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Socioeconomic inequalities in suicide mortality in European urban areas before and during the economic recession

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Background: Few studies have assessed the impact of the financial crisis on inequalities in suicide mortality in European urban areas. The objective of the study was to analyse the trend in area socioeconomic inequalities in suicide mortality in nine European urban areas before and after the beginning of the financial crisis. **Methods:** This ecological study of trends was based on three periods, two before the economic crisis (2000–2003, 2004–2008) and one during the crisis (2009–2014). The units of analysis were the small areas of nine European cities or metropolitan areas, with a median population ranging from 271 (Turin) to 193 630 (Berlin). For each small area and sex, we analysed smoothed standardized mortality ratios of suicide mortality and their relationship with a socioeconomic deprivation index using a hierarchical Bayesian model. **Results:** Among men, the relative risk (RR) comparing suicide mortality of the 95th percentile value of socioeconomic deprivation (severe deprivation) to its 5th percentile value (low deprivation) were higher than 1 in Stockholm and Lisbon in the three periods. In Barcelona, the RR was 2.06 (95% credible interval: 1.24–3.21) in the first period, decreasing in the other periods. No significant changes were observed across the periods. Among women, a positive significant association was identified only in Stockholm (RR around 2 in the three periods). There were no significant changes across the periods except in London with a RR of 0.49 (95% CI: 0.35–0.68) in the third period. **Conclusions:** Area socioeconomic inequalities in suicide mortality did not change significantly after the onset of the crisis in the areas studied.

Introduction

One of the most important causes of premature mortality and mortality among the young population in Europe is suicide. Eurostat collects approximately 60 000 suicides yearly for the European Union (EU). Moreover, suicide mortality is higher in populations with a low socioeconomic position.[1–6] A systematic review analysing area socioeconomic disadvantage and suicide behaviour in Europe described a significant association between socioeconomic disadvantage and suicide behaviour.[7] The geographical units of analysis in the studies reviewed ranged from small neighbourhoods to large cities but only a small number of studies focussed on the impact on urban areas.[7–11]

During the financial crisis that started in 2008, suicide mortality increased in many countries, including European countries, a finding that has been demonstrated in several systematic reviews.[12–14] However, the impact of the financial crisis on socioeconomic inequalities in suicide mortality has been less well analysed, with discrepant results, and has been even less in urban areas where the majority of the population lives.[15–18]

Therefore, the objective of this study was to analyse the trend in area socioeconomic inequalities in suicide mortality in nine European urban areas in two periods: before (2000–2003, 2004–2008) and after (2009–2014), the beginning of the financial crisis. Our hypothesis was that these inequalities increased in the cities and metropolitan areas analysed during the economic recession because people living in areas with higher socioeconomic deprivation tend to be those most affected by the crisis,[13,19] especially in the countries most negatively impacted by the crisis.

Methods

Design, units of analysis and study population

This ecological study of trends was based on three periods, two periods before the economic crisis and one during the crisis (2000–2003, 2004–2008 and 2009–2014). The units of analysis were the small areas of nine European urban areas (Athens metropolitan area, Barcelona city, Berlin-Brandenburg metropolitan region, Brussels metropolitan area, Lisbon metropolitan area, Greater London, Prague city, Stockholm metropolitan area and Turin city). The median population of the areas ranged from 271 (Turin) to 193 630 (Berlin) (table 1). These urban areas were selected by the EURO-HEALTHY project (a project funded by Horizon2020), to cover different areas within the EU with a diverse cultural, geographical and economic background (http://www.euro-healthy.eu/members). The study population consisted of the individuals residents in these areas during the different periods.

