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Trends in socioeconomic inequalities in cirrhosis mortality in an urban area of Southern Europe: a multilevel approach

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ABSTRACT

Background The objective of this study was to analyse inequalities in cirrhosis mortality at individual and area levels, using data from Barcelona for two time periods.

Methods Deaths from cirrhosis in Barcelona of men and women aged 25–74 years during the periods 1992–97 and 1998–2004 were included in the study. A multilevel Poisson regression analysis was performed, with the individual and the area as the respective units of analysis.

Results Inequalities in cirrhosis mortality were observed in relationship to individual and area socioeconomic levels, with the highest death rates among those with lowest educational level and in socioeconomically deprived areas. In the multilevel analysis, the largest effects were observed at the individual level. Between the two periods, death rates decreased for the highest and lowest educational levels (eg, from 116.2 to 88.7 per 100 000 inhabitants among men or men with no education aged 50–74 years), but not for intermediate levels. At the area level, absolute inequalities in mortality tended to decrease; however, higher mortality RR persisted in the least favoured compared to most favoured areas (eg, in men, from 1.74 (95% CI 1.36 to 2.24) to 1.80 (95% CI 1.42 to 2.27) in the two periods).

Conclusion This study demonstrated the persistence of socioeconomic inequalities in cirrhosis mortality in Barcelona between socioeconomic groups and city areas.

3% of all deaths, and that manual workers have consistently experienced liver cirrhosis death rates that are twice or more the rates experienced by non-manual workers. These inequalities appear to have increased in recent years and currently appear to be at historic highs (manual workers have death rates of about 2.5 times those of non-manual workers).⁷

The interactions between individual and area characteristics can be studied with multilevel studies and these have been used in health research since the end of the 1990s.^{8–9} Findings in these studies pointed out that after adjusting for individual and neighbourhood socioeconomic variables, area socioeconomic level affects health outcomes, particularly among people with the lowest socioeconomic position.^{10–15} In the international field, although there are studies analysing inequalities in cirrhosis mortality, there are no multilevel studies analysing individual and area effects.

Taking into account that cirrhosis mortality is one of the important causes of avoidable mortality, that trends in cirrhosis mortality inequalities have been sparsely studied, and that, to the authors' knowledge, there are no multilevel studies analysing individual and area effects in this mortality cause, the objective of this study was to analyse trends in socioeconomic inequalities in liver cirrhosis mortality in a Southern European city (Barcelona) at individual and area levels.

INTRODUCTION

Global liver cirrhosis death rate was the twelfth most important cause of death in 1990, and future projections estimate it will be the eleventh in this ranking.¹ Although there is plenty of scientific evidence to support the connection between individual socioeconomic position and health, showing that people with a less favourable socioeconomic position have higher morbidity and death rates than those with a more favourable socioeconomic position,^{2–3} there are few studies associating cirrhosis mortality with socioeconomic position.⁴

Recently, inequalities in mortality related to alcohol consumption have been described in European countries,⁵ and a few studies analysing inequalities in mortality have also included cirrhosis as a specific cause of death.⁶ Trends studies in cirrhosis mortality are also very scarce. An Australian study has shown that despite decreasing overall liver cirrhosis death rates over time, liver cirrhosis mortality continues to account for about

METHODS

Design and study population

A trends study of two cross-sections (1992–97 and 1998–2004), using individual and area data, was designed. These periods were chosen because 1992 is the first year when data were available on the educational level of the deceased, and 2004 is the last year available at the time of study. Two cross-sections were used to allow for enough observations for the stratification (sex, age group, educational level) and to see more easily the trends in mortality in those 13 years. The study population consisted of men and women aged between 25 and 74 living in Barcelona. Cirrhosis deaths among residents in the city aged between 25 and 74, with information on socioeconomic level at individual and area levels in both study periods were included (1868 men and 1057 women). The geographical areas corresponded to the 66 Barcelona primary health areas under the administrative division of 1994, with a median of 23 651 inhabitants per area.

This administrative division reflexes the area of influence of the city primary health centres, and respects the historical neighbourhoods of the city.

