Title: Area-level socioeconomic disadvantage and suicidal behaviour in Europe: A systematic review

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Abstract:

The relationship between adverse individual socio-economic circumstances and suicidal behaviour is well established. However, the impact of adverse collective circumstances – such as the socio-economic context where people live is less well understood. This systematic review explores the extent to which area-level socioeconomic disadvantage is associated with inequalities in suicidal behaviour and self-harm in Europe. We performed a systematic review (in MEDLINE, Embase, PsycINFO, EconLit and Social Sciences Citation Index) from 2005 to 2015. Observational studies were included if they were based in Europe and had a primary suicidal behaviour and self-harm outcome, compared at least two areas, included an area-level measure of socio-economic disadvantage and were published in the English language.

The review followed The Joanna Briggs Institute guidelines for quality appraisal. We identified 27 studies from 14 different European countries. There was a significant association (in 25/27 studies, all of which were rated as of medium or high quality) between socioeconomic disadvantage and suicidal behaviour (and self-harm), particularly for men, and this was a consistent finding across a variety of European countries. Socio-economic disadvantage was found to have an independent effect in several studies whilst others found evidence of mediating contextual and compositional factors. There is strong evidence of an association between suicidal behaviours (and self-harm) and area-level socio-economic disadvantage in Europe, particularly for men. Suicide prevention strategies should take this into account.

Keywords: suicide; health inequalities; deprivation; systematic review; neighbourhood effects; Europe; self-harm

Main text

1. BACKGROUND

Suicide is now among the second leading cause for aged 15 to 29 year olds globally based on latest statistics (WHO, 2017). The World Health Organization estimates the number of suicides per year worldwide amount to over 800,000, a rate of 11.4 per 100,000 (WHO, 2014). However, there are substantial variations in suicide rates *between-countr*iesin Europe which remain highest in Eastern Europe and Finland, and lowest in England, Italy and Spain (WHO, 2014). There are also considerable *within-country* inequalities in suicide rates. For example in England, the North East region has the highest rate (13.8 per 100,000) compared to London which has the lowest (7.9 per 100,000). It has also been noted that there are inequalities at a smaller geographical scale with neighbourhoods that are the least socio-economically

disadvantaged having considerably lower rates of suicidal behaviour than those that are the most disadvantaged (Rehkopf and Buka, 2006; Platt, 2015). Area-level deprivation may well explain such differences at smaller scales.

Health geography literature suggests that there are area effects that link place to health (including mental health and suicide) through a variety of 'salutogenic' or 'pathogenic' pathways - operating at the compositional and contextual level (Bambra, 2016). The composition of the area (demographic, behaviour of the individual and socio-economic status) influences health outcomes. In terms of suicide, the differences in suicidal behaviours between areas of high and low socio-economic disadvantage are therefore a result of the different characteristics of people living in the areas. Specific suicidogenic pathways postulated at the compositional level include: accumulated adverse life course experiences; powerlessness, stigma and disrespect; experiencing other features of social exclusion; poor health; unhealthy lifestyles; and social disconnectedness (Platt, 2015).

The contextual approach suggests that the economic, social, and physical environment of a place also contributes to area-level health: poor places lead to poor health (Bambra, 2016). For example, the area-level prevalence of brownfield land has been associated with higher rates of limiting long-term illness (Bambra et al., 2014), social cohesion has been associated with better rates of mortality and morbidity (Cairns-Nagi & Bambra, 2013), and area-level unemployment has been found to be associated with premature mortality and a greater prevalence of mental ill-health (Möller et al., 2013). Health-promoting environments (less crime, more greenspace, etc.) are more likely to be found in more affluent areasleading to area-level health inequalities. In terms of suicide, the specific suicidogenic pathways

postulated at the contextual level include: physical (e.g., poor housing conditions); cultural (e.g., tolerant attitudes to suicide); political (e.g., adverse public policy); economic (e.g., lack of job opportunities); social (e.g., weak social capital); history (e.g., high incidence of suicidal behaviour); infrastructure (e.g., poor quality, accessibility, acceptability of services); and health and wellbeing (e.g., high prevalence of poor general and mental health) (Platt, 2015).