Data

The data used in the present study were the following:

(1) Mortality, corresponding to the number of deaths due to suicide and intentional self-harm (International Classification of Diseases-ICD-9n revision: E950–E959, ICD 10: X60–X84) by area, age-group and sex. Mortality data were obtained mainly from mortality registries.
(2) Population, corresponding to the number of inhabitants living in the area. Most of the urban areas had population data for the whole period or for at least 2 years. Population data were stratified by age (5-year groups) and sex and were obtained from census or population registries.
(3) Socioeconomic data, obtained from the census, consisting of several indicators selected to identify the level of deprivation of the areas.

Measures

The suicide mortality indicator used for the analysis was the standardized mortality ratio (SMR). For descriptive purposes, we calculated the indirectly standardized rate, calculated by multiplying the SMR for the city/metropolitan area by the crude rate in the standard population which was the population of the EU-28 in the year 2007.

We built a composite socioeconomic deprivation index using principal component analysis within each city. This analysis included the following variables for 2001 (or 2002 in the case of Berlin): the percentage of unemployment (≥16 years, economically active population), the percentage of manual workers (≥16 years), the percentage of people with primary education as the highest attainment [International Standard Classification of Education (ISCED) 0 and 1, except for London, which was ISCED 0, 1, 2] (25–64 years) and the percentage of people with university education (25–64 years). The percentage of manual workers was not available for Stockholm and the index was performed with the other three indicators. The index was the first component of the principal component analysis performed.

Data analysis

The SMR is dependent on population size since its variance is inversely proportional to the expected values; thus areas with a small population size tend to show highly unstable estimates. To

Table 1 Description of the nine European urban areas: number and type of small areas, population year and first, second and third quartiles of the population by small area, for men and women

Urban area	Name used	Number of small areas	Type of small areas	Population							
				Year	Men				Women			
					Total	p25	p50	p75	Total	p25	p50	p75
Athens metropolitan area	Athens	40	Municipalities	2001	1 577 172	18 565	29 745	35 489	1 710 446	20 136	32 163	39 965
Barcelona city	Barcelona	1491	Census tracts	2000	697 563	365	457	577	796 497	418	517	648
Berlin-Brandenburg metropolitan region	Berlin	30	Districts	2002	2 927 616	66 326	96 176	129 157	3 047 188	68 041	97 454	130 560
Brussels metropolitan area	Brussels	145	Neighbourhoods	2001	464 364	2727	4004	5707	505 673	3058	4288	6172
Lisbon metropolitan area	Lisbon	188	Parishes	2001	1 275 813	2694	5437	8962	1 386 314	2938	5835	9904
Greater London	London	983	Census tracts	2001	3 597 120	3442	3810	4284	3 725 283	3526	3960	4382
Prague city	Prague	57	Districts	2001	549 652	1010	2206	15 001	610 466	1024	2100	14 838
Stockholm metropolitan area	Stockholm	1299	Census tracts	2001	897 487	218	560	1050	936 977	232	599	1104
Turin city	Turin	2678	Census tracts	2000	425 782	88	129	196	465 987	96	142	215

smooth the SMR, we used the hierarchical Bayesian model proposed by Besag, York and Mollié.[20] 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. We estimated smoothed SMR (sSMR) for both sexes and periods using the following model:

$$O_i \sim \text{Poisson}(E_i\theta_i)$$

$$\log(\theta_i) = \alpha + S_i + H_i(model1)$$

where, for each area i, O_i is the number of observed cases, E_i the expected cases, θ_i, the sSMR, with respect to the European population, S_i the spatial effect and H_i the heterogeneous effect. Expected cases were calculated by indirect standardization taking the suicide mortality rates of the EU-28 in 2007 as reference (using the year approximately in the middle of the period), by age (using 5-year groups).