Information sources

Cirrhosis deaths that occurred during 1992–2004 were selected from the mortality registry of Barcelona. This register is based on information on the underlying cause of death obtained from death certificates, as coded by specialists. The register includes all deaths of residents in the city.¹⁶ Up to 1999 the underlying cause of death was coded using the International Classification of Diseases (ICD) 9th revision, and from 2000 using ICD-10 (ICD-9 code 571 and ICD-10 codes K70, K72.1, K73, K74, K76.1 and K76.9). The municipal population census (a census obtained from the city administration) was used to obtain the area of residence and educational level of each deceased person. Deaths where information was missing about the area of residence or

the educational level were excluded from the analysis (197 deaths among men (9.1%) and 98 deaths among women (8.5%)). (table 1). The population statistical censuses (obtained from the Spanish Institute of Statistics only for statistical use) of 1991, 1996 and 2001 were used to estimate the population at risk in the study periods and to stratify them by sex, educational level and area of residence. Moreover, the information used to construct the index of socioeconomic level at area level also was extracted from these censuses.

Variables and indicators

As individual variables, sex, age, educational level, year of death (1992–97 and 1998–2004), and area of residence (obtained through the census tract and the district of residence) were used. Age was categorised into two groups, 25–49 years old and 50–74 years old, in order to study if inequalities changed by age group; the number of individuals obtained from the two

Table 1 Distribution of cirrhosis deaths and of population (number and percentages) by age group, individual educational level and area socioeconomic level, in men and women of Barcelona in both study periods

1992–97	Deaths				Population			
	Men	n %	Women	n %	Men	n%	Women	n%
25–49 years old								
Illiterate or with no education	23	(10%)	16	(23%)	46741	(3%)	69936	(4%)
Not finished primary studies	92	(40%)	19	(28%)	293185	(19%)	362068	(23%)
Finished primary studies or more	116	(50%)	33	(49%)	1179302	(78%)	1172054	(73%)
Total	231	(100%)	68	(100%)	1519228	(100%)	1604058	(100%)
50–74 years old								
Illiterate or with no education	326	(38%)	261	(48%)	280472	(22%)	476689	(31%)
Not finished primary studies	308	(35%)	191	(35%)	418649	(34%)	586764	(39%)
Finished primary studies or more	231	(27%)	90	(17%)	545605	(44%)	452734	(30%)
Total	865	(100%)	542	(100%)	1244726	(100%)	1515187	(100%)
Area socioeconomic level								
1, least favoured	348	(32%)	182	(30%)	536905	(19%)	565926	(18%)
2	288	(26%)	164	(27%)	698176	(25%)	772933	(25%)
3	250	(23%)	136	(22%)	741539	(27%)	840415	(27%)
4, most favoured	210	(19%)	128	(21%)	787334	(29%)	940971	(30%)
Total	1096	(100%)	610	(100%)	2765954	(100%)	3120245	(100%)
Missing data								
Educational level	112	(9%)	52	(8%)				
Area of residence	1	(0%)	0	(0%)				
1998–2004	Deaths				Population			
	Men	n %	Women	n %	Men	n%	Women	n%
25–49 years old								
Illiterate or with no education	20	(11%)	11	(19%)	59032	(3%)	59478	(3%)
Not finished primary studies	61	(33%)	17	(29%)	179201	(9%)	177938	(9%)
Finished primary studies or more	102	(56%)	30	(52%)	1681392	(88%)	1752800	(88%)
Total	183	(100%)	58	(100%)	1919625	(100%)	1990116	(100%)
50–74 years old								
Illiterate or with no education	190	(28%)	164	(42%)	214147	(15%)	359049	(21%)
Not finished primary studies	252	(36%)	141	(36%)	371804	(27%)	561384	(33%)
Finished primary studies or more	247	(36%)	84	(22%)	817714	(58%)	777989	(46%)
Total	689	(100%)	389	(100%)	1403665	(100%)	1698422	(100%)
Area socioeconomic level								
1, least favoured	271	(31%)	130	(29%)	643551	(19%)	652845	(18%)
2	230	(27%)	109	(24%)	837052	(25%)	918498	(25%)
3	186	(21%)	110	(25%)	899523	(27%)	1010561	(27%)
4, Most favoured	185	(21%)	98	(22%)	943164	(29%)	1106734	(30%)
Total	872	(100%)	447	(100%)	3323290	(100%)	3688638	(100%)
Missing data								
Educational level	78	(8%)	42	(8%)				
Area of residence	6	(1%)	4	(1%)				

Table 2 Cirrhosis death rates, attributable risk and RR by age groups and individual educational level, in men and women of Barcelona in both study periods