Given this wider literature, the mixed findings of the previous review (Rehkopf & Buka, 2006) examining the association between socioeconomic disadvantage and suicide are unexpected. The objective of this systematic review is therefore to examine the association between area-level socioeconomic disadvantage and suicidal behaviour from 2005 to 2015 in Europe for comparability purposes, updating a previous review (Rehkopf & Buka, 2006) which examined the association between socioeconomic disadvantage and suicide (not suicidal behaviour) for studies published between 1897 and 2004; however, this is not a completed update as we have limited our studies to Europe only for comparability purposes.

2. METHODS

2.1 Study design and inclusion criteria

The review is registered with The Joanna Briggs Institute: http://joannabriggs.org/research/registered_titles.aspx. We included observational studies (cross-sectional; prospective and retrospective cohorts, time series, repeat cross-sectional). Studies had to compare at least two areas and have some area-level measure of socio-economic disadvantage. Area-level socio-economic disadvantage can be measured differently but essentially involves ranking areas on the basis of relative local scores for factors such as

income, employment and housing quality. Common measures include indices of multiple deprivation, percentage of poverty, or percentage unemployed (Rehkopf & Buka, 2006).

2.2 Search strategy

We searched for peer-reviewed papers published in English, based in Europe and published between 2005 and 2015 using the search terms in **Table 1**. In keeping with previous work, five main databases were searched: MEDLINE, Embase, Psycinfo, EconLit, and the Social Sciences Citation Index (Rehkopf & Buka, 2006).

2.3 Outcomes

The outcome of interest was suicidal behaviour, which is defined as completed suicide (a fatal suicidal act resulting in death), para-suicide (a non-fatal suicide attempt where the aim is not death), suicidal ideation (thoughts about suicide ranging from fleeting thoughts to planning to act on these thoughts), or deliberate self-harm (to cause harm or injury to one self although this may not necessarily be due to suicidal thoughts so this is a limitation).

2.4 Data extraction and quality appraisal

Two researchers (JC/EG) screened the title and abstracts, with a random 10% of the sample checked by the other reviewer (JC/EG). Disagreements over inclusion were discussed with the project lead (CB). Full texts of eligible studies were retrieved and data extracted by one reviewer (JC or EG) and checked by a second reviewer (JC or EG). The methodological quality of each study was critically appraised in accordance with the Joanna Briggs Institute guidelines

using the critical appraisal checklist for reporting observational studies, which includes questions on sampling, inclusion criteria, confounding, types of outcomes and statistical analysis (Appendix 1). JC/EG independently critically appraised the included studies and there was a high agreement kappa score (0.78).

2.5 Analysis and synthesis

A narrative synthesis thematically describing studies was undertaken. Unfortunately, due to heterogeneous measures being used by authors there were not enough studies with the same outcome measure to be able to conduct a meta-analysis. In this review we report on the overall association between area-level socioeconomic deprivation and suicidal behaviours. Differences by gender, age, and individual-level socio-economic status as well as other contextual confounders were also analysed when sufficient data was available in the studies.

3. RESULTS

The study search flow chart is shown in **Figure 1**. A total of 9,243 hits were retrieved; this reduced to 5,931 after the removal of duplicates. 5,667 were excluded at title screening stage, followed by 134 at abstract screening stage because they were not in Europe or not published in English, leaving 130 studies. Of these, 100 were excluded at the full paper stage because they adjusted for deprivation or there was no suicidal behaviour outcome. The remaining 30 papers were included in the synthesis, reporting on 27 unique studies.