In addition, to analyse the trend in socioeconomic inequalities, we fitted an ecological regression model, which included the socioeconomic deprivation index (D), the period (through two dummy variables P_2 and P_3) and their interaction:

$$O_{it} \sim \text{Poisson}(E_{it}\theta_{it})$$

$$\log(\theta_{it}) = \alpha + \beta_1 D_i + \beta_2 P_{2t} + \beta_3 P_{3t} + \beta_4 P_{2t} D_i + \beta_5 P_{3t} D_i + S_{it} + H_{it}(model2)$$

where, for each area i and period t ($t=1$ for the first period, $t=2$ for the second period and $t=3$ for the third period), O_{it} is the number of observed cases, E_{it} the expected cases, θ_{it} the sSMR with respect to the European population, S_{it} the spatial effect and H_{it} the heterogeneous effect. Finally, P_{2t} and P_{3t} took the following values: $P_{jt}=1$ if $j=t$, and 0 otherwise. The expected cases were calculated as in the previous model. Changes between periods in the relationship between socioeconomic deprivation index and mortality were evaluated through the interactions included in model 2. Specifically, we studied the change between the first and second period (β_4) and the second and third period ($\beta_5 - \beta_4$).

In the two models (models 1 and 2), an intrinsic conditional autoregressive prior distribution was assigned to the spatial effect, which assumed that the expected value of each area coincided with the mean of the spatial effect of the adjacent areas and had a variance of σ_s^2, while the heterogeneous effect was represented using independent normal distributions with mean 0 and variance σ_h^2. A uniform distribution U(0,∞) was assigned to the standard deviations σ_s and σ_h. A normal vague prior distribution was assigned to the parameters α, β_1, β_2, β_3, β_4 and β_5.

As the socioeconomic deprivation index scale is dimensionless and arbitrarily fixed, for each city/metropolitan area, we calculated the relative risk (RR) that compares suicide mortality of the 95th percentile value of socioeconomic deprivation (severe deprivation) to its 5th percentile value (low deprivation). RR estimates were obtained based on the mean of their subsequent distribution, along with corresponding 95% credible intervals (95% CIs).

To support the analysis of suicide sSMR, and the socioeconomic deprivation index, these variables were represented on maps using a classification based on septiles.

All analyses were performed using the INLA library of the R statistical package.

Results

The characteristics of the nine areas studied, some of which are cities and others metropolitan areas, are shown in table 1. By population size, the largest is Greater London (7 322 403 inhabitants) and the smallest Turin (891 769 inhabitants). Except for Athens metropolitan area and Berlin, all the other cities and metropolitan areas were analysed by small areas with a median population of less than 6000 for men and women. The areas of analysis were districts for Berlin (median population of approximately 100 000 for men and women) and municipalities for Athens (median population of approximately 30 000 for men and women).

The socioeconomic indicators used to build the socioeconomic deprivation index for each small area are presented in the Supplementary table. Variations in some indicators between the cities included in the analyses were large, for example, the median percentage of the population with primary education as their highest attainment ranged from 37.6% (Lisbon) to 0.9% (Berlin). Of note, the figure for London (54.0%) was not strictly comparable, as explained in the Methods section due to having included ISCED 0–2. The table also shows the correlation coefficients between the indicators and the socioeconomic deprivation index. The highest correlations were observed with university education followed by manual workers in most of the cities/metropolitan areas.

The description of mortality data is presented in table 2. The first period included 4 years (2000–2003), and the second and the third 5 years (2004–2008 and 2009–2013) for most of the cities. Suicide mortality rates (crude and age-adjusted) were higher among men than women. Suicide mortality rates were lower in Athens, Barcelona and London than in other cities. During the crisis, suicide death rates increased mainly in Athens: among men, the age-standardized mortality rate increased from 4.37 per 100 000 inhabitants in the second period to 7.07 in the third. These rates among women were 1.03 and 1.24, respectively.

The RR of association between the socioeconomic deprivation index and suicide mortality for the three periods for men and women and each city or metropolitan area are shown in figures 1 and 2. Among men, RR were higher than 1 in Stockholm and Lisbon in the three periods. In Barcelona, the RR was 2.06 (95% CI: 1.24–3.21) in the first period, decreasing in the other periods. For the other cities/metropolitan areas, there were no significant associations. No significant changes were observed across the periods.