Men	1992–97				1998–2004			
	DR	AR	RR	RR (95% CI)	DR	AR	RR	RR (95% CI)
25–49 years old								
Illiterate or with no education	49.21	39.37	5.00	1.54 to 16.21	33.88	27.81	5.58	1.24 to 25.19
Not finished primary studies	31.38	21.54	3.19	1.55 to 6.55	34.04	27.97	5.61	2.07 to 15.21
Finished primary studies or more	9.84		1		6.07		1	
50–74 years old								
Illiterate or with no education	116.23	73.89	2.75	1.75 to 4.30	88.72	58.51	2.94	1.74 to 4.97
Not finished primary studies	73.57	31.23	1.74	1.10 to 2.74	67.78	37.57	2.24	1.38 to 3.65
Finished primary studies or more	42.34		1		30.21		1	

Women	1992–97				1998–2004			
	DR	AR	RR	RR (95% CI)	DR	AR	RR	RR (95% CI)
25–49 years old								
Illiterate or with no education	22.88	20.06	8.13	4.00 to 16.51	18.49	16.78	10.81	3.43 to 34.01
Not finished primary studies	5.25	2.43	1.86	0.95 to 3.64	9.55	7.84	5.58	2.01 to 15.01
Finished primary studies or more	2.82		1		1.71		1	
50–74 years old								
Illiterate or with no education	54.75	34.87	2.75	1.02 to 7.41	45.68	34.88	4.23	2.24 to 8.01
Not finished primary studies	32.55	12.67	1.64	0.58 to 4.62	25.12	14.32	2.33	1.21 to 4.48
Finished primary studies or more	19.88		1		10.80		1	

DR, death rates per 100 000 inhabitants; AR, attributable risk per 100 000 inhabitants.

cross-sections and the three categories of educational level did not allow for more than two age groups.

Educational level, that is, the indicator of the individual socioeconomic position, was grouped into three categories: illiterate or with no education, did not finish primary studies and finished primary studies or more. More disaggregated educational level groups showed that cirrhosis mortality inequalities by educational level differed mainly between these three groups.

A composite index of the area socioeconomic level was used. This index was constructed with principal component analysis, using the following indicators: the area unemployment rate among men aged 16 years or older for 1986, 1991, 1996 and 2001, and the percentage of men aged 16–29 years who had primary studies or less in each area for 1991, 1996 and 2001. The index was divided into quartiles in order to group primary health areas according to their socioeconomic level: the first quartile corresponded to the least favoured areas and the fourth quartile to the most favoured ones.

Data analysis

Analysis was carried out for both study periods (1992–97 and 1998–2004) and for both sexes. As a descriptive analysis, specific cirrhosis death rates were calculated at individual and area levels. In order to be able to analyse changes in relative, as well as in absolute, educational level inequalities, the RR and the attributable risks (AR) were obtained, also at individual and ecological levels. In the ecological analysis, maps with fixed intervals were drawn according to the quartiles of the distribution of age-standardised death rates in both periods in men and women separately. Finally, Poisson models were adjusted in both age groups, taking the death rates logarithm as a dependent variable, and the socioeconomic level index as an independent variable, estimating cirrhosis mortality RR in the four area groups, together with 95% CIs.

Multilevel analysis was carried out using Poisson models, with the individual data on the first level, and the area data on the second level. This kind of model estimates the relationship

between cirrhosis mortality, age group and educational level, and the area variable (groups of areas according to the socioeconomic level index). Three models were created: model 1: empty model, with a random parameter (constant); model 2: adding individual variables (age, educational level and the interaction between