The included studies spanned 14 countries: England (n=9), Scotland (n=6), Northern Ireland (n=2), Spain (n=2), Republic of Ireland (n=1), Finland (n=1), Denmark (n=1), Sweden (n=1), Portugal (n=1), Netherlands (n=1), Switzerland (n=1), and a multi-country study (Slovakia, Italy, Hungary, Sweden, Switzerland and Portugal). The majority of studies (17/27) came from the UK (England, Scotland and Northern Ireland with no Welsh studies). Areas ranged from small neighbourhoods (containing approximately 1,500 residents) to large cities. The majority of studies (n=20) examined completed suicide, five studies were of deliberate self-harm, and two studies examined both completed suicide and deliberate self-harm. The methodological quality of the evidence base was high ranging from 5/8 (moderate) to 8/8 (high quality) and with no low quality scoring studies (see Appendix 2). This may be due to using an instrument specifically designed for cross-sectional studies rather than deeming quality on design of the study.

Overall, the review found a significant association in 25/27 studies although 3 of these 25 studies only found partial associations between socioeconomic disadvantage and suicidal behaviour. All studies adjusted for age and gender whilst thirteen of the studies also provided gender stratified analysis. The majority of these found that area-level deprivation had a stronger influence on suicide among men than women. Eleven studies made further adjustments (beyond age and gender) so were able to explore whether there is an independent effect of socioeconomic disadvantage. Below the results for each study in terms of the association between social economic disadvantage and suicide are narratively synthesised firstly by country and then by looking at the suicidogenic pathways.

3.1 The association between socio-economic disadvantage and suicide

England

Coope and colleagues (2014) measured quarterly changes in suicide rates over a ten year period between 2001 and 2011, for small areas/neighbourhoods (Lower Super Output Areas (LSOAs) consisting of approximately 1,500 residents) in England. Deprivation was measured using the Indices of Multiple Deprivation (IMD) in 2010 which contains data on seven domains: income, employment, education, crime, health, housing and living environment. Consistently in each year, area-level deprivation was positively associated with suicide: the most deprived areas had the highest suicide rates for both men and women. However, suicide rates among men in the least deprived areas increased slightly from 11.2 per 100,000 in 2007 to 13.3 per 100,000 in 2011 while they reduced slightly from 34.6 per 100,000 to 31.4 per 100,000 in the most deprived areas. But there was still almost a threefold difference between the most and least deprived areas in 2011.

Green (2013) examined spatial inequalities in cause-specific mortality in young men and women aged 16-21 over three time periods (2002/04, 2005/07, and 2008/10) at LSOA level in England. Area-level deprivation was measured using IMD (2010). The study found that there was a significant gap in self-harm related deaths between the least and most deprived areas, at all time points. For young men, there was a reduction in the least deprived areas between 2002/04 and 2008/10 (4.38 vs. 1.44 per 100,000) but not in the most deprived areas (5.99 vs. 5.70 per 100,000). For young women, there was also a decrease in the least deprived areas (1.02 vs. 0.50 per 100,000) but an increase in the most deprived areas (1.65 vs. 2.15 per 100,000).

The study by Brock and colleagues (2006) showed a positive, linear association between suicide rates (aged 15+) and socioeconomic deprivation as measured by the Carstairs-Morris

index (referred to hereafter as Carstairs) comprising four variables: lack of car ownership, low occupational social class, overcrowded households and male unemployment in England. During a five year period (data pooled for 1999-2003), suicide rates among those living in the most deprived local authorities (25.4 per 100,000 for men vs. 7.4 per 100,000 for women) were double the rates among those living in the least deprived areas (11.9 per 100,000 for men vs. 3.6 per 100,000 for women).