Among women, a positive significant association was identified only in Stockholm (RR around 2 in the three periods). There were no significant changes during the periods except in London with an RR lower than 1 in the third period (RR 0.49, 95% CI: 0.35–0.68) which implies that the lower the socioeconomic deprivation of the area the higher the risk of suicide mortality.

The associations between the socioeconomic deprivation index and suicide sSMR can also be observed through maps. The Supplementary figure illustrates the example of men in Lisbon, showing similar geographical patterns for the socioeconomic deprivation index and suicide sSMR. The other example illustrates the maps for women in London, where the pattern shows an inverse relationship.

Discussion

This study shows that suicide mortality rates were higher for men than for women, varied among urban areas, and increased significantly only in Athens during the financial crisis. Suicide mortality was higher in deprived areas of Stockholm for men and women and in London and Lisbon for men. Socioeconomic inequalities did not change significantly in the three periods (with the exception of London among women where the RR decreased in the third period showing an inverse relationship between socioeconomic deprivation and suicide mortality).

As shown by previous studies,[6,9] in our study suicide rates differed in cities/metropolitan areas. Moreover, death rates were higher for men than for women. Previous publications have reported that men make fewer suicide attempts than women but are more likely to be successful.[5,21] This could be explained by traditional gender roles: in men a higher level of strength, risk taking behaviour, independence,

Table 2 Description of suicide mortality in nine urban areas: years, number of deaths and crude mortality rate (MR) and indirectly age-standardized mortality rate (ISR) by 100 000 inhabitants, for men and women in each study period

	First period				Second period				Third period			
	Years	Deaths	Crude MR	ISR	Years	Deaths	Crude MR	ISR	Years	Deaths	Crude MR	ISR
Men												
Athens	2000–2003	272	4.34	4.55	2004–2008	323	4.26	4.37	2009–2013	521	7.05	7.07
Barcelona	2000–2003	264	9.17	9.08	2004–2008	408	10.75	10.60	2009–2013	378	9.82	9.60
Berlin	2002	582	19.88	20.15	2006	532	17.59	17.72	2011	469	16.00	15.81
Brussels	2001–2003	249	17.60	19.44	2004–2008	519	20.59	22.88	2009–2011	257	15.80	17.65
Lisbon	2000–2003	732	14.33	15.13	2004–2008	979	15.16	15.82	2009–2012	839	15.81	16.31
London	2000–2003	1097	7.58	8.65	2004–2008	1362	7.27	8.27	2009–2014	1682	6.88	7.80
Prague	2001–2003	418	25.23	25.55	2004–2008	574	19.92	20.04	2009–2014	796	21.86	22.01
Stockholm	2001–2003	449	16.56	17.92	2004–2008	706	14.99	16.22	2009–2011	418	14.41	15.59
Turin	2000–2003	183	10.71	10.29	2004–2008	231	10.81	10.28	2009–2013	271	12.56	11.84
Women												
Athens	2000–2003	53	0.78	0.78	2004–2008	87	1.05	1.03	2009–2013	106	1.31	1.24
Barcelona	2000–2003	139	4.27	3.95	2004–2008	190	4.51	4.17	2009–2013	182	4.28	3.94
Berlin	2002	239	7.84	7.57	2006	194	6.23	6.01	2011	152	4.98	4.73
Brussels	2001–2003	136	8.86	9.17	2004–2008	277	10.27	10.78	2009–2011	138	8.04	8.55
Lisbon	2000–2003	233	4.19	4.18	2004–2008	382	5.37	5.29	2009–2012	265	4.49	4.37
London	2000–2003	439	2.94	3.21	2004–2008	479	2.48	2.72	2009–2014	535	2.14	2.35
Prague	2001–2003	140	7.65	7.21	2004–2008	201	6.47	6.09	2009–2014	216	5.60	5.33
Stockholm	2001–2003	224	7.93	8.23	2004–2008	360	7.39	7.70	2009–2011	214	7.19	7.53
Turin	2000–2003	95	5.08	4.62	2004–2008	90	3.84	3.47	2009–2013	98	4.13	3.69