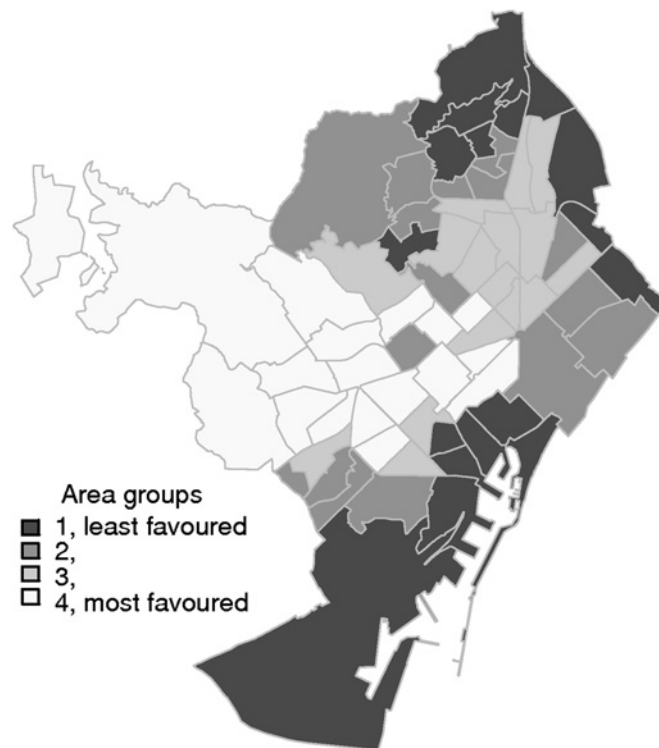


Figure 1 Distribution of areas of Barcelona according to quartiles of socioeconomic level index. The socioeconomic level index was constructed with principal component analysis, using the following indicators: the area unemployment rate among men aged 16 or older for 1986, 1991, 1996 and 2001, and the percentage of men aged 16–29 having finished primary studies in each area for 1991, 1996 and 2001.

both); and model 3: adding the area variable to quantify the variation between area groups. Moreover, the values of the second level variations of each of these models were included, the proportional change in variances (calculated as the variation in percentage terms between the current model and the previous specified model, ie, a positive result indicates a reduction of the variability) and the median rate ratio (a measure used to quantify the variation among primary health areas, ie, the higher the median RR, the higher between-areas variation).¹⁷

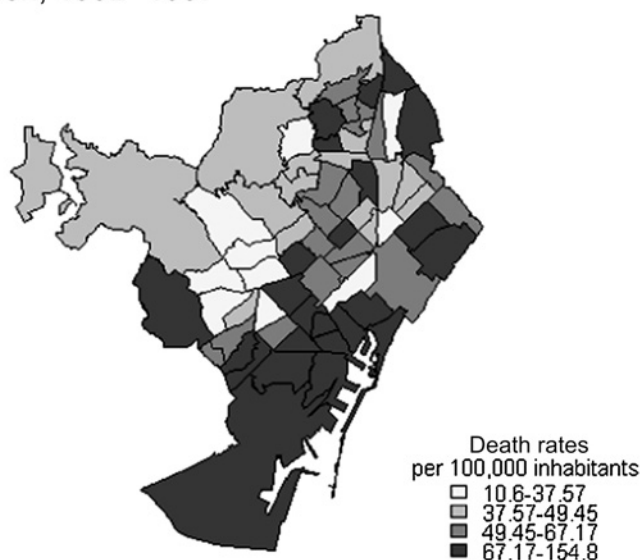
RESULTS

Table 1 presents the distribution of deaths and population by the main variables. The percentage of people who are illiterate or with no education is higher among cirrhosis deaths than among the general population. Similarly, the percentage of men who

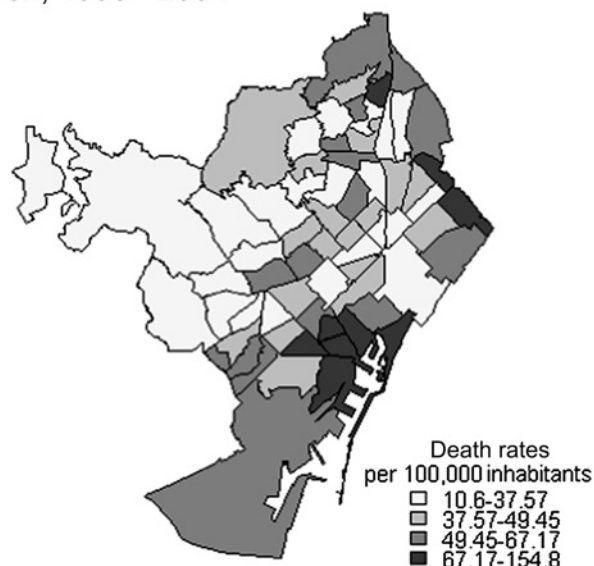
have not finished primary studies is higher among cirrhosis deaths than among the general population. Finally, the least favoured areas, despite having less population than the rest of the groups, have more cirrhosis mortality cases than the other areas. There is no variation in the percentage of cirrhosis deaths between study periods in each area socioeconomic level.