Similarly, a study by Rezaeian and colleagues (2005, 2006a, 2006b) found a linear association between IMD and suicide rates at local authority level: suicide rates decreased with improving socioeconomic status among those aged 10 years and older in England in 1996-98 (data for three years pooled). The unadjusted linear model showed that with increasing one unit in the quartile rank of the variable in terms of deprivation (improving economic conditions – quartile is the most deprived) the rate of suicide decreases by 12% for men aged 10-29 years, between 11 and 13% for males aged 30-49 years, and between 4 and 5% for males aged 50 years and over. The respective rates for women were between 10 and 12% for women aged 10-29 years, between 15 and 17% for women aged 30-49 years, and no consistent pattern for women aged 50 years and over. In the age/gender adjusted model the results showed that with increasing one unit in quartile rank of deprivation, the rate of suicide decreases between 7 and 10%.

Harriss and Hawton (2011) examined the association between ward-level deprivation and age-adjusted non-fatal deliberate self-harm (DSH) among those aged 15+ residing in Oxfordshire, England in 2001-06 (data for five years pooled). Their results showed that incident rate ratios of DSH were 20%, 49% and 98% higher, respectively, in each quartile of increasing deprivation compared to the least deprived quartile ($p<0.001$). This association was independent of the effects of gender, age, rurality and social fragmentation.

A study by Congdon and colleagues (2013) pooled data for five years (from 2006/07 – 2010/11) in large neighbourhoods (Middle Super Output Areas containing approximately 7,500 population) in England and showed a strong association between self-harm which resulted in hospital stays, suicide (age unspecified) and deprivation (as measured by IMD) for both men and women: areas with high deprivation scores had suicide rates three times higher than those areas with low deprivation scores. Area-level deprivation had a stronger influence on suicide among men than among women and this association was independent of the effects of rurality and social fragmentation. Similarly, self-harm rates were elevated in deprived areas with a ratio of 3.19 in the most deprived quintile (over three times more likely to self-harm in these areas compared to the least deprived areas).

Congdon (2012) examined suicidal thoughts, suicide attempts and self-harm and small area-level deprivation across England based on IMD quintiles. All three measures of suicide risk were positively associated with deprivation (although the study does not provide data on area deprivation from model 1 to be able to report the strength and significance of the association). However, later in the paper it is reported that the effects of deprivation were small compared to individual-level factors and seemed to be mediated by social capital.

Another study by Congdon (2011) examined suicide and self-harm rates in the East and South East of England at small area-level (CAS wards) using the IMD. For both self-harm and completed suicide/attempted suicide, deprivation was found to be the strongest predictor for men and women, with some evidence of a gradient between attempted suicide and

deprivation - as one increased the other increased for both genders (e.g. in the least deprived decile, 33 men attempted suicide compared to 208 men in the most deprived decile).

Only one study by Bergen and colleagues in 2012 found that there was no significant association between death by external causes among people who had self-harmed and area-level socio-economic deprivation ($p = 0.58$). This longitudinal cohort study investigated the association between mean years of life lost (YLL) to external causes and area-level deprivation (IMD) for neighbourhoods in three English cities (Oxford, Manchester and Derby), among people aged 15 years or older, pooling data for the eight years 2000-2007. The limitation of this study was that we were unable to examine suicide separately as they only provided data on external causes which includes accidental, suicide and undetermined deaths so this may partly explain the lack of association.

Scotland

The study by Exeter and colleagues (2007) examined suicide rates and the association with area-level deprivation (measured using Carstairs) in Scotland across three decades (1981, 1991 and 2001) among 15-64 year olds. They compared suicide rates by deprivation for small areas/neighbourhoods (Census Area through Time - CATTs) for both Glasgow and the rest of Scotland. They found a strong, positive association between suicide rates and deprivation in each decade: as deprivation increased, suicide rates increased. Between 1981 and 2001, the proportion of suicides occurring in the most deprived areas of Scotland increased from 27.2% to 30.9%. However, in Glasgow, the proportion of suicides occurring in the most deprived neighbourhoods decreased from 80.4% in 1981 to 67.8% in 2001.