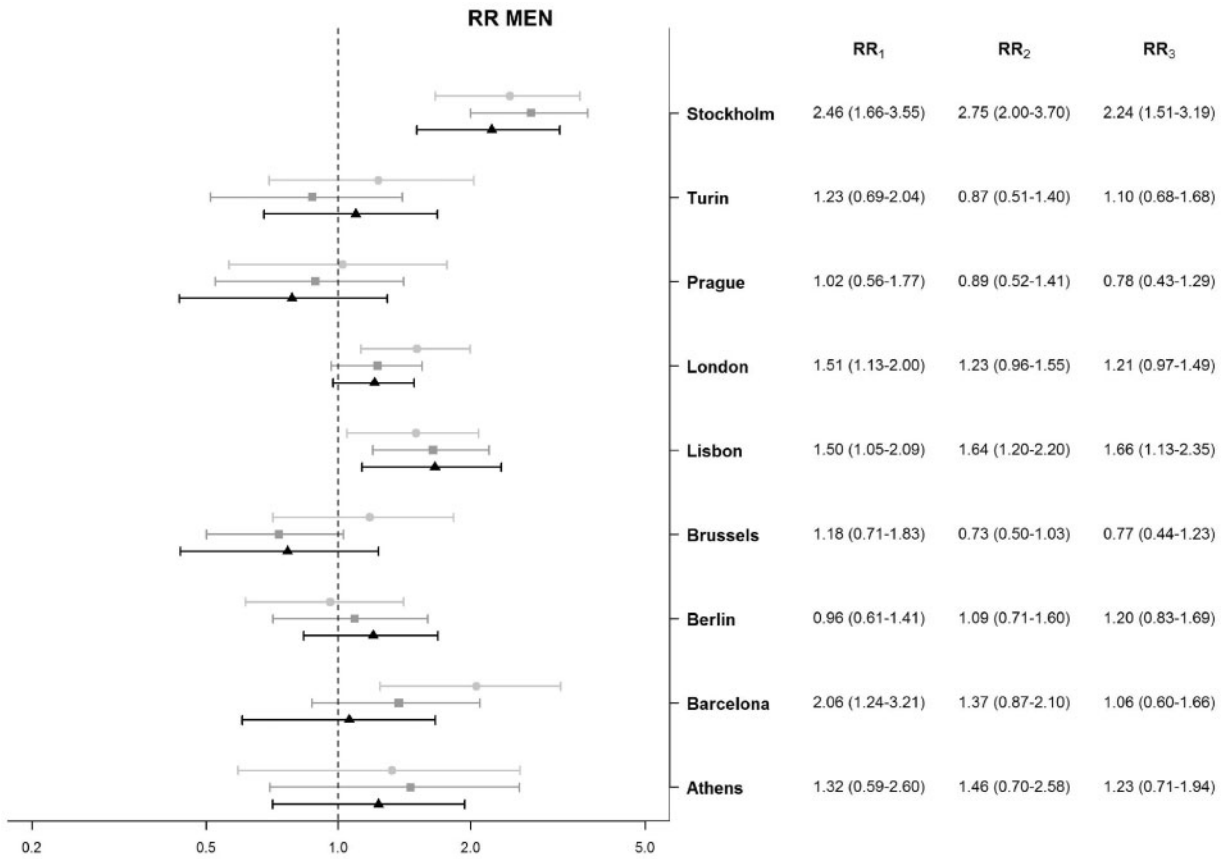

Figure 1 Association between socioeconomic deprivation index and suicide mortality, relative risk (RR) and 95% credible intervals for men in nine urban areas. *Notes:* RR compares suicide mortality of the 95th percentile value of socioeconomic deprivation (severe deprivation) to its 5th percentile value (low deprivation). RR_1: RR of first period; RR_2: RR of second period; RR_3: RR of third period.

