data in relation to social class since most death certificates do not mention the deceased's oc-

cupation,⁴⁶ and mortality and census data cannot be linked.⁴⁷

The other indicators used in this study (the age and power of cars, telephone use, and rateable value) are indirect indicators of the level of income and have not been used in previous research. However, all are highly correlated with each other, which indicates that they are all measuring the same phenomenon. In order to study inequalities in women, it would be interesting to have more specific data, since the indicators used often reflect better the socioeconomic level of men.⁴⁸

The neighbourhoods studied are administrative areas, and hence not homogenous in themselves. Furthermore, they are small areas, which means that the variability of some mortality indicators may be considerable, even after having aggregated seven years.⁴⁹ It would have been interesting therefore to have studied other indicators related with health inequalities such as infant and perinatal mortality^{50–52} but the low number of deaths in these age groups, even aggregating seven years, would show such wide variability that results could be unreliable.

In the future, it would be interesting to study inequalities in more homogenous areas, as well as to look more closely at the various causes of death, and especially at the causes of avoidable death, the study of which could be useful as a criterion for the distribution of health care services and for the development of intersectoral-coordinated actions.

This study has detected significant correlations of illiteracy, unemployment, and income levels with life expectancy, premature death rates (RPYLL), and CMF in the city of Barcelona. Although it is important to develop further research on health inequalities, this evidence is already sufficient to enable the formulation of strategies directed at reducing inequalities.

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