Another study by the same authors as above (2011) examined trends in Scottish premature mortality (deaths under the age of 75) between 1981 and 2001, including premature deaths from suicide. They examined variations in suicide rates by deprivation (Carstairs) for small areas/neighbourhoods (CATTs). Suicide rates in the most deprived quintile of neighbourhoods increased from 24 per 100,000 in 1981 to 41 per 100,000 in 2001. These rates were significantly higher than rates in the least deprived category (8.8 per 100,000 in 1981 and 7.3 per 100,000 in 2001). Between 1981 and 2001 suicide rates in the least deprived areas decreased while rates in the most deprived areas increased significantly, so that by 2001 suicide rates were 1.7 times higher in the most deprived neighbourhoods of Scotland than in the least.

A study by Stark and colleagues (2007) examined suicide rates among people aged 15 years and older, in Scotland, between 1981 and 1999. The postcode sector within which the individual died was assigned a deprivation score (as measured by Carstairs) and grouped into deprivation quintiles according to place of usual residence. Consistently across time, for both men and women, the highest suicide rates were in the most deprived quintile of neighbourhoods. Suicide rates among men in the least deprived neighbourhoods were 18.5 per 100,000 in 1981-85, 20.7 per 100,000 in 1986-90, 20.8 per 100,000 in 1991-95 and 22.6 per 100,000 in 1996-99. In comparison, suicide rates among men in the most deprived neighbourhoods were 32.4, 42.1, 58.6 and 54.8, respectively. While suicide rates among women were much lower than rates among men, the same trend emerged when least and most deprived areas were compared, with suicide rates almost four times higher in the most deprived, compared to the least deprived, neighbourhoods.

A study by Boyle and colleagues (2005) examined the gap in suicide rates among young adults (≤45 years) compared to older adults (≥45 years) between the most and least deprived small areas of Scotland (CATTs) between 1980/82 and 1999/2001. Area-level deprivation was measured using Carstairs broken down into quintiles. There was a clear gradient in the association between deprivation quintiles and suicide rates, with suicide increasing across the quintiles of increasing deprivation, particularly for young men in the most deprived fifth. Among young women the rise in suicides over the 20-year period was six times greater between the most and least deprived areas (154 vs. 24 per 100,000). Among older adults suicide rates declined significantly in all deprivation fifths; the ratio between the most and least deprived fifths, however, widened slightly from 1.51 (1.26, 1.81) per 100,000 to 1.81 (1.50, 2.21) per 100,000.

Leyland and colleagues (2007) examined changes in deprivation and mortality (including suicide) over two decades between 1980/82 to 2000/02 in Scotland and found that there were substantial increases in the suicide gradient. Area-level deprivation was measured using Carstairs scores. The increase in suicide rates for men between 1980/82 and 2000/02 was 3 per 100,000 in the least deprived areas versus 10 per 100,000 in the most deprived. However, for women there were modest decreases in suicide rates in both the most and least deprived areas. There were still area-level differences in suicide mortality.

A study by Platt (2011) examined changes in suicide rates in Scotland from 1989-1995 to 1996-2002 using Carstairs scores as the measure of deprivation at CATT level. This study found that there was a clear gradient, with suicide rates increasing with increasing levels of deprivation. The standardised suicide mortality ratio (SMR) in the most deprived areas was between two

to three times higher compared to the least deprived areas for both time points (1989-1995: most deprived SMR =165 versus least deprived SMR 55; 1996-2002: most deprived SMR = 65 versus least deprived SMR 135 – note these figures are approximate based on the results provided in graph from the publication).

Northern Ireland & Republic of Ireland

The cross-sectional study by O'Reilly and colleagues (2008) examined the association between area-level deprivation (as measured by housing tenure and car ownership) and suicide among 16-74 year olds in Northern Ireland in 2001 at Census Output Area level. Suicide rates were significantly higher in the most deprived areas (hazard risk ratio = 1.79 (1.37-2.34)) but the effect disappeared in the fully adjusted model (adjusting for economic activity, general health, marital status and household size) 0.80 (0.59-1.09; p value = 0.40).