economic status, etc. are often stressed. As 'bread-winners', they tend to feel a high degree of pressure and stress to maintain the family's economic status. Moreover, reinforcement of these traditional gender roles often prevent men from seeking help when they feel depressed or suicidal. Therefore, dominant masculinity increases the risk of suicidal thinking.[22,23] Moreover, men more often use highly lethal methods in suicidal behaviour and their suicide attempts are more serious, independently of the method used, suggesting gender differences in intentionality associated with suicidal behaviour.[24]

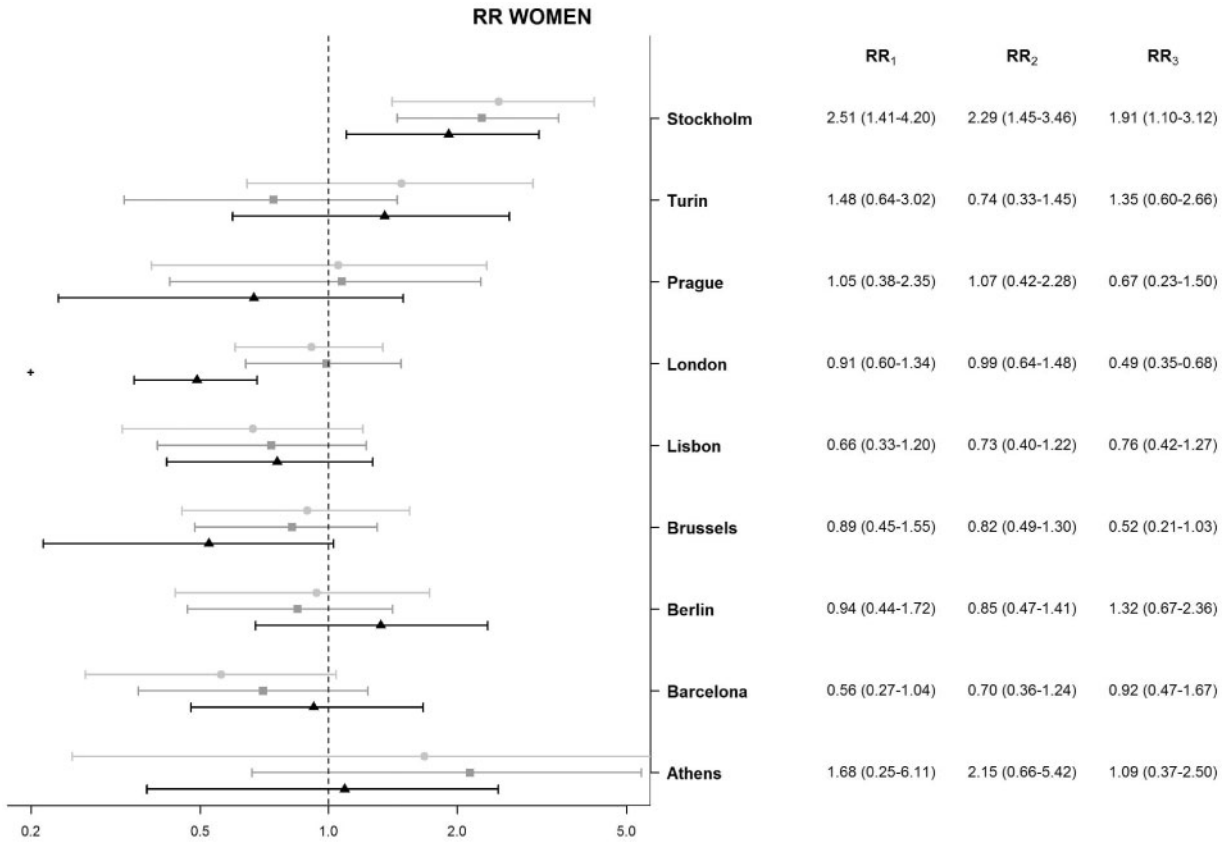

Figure 2 Association between socioeconomic deprivation index and suicide mortality, relative risk (RR) and 95% credible intervals for women in nine urban areas. *Notes:* RR compares suicide mortality of the 95th percentile value of socioeconomic deprivation (severe deprivation) to its 5th percentile value (low deprivation). RR_1: RR of first period; RR_2: RR of second period; RR_3: RR of third period. + indicates that RR_3 is statistically significantly different from RR_2 (no RR_2 is statistically significantly different from RR_1)

Death rates from suicide tended to increase mainly in Athens for both men and women after the start of the financial crisis but not in other settings; these results are consistent with those of other studies conducted in Greece.[25,26] This finding could be connected to the severity of the financial crisis in Greece compared with the rest of EU, although other southern European countries were also strongly affected by the financial crisis (http://ec.europa.eu/eurostat/statistics-explained/index.php/Unemployment_statistics#Recent_developments).

In view of other studies published on the topic, our finding of no increase in suicide mortality in the other cities/metropolitan areas was unexpected. Previous reviews have shown that during past recessions[12] and the recession of 2008,[13,14] most studies reported an increase in suicide mortality, mainly among men of working age and the unemployed. A review by Karanikolos et al.[13] found 28 studies that focussed on mental health in different countries and all the studies reported worsening in a least one mental health indicator during the crisis. However, most of these studies focussed on countries.[27] Our study is based on urban areas and suicide rates are often higher in rural than in urban areas.[28,29] Like the present study, a previous study analysing trends in socioeconomic inequalities in suicide mortality in Barcelona and the Basque Country, Spain, found no increase in suicide mortality.[18]