The individual analysis shows that the highest death rates are among men who are illiterate or with no education between 50 and 74 years old in the first study period (table 2). Death rates have diminished between the two periods as well as AR comparing the highest and the lowest educational level groups. For example, AR for women aged 25–49 years old who did not finish primary studies is 20.06 per 100 000 inhabitants in the first study period, and 16.78 per 100 000 inhabitants in the second. Death rates and AR are higher in men than in women for both

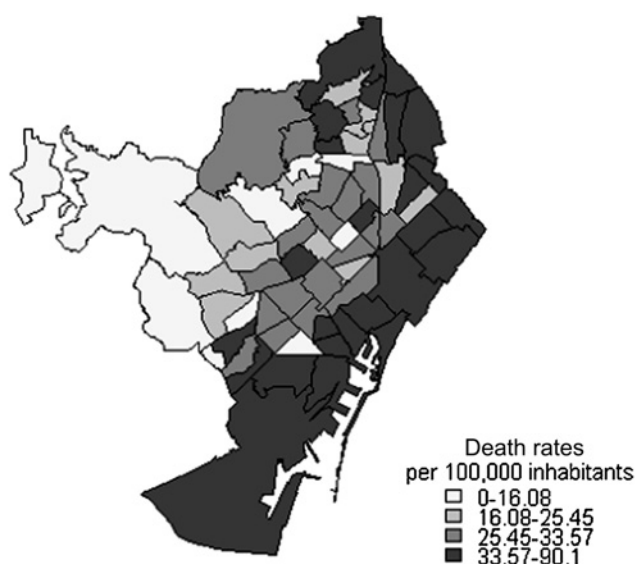
Men, 1992 -1997



Men, 1998 - 2004



Women, 1992 -1997



Women, 1998 - 2004

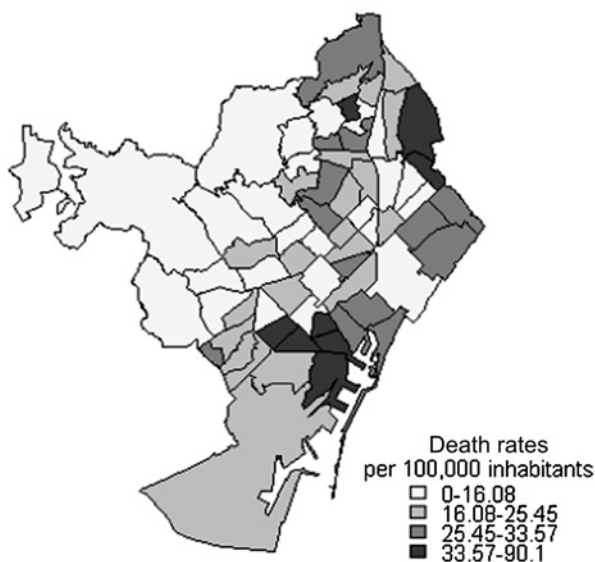


Figure 2 Distribution of age-standardised cirrhosis death rates among areas of Barcelona for people aged 50–74, in men and women, in both study periods.

study periods and age groups. Finally, RR comparing mortality with the group with more studies, are highest and statistically significant among men and women who are illiterate or with no education for both study periods and age groups; however, these relative inequalities tend to increase in the second period.

Figure 1 shows the distribution of the areas in quartiles according to the socioeconomic position index; the least favoured areas are downtown in the city (near the Mediterranean coast), the northeast and coastal areas, whereas the most favoured are in the northwest.

Figure 2 shows the area distribution of age-standardised death rates in men and women aged 50-74 in both study periods. Death rates follow the same pattern as the area socioeconomic index: northeastern and centre littoral areas have the highest death rates whereas northwestern areas have the lowest. Death rates have decreased over time and generally there is an improvement in many areas. Nevertheless, the downtown city areas still have the highest death rates, and the northwest areas have the lowest death rates (especially among women).

The associations found in the ecological analysis are presented in table 3. For men and women and for both study periods, RR are statistically significant in the least favoured areas. RR are highest among those aged 25-49 years, and among women. Although RR do not vary in the two periods, AR tend to decrease, mainly among men, for example, in the 50-74 age group AR decreases from 52.82 to 38.45 per 100 000 among illiterate men or with no education.