The study by Corcoran and colleagues (2007) examined non-fatal deliberate self-harm (DSH) among 15-64 year olds in electoral divisions in the Republic of Ireland (ROI) in 2002. Deprivation was measured using the Irish National Deprivation Index. The most deprived electoral divisions had a 52% higher incident rate of DSH than the least deprived areas, even after controlling for rural/urban, age, gender and social fragmentation.

Similarly, a more recent study by Farrell and colleagues (2016) examined non-fatal DSH between 2009 and 2011 among 15-64 year olds at electoral division level in the ROI, using the same measure of deprivation. Compared to their peers in the least deprived areas, rates of DSH in men aged 15-39 years in the most deprived areas were three times higher; and among men aged 40-64 and women aged 15-39 years and 40-64 years, over two times higher. In each

demographic group, self-harm was significantly higher in the most deprived areas and this relationship remained after adjustment for other potentially explanatory variables (social fragmentation, population density and travel time to nearest hospital). After controlling for the potential confounders the incident rate ratio in the most deprived category was 1.52 (1.31-1.76) which is 52% higher than the least deprived category.

Spain

A study by Gotsens and colleagues (2011) compared suicide rates in areas with low and high levels of deprivation across 10 cities in Spain for the years 2000-2008 (years pooled). The authors calculated a deprivation score for small areas (census tracts) within each city based on area rates of manual labour, unemployment, temporary work, and education. Mortality information was abstracted from death certificates or provided by the National Institute of Statistics. Comparing men only in the 95th percentile of deprivation (more deprived areas) to those in the 5th percentile (less deprived areas), the relative risk of suicide was significantly higher in four of the 10 cities. Significant risk ratios ranged from 1.56 (1.11, 2.12) in Madrid to 2.02 (1.26-3.06) in Sevilla. In men and women under age 45, the ratio of suicide in high- compared to low-deprivation areas was only significant in Sevilla (RR=2.57, 1.34-4.55). In women and in the total population aged 45 years or older, no significant associations were found between area-level deprivation and suicide rates.

The same authors as above (Gotsens et al, 2013a) also analysed the association between area-level deprivation and mortality rates in men in 26 Spanish cities in a repeated cross-sectional study. A deprivation score was calculated for each census tract in 2001 using rates of unemployment, education, and manual or temporary work. Suicides were ascertained using

mortality records and were aggregated in the analysis as occurring between 1996-2001 or 2002-2007. The authors found that the area-level deprivation score was associated with higher rates of suicide in large Spanish cities, but that this association was not significant in smaller cities. The relationship between suicide rates and deprivation scores significantly decreased over time in Logrono ($RR_{1996-2001}$ = 3.09, $RR_{2002-2007}$ = 1.13) and Valencia ($RR_{1996-2001}$ = 1.47, $RR_{2002-2007}$ = 0.76), but significantly increased in Las Palmas ($RR_{1996-2001}$ = 1.05, $RR_{2002-2007}$ = 2.46).

Finland

A study by Huikari and Korhonen (2015) studied associations between regional unemployment rates and suicide in Finland from 1991-2011 (years pooled). Data on suicide, mortality, and unemployment was provided by Statistics Finland. This study found a significant correlation between regional unemployment rates and suicide rates (0.57(-0.15, 0.63)), though this relationship was stronger in men (0.61 (0.05, 0.71)) than in women (0.18 (-0.15, 0.63)) and varied considerably between regions. The authors also divided regions into those with high and low levels of unemployment (above or below the national unemployment rate) in order to assess social norm effects. In men, job loss in regions with low unemployment was more strongly associated with suicide than job loss in regions with high unemployment (linear regression coefficient of 0.032 ($p<0.001$)) of job loss in regions with low unemployment and 0.023 ($p<0.001$) in high unemployment regions. There were no statistically significant associations between job loss and suicide in women in either low or high unemployment regions. The authors suggest that men who lose their jobs in regions where unemployment is uncommon may have a more marked change in social class than those who lose their jobs in

regions where unemployment is more prevalent. This change in social class may influence suicidal behaviour.