This study found minor results concerning socioeconomic inequalities in suicide mortality and the trend in these inequalities: only two metropolitan areas showed socioeconomic inequalities among men and one among women and the trend did not change across the periods studied. We also found stronger associations among men than women, but for most cities/metropolitan areas the RR had a 95% CI that included the value of 1. The results found in the pre-crisis period are similar to those described by Gotsens et al.[9] analysing area deprivation inequalities in several external causes of death (including suicide) in 15 cities/metropolitan areas of Europe (7 of them are included in our study). However, a review by Cairns et al.[7] found a significant association (in 25/27 studies) between area socioeconomic disadvantage and suicidal behaviour in Europe. The majority of studies of this review were performed in the UK and 20 of them analysed completed suicides. Area-level deprivation had a stronger influence on suicide among men than women. Although most of the studies were not centred on urban areas, several pathways are discussed by the authors to understand the associations:[7] some studies explain their results in terms of compositional factors because the associations disappeared when individual factors were adjusted; other studies found contextual factors explaining the associations found, such as social fragmentation, city size (associations were strongest in large cities), rurality or regional unemployment levels; other studies found an independent effect of area-level disadvantage on suicide behaviours, after analysing individual and contextual factors.

Our results are contrary to our previous hypothesis. In some countries, the economic recession resulted in increased debt, reduced public spending, job loss and consequently high unemployment and sometimes an inability to afford housing costs followed by eviction;[30] these factors are related to poor health outcomes, including poor mental health.[15] A possible explanation for our results could be that the impact of the crisis on suicide behaviour also affected the most privileged areas, as reported by studies performed in Japan[16,17] and South Korea[31] where, following the 2008 economic downturn, suicide mortality in men increased more markedly among those who held managerial and professional

posts. Also, a study done in England and Wales did not find an increase in socioeconomic inequalities in suicide mortality between 2001 and 2011.[15]

Strengths and limitations

The results show the pattern of socioeconomic inequalities in suicide mortality in the cities/metropolitan areas and their changes over time. These results are important because few studies have shown how these inequalities have changed in urban areas. But the results of the study should be interpreted with some limitations in mind.