Table 4 shows the results of the multilevel analysis. The individual and area patterns are the same. Those with less years of schooling have the highest RR, as well as those living in the least favoured areas. At individual level, and except for women aged 25-49 in the first study period, RR are greater than 1 and are significant for those who are illiterate or with no education and those who did not finish primary studies, in both age groups

and in both study periods. It is not possible to say whether there are differences between educational categories as the CIs partially overlap. In men and women, RR are higher in the 25-49 age group. In the second study period, RR for men and women aged 25-49 who did not finish primary studies are significantly higher than in the first study period: among men, RR are 2.43 (95% CI 1.89 to 3.12) in the first study period and 4.50 (95% CI 3.31 to 6.13) in the second study period; among women, RR are 1.16 (95% CI 0.72 to 1.87) and 4.05 (95% CI 2.11 to 7.75) respectively. RR among illiterate women or with no education aged 25-49 increases in the second study period: RR is 3.83 (95% CI 1.94 to 7.54) in the first study period and 7.80 (95% CI 4.16 to 14.62) in the second study period.

Multilevel analysis shows that after adjusting for age group and educational level, in both study periods and among men and women, those living in the least favoured areas have the highest RR, being similar in the two periods. Results show that there is still significant variability among areas in both study periods and both sexes. For example, in the first study period, variability is 0.086 and 0.053 in men and women respectively. After incorporating the area socioeconomic level index in the second level (model 3), there is still significant variability among men in both study periods; this is not the case for women.

DISCUSSION

To the authors' knowledge, this is the first study that analyses cirrhosis mortality taking into account individual and area level effects. Results show that inequalities in cirrhosis mortality in Barcelona were observed in relation to both individual and area socioeconomic levels. Moreover, those inequalities persisted when simultaneously analysing individual and area characteristics. Among men and women in both age groups there has been a decrease in death rates as well as in absolute educational level

Table 3 Cirrhosis death rates, attributable risk, RR by age groups and area socioeconomic level, in men and women of Barcelona in both study periods

	1992-97				1998-2004			
	DR	AR	RR	RR (95% CI)	DR	AR	RR	RR (95% CI)
Men								
25-49 years old								
1, least favoured	31.57	24.02	3.38	2.39 to 4.77	19.01	13.07	2.59	1.65 to 4.06
2	15.11	7.56	1.61	1.11 to 2.34	11.28	5.34	1.53	0.95 to 2.45
3	12.00	4.45	1.27	0.87 to 1.86	4.63	-1.31	0.78	0.44 to 1.38
4, most favoured	7.55		1		5.94		1	
50-74 years old								
1, least favoured	103.35	52.82	2.04	1.65 to 2.53	76.26	38.45	2.05	1.84 to 2.27
2	71.98	21.45	1.42	1.14 to 1.77	49.13	11.32	1.32	1.18 to 1.47
3	61.57	11.04	1.22	0.97 to 1.52	42.51	4.70	1.13	1.01 to 1.26
4, most favoured	50.53		1		37.81		1	
Women								
25-49 years old								
1, least favoured	7.56	5.73	4.16	2.60 to 6.64	7.27	5.93	4.39	2.79 to 6.92
2	5.38	3.55	2.94	1.84 to 4.70	2.66	1.32	1.99	1.20 to 3.30
3	3.82	1.99	1.67	1.03 to 2.71	2.01	0.67	1.50	0.89 to 5.53
4, most favoured	1.83		1		1.34		1	
50-74 years old								
1, least favoured	55.86	29.43	2.13	1.43 to 3.18	35.21	17.59	2.06	1.41 to 3.02
2	37.39	10.96	1.40	0.93 to 2.12	22.36	4.74	1.29	0.88 to 1.91
3	30.10	3.67	1.13	0.74 to 1.74	21.39	3.77	1.22	0.83 to 1.80
4, most favoured	26.43		1		17.62		1	

DR, death rates per 100 000 inhabitants; AR, attributable risk per 100 000 inhabitants.