Denmark

Agerbo and colleagues (2006) examined individual and area characteristics associated with suicide in regions of Denmark among the population aged 25 to 60 for the years 1982-1997 (years pooled). A total of 9011 cases were identified, and each case was matched to 20 controls of the same gender, born in the same year, and alive on the date of suicide. Measures of gross income and unemployment were assessed at the municipal level and divided into quartiles. A significant decreased risk of suicide was observed in quartiles with lower levels of unemployment in men (0.80 (0.65, 0.99) for men aged 25-40; 0.71 (0.56, 0.90) in men aged 41-60) but trends were not significant for women. Similarly, a decreased risk of suicide was found in quartiles with higher income in men only. However, after adjustment for individual socio-economic status, neither municipal-level unemployment rates nor municipal-level gross income was significantly associated with suicide in either gender. These results suggest that individual indicators for suicide may play a larger role than area characteristics.

Sweden

A study by Reimers and Laflamme (2006) in Stockholm for the years 1999-2003 examined associations between area-level characteristics and deliberate self-harm in girls aged 12 to 19. This study identified cases in 92 parishes (small area units) of the Stockholm Metropolitan area. Cases were categorized as being hospitalized only once or more than once. The proportion of adults who were unemployed in each area was the most relevant measure of deprivation, though the authors also assessed the proportion of low income earners and

social welfare recipients. Unemployment rates in adults aged 25-64 were calculated for each small area and analysed in tertiles. However, no significant associations were observed between tertiles of unemployment rates and either single or multiple hospitalizations for self-harm (RR for one hospitalization for self-harm comparing regions with high and low unemployment was 1.32 (0.90, 2.03); RR for more than multiple hospitalizations was 1.35 (0.82, 2.37).

Portugal

Santana and colleagues (2015) examined the relationship between material deprivation and suicide rates in the Portuguese population added 10 or over at three different time points. Each municipality in Portugal was assigned a deprivation score for 1991, 2001, and 2011, comprised of the area's literacy rate, unemployment rate, and substandard housing rate. Suicide information was obtained from the Portuguese National Statistics Institute for the years 1989-1993, 1999-2003, and 2008-2012. In men, a graded relationship was seen between municipal deprivation quintiles and suicide rates in both 1989-1993 and 2008-2012 but not 1999-2003. In 1989-1993, the rate ratio (RR) in the most deprived quintile was 1.99 (1.41, 2.78) compared to the least deprived quintile and in 2008-2012 while the relative risk had decreased it was still significantly higher (RR 1.46 (1.19, 1.80)). In women, deprivation was only significantly associated with suicide rates in 1989-1993, with a RR of 2.13 (1.34, 3.32) comparing the highest and lowest deprivation quintiles. Associations were attenuated after adjusting for rurality, and only remained significant in men between 1989 and 1993.

Netherlands

A study by Kunst and colleagues (2013) assessed relationships between neighbourhood social capital and suicide mortality across the Netherlands. Neighbourhoods were defined using postcodes and most often corresponded to meaningful socioeconomic or geographic areas. Deprivation was measured for the year 1995 by calculating the proportion of residents in each neighbourhood with an income below 40% of the national income distribution. Suicides were obtained from Statistics Netherlands for the entire population from 1995 to 2000. Suicide rates increased with each deprivation quintile, with a RR of 1.60 (1.48, 1.73) comparing the most with the least deprived quintiles when adjusting for age, sex, and country of birth. After further adjustment for marital status, neighbourhood social capital, population density, and neighbourhood religious activity, results were attenuated but still significant with a RR of 1.31 (1.21-1.42) comparing most with least deprived quintiles.