Our study focussed on differences in suicide mortality between areas with different levels of deprivation based on the level of unemployment, proportion of manual workers, the number of residents with primary education and those with university education. These indicators of deprivation may have different meanings in the cities studied. Moreover, it is necessary to take into account that data for socioeconomic indicators were from 2001 and the deprivation of areas could have changed, however, probably the rank of areas by socioeconomic deprivation is maintained.

In addition, the number of areas per city varied considerably, which may have affected the robustness of estimates of suicide mortality on area level (small number of deaths) and the level of differentials observed within each city. For some cities (Athens and Berlin) the number of areas was very small, a larger number of areas with a smaller population size would lead to a higher statistical power and probably a greater gradient of difference across areas.

We were unable to include migration, a factor that is important for suicide mortality. Suicide risk among immigrant populations also depends on cultural factors, and on the suicide risk in the countries of origin and for these reasons suicide death rates may change by country of origin.[32]

Although our study includes a trend analysis of 13–14 years, it would be interesting to study longer trends in order to be able to assess changes in those trends for a greater number of years. However, this potential limitation is partially overcome by the inclusion of two periods before the crisis.

Finally, the quality of injury mortality statistics, including suicide, may change in the different countries due to various factors, such as those described by Värnik et al.:[33] routines for registering suicides, the resources available for medical and legal inquests into causes of death, adherence to regulations referring to causes of death, varying proportions of suicide methods, cultural aspects, stigma associated with suicide, financial implication for relatives and the sociopolitical situation. However, we believe that these differences were unlikely to have affected the inequalities found in the different cities/metropolitan areas studied.

Conclusion

The main conclusion of this study is that area socioeconomic inequalities in suicide mortality did not change significantly after the onset of the crisis in the European cities/metropolitan areas studied. However, these inequalities should continue to be monitored because these results could change in the long run. Moreover, it is important to emphasise the importance of implementing policies to tackle suicide mortality and inequalities in suicide, including a broader view of the social determinants of health during the life course.[34]

Supplementary data

Supplementary data are available at *EURPUB* online.

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Conflicts of interest: None declared.

Ethical approval

This manuscript uses only secondary data, for this reason we do not enclose ethical approval.

Key points

- During the financial crisis that started in 2008, suicide mortality increased in many countries.
- The study of the impact of the financial crisis on socioeconomic inequalities in suicide mortality has been less well analysed, with discrepant results.
- Suicide mortality was higher in deprived areas of Stockholm for men and women and in London and Lisbon for men.
- Socioeconomic inequalities in suicide mortality did not change significantly in the three periods.
- It is important to emphasise the importance of implementing policies to tackle suicide mortality and inequalities in suicide.

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Social mobility, accumulation of disadvantages and health. An analysis with retrospective data from the GSOEP (2002–14)

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Background: Socioeconomic position (SEP) in different life stages is related to health-related quality of life (HRQoL). Yet, research on the relevance of life course processes is scarce. This study aims to analyse the association between accumulation of disadvantages, social mobility and HRQoL. **Methods:** Analyses were conducted using population-averaged panel-data models and are based on data from the German Socio-Economic Panel 2002–14, including retrospective biographical information, comprising 25 473 observations from 8666 persons. Intergenerational and intragenerational mobility included the occupational positions in childhood (parental position), first job and middle age. Accumulation of disadvantages was measured using an accumulation index. HRQoL was assessed using the Mental and Physical Component Summary Scores of the SF12v2. **Results:** Accumulation of disadvantages was the main predictor for the Physical Component Summary in mid-age. Men and women in a stable low SEP or with a steep downward mobility showed the least favourable physical HRQoL. This holds for intergenerational and intragenerational mobility. Mental HRQoL did not seem to be associated with accumulation or social mobility. **Conclusion:** The results show that physical HRQoL is related to social mobility and accumulation of (dis-)advantages. Further research is needed thoroughly analysing this association.