Table 4 Multilevel association between cirrhosis mortality and individual and area socioeconomic level, in men and women of Barcelona, in both study periods and age groups

Men	1992–97			1998–2004				
	RR	RR (95% CI)		RR	RR (95% CI)			
25–49 years old								
Illiterate or with no education	3.17	2.05 to 4.90		4.30	2.47 to 7.48			
Not finished primary studies	2.43	1.89 to 3.12		4.50	3.31 to 6.13			
Finished primary studies or more	1			1				
50–74 years old								
Illiterate or with no education	2.09	1.70 to 2.56		2.05	1.67 to 2.51			
Not finished primary studies	1.47	1.25 to 1.74		1.77	1.46 to 2.14			
Finished primary studies or more	1			1				
Area socioeconomic level								
1. least favoured	1.74	1.36 to 2.24		1.80	1.42 to 2.27			
2	1.23	0.97 to 1.56		1.31	1.06 to 1.63			
3	1.10	0.88 to 1.38		1.10	0.88 to 1.36			
4. most favoured	1			1				
Models*	σ_i^2	p Value	PCV (%)	MRR	σ_i^2	p Value	PCV (%)	MRR
Model 1	0.128	<0.001		1.41	0.037	0.109		1.20
Model 2	0.086	<0.001	32.97	1.32	0.074	<0.001	–99.73	1.29
Model 3	0.050	<0.001	73.00	1.23	0.036	0.023	51.08	1.19
Women	1992–97			1998–2004				
	RR	RR (95% CI)		RR	RR (95% CI)			
25–49 years old								
Illiterate or with no education	3.83	1.94 to 7.54		7.80	4.16 to 14.62			
Not finished primary studies	1.16	0.72 to 1.87		4.05	2.11 to 7.75			
Finished primary studies or more	1			1				
50–74 years old								
Illiterate or with no education	1.79	1.37 to 2.35		2.86	2.14 to 3.82			
Not finished primary studies	1.28	1.00 to 1.65		1.80	1.35 to 2.41			
Finished primary studies or more	1			1				
Area socioeconomic level								
1. least favoured	1.57	1.26 to 2.00		1.48	1.11 to 1.98			
2	1.10	0.91 to 1.32		0.98	0.73 to 1.32			
3	0.91	0.71 to 1.17		1.02	0.73 to 1.42			
4. most favoured	1			1				
Models*	σ_i^2	p Value	PCV (%)	MRR	σ_i^2	p Value	PCV (%)	MRR
Model 1	0.101	<0.001		1.35	<0.001	0.240		1.00
Model 2	0.053	0.009	47.97	1.24	0.047	0.063	–36384.62	1.22
Model 3	<0.009	0.335	82.06	1.09	0.001	0.162	99.92	1.03

σ_i^2 second level variances; PCV, proportional change in variances; MRR, median rate ratio.

*Model 1: empty model; model 2: adding individual variables; model 3: adding the area variable of the area.

inequalities between the two periods; however, relative inequalities have increased in the 25–49 age group, especially among women.

Results are similar to other studies done in Barcelona at individual and ecological levels relating global mortality and other mortality causes to the individual and the area socioeconomic levels: those living in less favoured areas have higher death rates than those living in more favoured ones, and the risk of dying among individuals with no education was higher than in those with intermediate or university studies.^{16 18–23} These findings are in line with ecological studies on inequalities in avoidable mortality in small areas of several Spanish cities, which also described inequalities in cirrhosis mortality among men and women.²⁴ The present study adds the analysis of the interaction of individual and area effects.

Mortality inequalities by educational level in men and women could be due to behaviour patterns related to excessive

alcohol consumption or could be due to the higher risk of hepatitis B and C infection, in the sense that alcohol consumption and risky behaviours are more frequent among people with lower educational levels. Although in Spain excessive alcohol consumption is higher among men with the lowest socioeconomic position, studies undertaken in Barcelona did not find socioeconomic inequalities in excessive alcohol consumption, although those studies are based on self-declared information in health surveys, and under-reporting of alcohol consumption cannot be ruled out.^{25 26} However, excessive alcohol consumption (>40 g/day) has been studied in the homeless population in Barcelona and has been found in 54% of those living on the streets and in 42% of those living in sheltered housing.²⁷ Studies on drinking trends of the Spanish population using data from the National Health Survey show that drinking trends seem to remain stable: ‘weekly drinkers’ aged between 25 and 34 years have increased consistently in

men and women, whereas 'daily drinkers' have decreased in both genders.²⁸ Consumption data show a progressive decrease of the consumption per capita observed in recent years, going from 99.8 l in 1996 to 90.1 l in 2006.²⁹

A study from Australia that analysed trends in inequalities in cirrhosis mortality found an increase in relative inequalities suggesting that lower socioeconomic position groups have, over time, increased their level of harmful alcohol consumption relative to middle and higher socioeconomic position groups.⁷ Another study showed a substantial increase in alcohol-related mortality mainly in a low socioeconomic group, among men and women, after a reduction in the price of alcohol in Finland.³⁰

The least favoured areas have the highest death rates, and the differences between area groups are not equal. These differences still persist when individual socioeconomic level is taken into account suggesting the existence of an area effect. This is also the case in other multilevel studies analysing socioeconomic inequalities in mortality in Barcelona.^{14 31} Higher cirrhosis death rates in least favoured areas could be related to the existence of marginal populations in those areas, such as drug addicts and the homeless,^{14 27} alcohol consumption being a mechanism to cope with the marginalisation, and to cultural patterns of alcohol use and other poverty-related conditions. For example, hepatitis C prevalence in the general Spanish population is around 1.6–2.6%, whereas prevalence is around 40% and 98% in socially excluded groups such as drug addicts and prison inmates.³² Barcelona is not an exception: hepatitis C prevalence among intravenous drug users is between 83% and 97%.³³ Despite the importance of analysing socioeconomic inequalities in cirrhosis mortality related to hepatitis B and C infection, there are no data available to analyse this relationship.

Issues such as access to the healthcare system, to new treatments and to liver transplants for those patients in the last stage of liver failure should not present socioeconomic inequalities. In the region where Barcelona is located, social class inequalities have not been found in the utilisation of hospital care, and the prioritisation of candidates for liver transplants is made using clinical criteria.^{34 35}

One fact that could explain the decrease of cirrhosis death rates, and therefore the decrease in the absolute differences between educational level groups in Barcelona, is the substantial increase in the number of liver transplants over time.³⁶ Another is better graft survival results, influenced by improvements in pharmacological treatment and in surgical and anaesthetic techniques in patients with a transplant procedure.³⁷ However, it is assumed that the impact on the results of the present study is minimal.

There are some limitations to the present study. First, the underlying cause of death was coded using ICD-9 up to 1999 and ICD-10 from 2000. However, no differences in cirrhosis death rates have been found using both classifications.³⁸ Second, the educational level of the individual was obtained from the municipal census and the population at risk was obtained from the statistical census, which could lead to bias, although this bias is expected to be almost non-existent because the distributions of the population by educational level from both sources are very similar (data not shown).

Finally, the area socioeconomic level was measured with a composite index that included male unemployment and percentage of men having primary studies or less, as both indicators are very good descriptors of area socioeconomic level and have been used previously.^{39 40} However, it would be convenient to have other area indicators such as the percentage of people with excessive alcohol consumption, the poverty level and the prevalence of hepatitis B and C infection. Although, it should be

What is already known on this subject

- ▶ Inequalities in mortality related to alcohol consumption have been described in European countries and a few studies that have analysed inequalities in mortality have also included cirrhosis as a specific cause of death.
- ▶ Trends studies in inequalities in cirrhosis mortality are also very scarce. There are no studies analysing individual and area effects in this cause of death.

What this study adds

- ▶ Inequalities in cirrhosis mortality in Barcelona were observed in relationship to both individual and area socioeconomic levels.
- ▶ Among men and women there has been a decrease in death rates as well as in absolute educational level inequalities between the two periods; however, relative inequalities have increased in the 25–49 year age group, especially among women.
- ▶ These results have to be taken into account when implementing policies to reduce the determinants of liver cirrhosis.

noted that, in the multilevel analysis, area socioeconomic level might be overestimated because individual socioeconomic position is measured by educational level only as it is impossible to obtain other individual characteristics such as income or wealth. This could also lead to underestimation of the individual RR. The significant variability of the multilevel models among men in both study periods may mean that there are alternative explanations for male cirrhosis mortality not included in the models.

To conclude, this study has shown the persistence of inequalities in cirrhosis mortality in Barcelona at individual and area levels in the period 1992–2004. However, a general decrease in absolute inequalities in educational level has been found. These results have to be taken into account when implementing policies to reduce the determinants of liver cirrhosis, designing tailored interventions to the socioeconomic groups with the highest risk of cirrhosis mortality.

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