Switzerland

Pancazak and colleagues (2012) studied neighbourhood socio-economic position and adult suicide in Switzerland. The authors derived a score of neighbourhood socio-economic status for each individual residential building in Switzerland based on measures of rent, education, overcrowding, and manual or unskilled occupations in each building and the 50 closest households. Socio-demographic information from each household was taken from census information in 2000. Suicide information was extracted from the Swiss National Cohort study, which linked census information with mortality records, from December 2000 to December 2008. Results indicated that households in the highest decile of neighbourhood socio-economic position had a 14% lower suicide rate than households in the lowest decile of socio-economic position (hazard risk ratio 0.86 (0.78, 0.95)). This association remained significant

after adjustment for individual socio-economic characteristics (hazard risk ratio 0.82 (0.74, 0.91).

Multi-country

Lastly, Gotsens and colleagues (2013b) assessed the relationship between small area deprivation and injury mortality in 15 cities across Europe. Small areas were determined using census data or government registries, and ranged from 17 small areas in Bratislava (median population per area=18,720) to 2666 small in Turin areas (median population per area 274). The authors calculated an index of socioeconomic deprivation for each small area using rates of unemployment, manual labour, education, and foreigners from low-income countries. In men, higher deprivation scores were significantly associated with increased suicide rates in 7 cities. Significant rate ratios per 1 unit increase in deprivation score ranged from 1.09 (1.03, 1.16) in Budapest to 1.22 (1.15, 1.30) in Stockholm. In women, higher deprivation scores were significantly associated with increased suicide rates in Stockholm (1.18 (1.09, 1.29)) but were associated with reduced suicide rates in Zurich (0.84, (0.78, 0.89)) and Lisbon (0.90 (0.82, 0.00).

3.2 Suicidogenic Pathways

11/27 studies provided adjusted analyses revealing potential suicidogenic pathways linking area-level socio-economic disadvantage and suicidal behaviours at both the compositional and contextual levels.

In terms of compositional factors, the study in Northern Ireland (O'Reilly et al., 2008) found that the association between area-level deprivation and suicide disappeared when adjustments were made for individual-level economic activity, general health, marital status and household size. Similarly, an English study (Congdon, 2012) showed the effect of area-level deprivation disappeared once adjustments were made: deprivation effects were small compared to individual-level factors and seemed to be mediated by social capital. Further, the Danish study (Agerbo et al., 2007) found that after adjustment for individual socio-economic status, neither municipal-level unemployment rates nor municipal-level income were significantly associated with suicide. These studies suggest that compositional factors may play a larger role in suicidal behaviours than area-level socio-economic disadvantage.

However, four studies found evidence of the role of contextual factors, suggesting there is a relationship between area-level socio-economic disadvantage and suicidal behaviours but that this might be indirect, mediated by other contextual characteristics. For example, an English study (Congdon, 2012) found that the social fragmentation experienced by an area, might be a mediating pathway between area-level deprivation and suicidal behaviour. A Spanish study (Gotsens et al., 2013a) found that the association between area-level deprivation and higher rates of suicide was mediated by city size as the association was present in large Spanish cities, but not in smaller cities. Similarly, in Portugal (Santana et al., 2015) associations were attenuated after adjusting for rurality. Furthermore, a Finnish study (Huikari & Korhonen, 2015) found that regional unemployment levels influenced the relationship between area-level socio-economic disadvantage and suicidal behaviours.

However, some studies also found evidence of a direct relationship between area-level socio-economic disadvantage and suicidal behaviours: even when studies adjusted for potential confounding factors, the majority still found a significant independent effect of area-level socio-economic disadvantage. For example, one of the English studies (Harriss & Hawton, 2011) found that the association between non-fatal deliberate self-harm and deprivation was independent of the effects of the gender and age composition of the population, rurality and social fragmentation. The ROI study (Corcoran et al., 2007) found that the higher incident rate of deliberate self-harm in the least deprived areas remained even after controlling for rural/urban, age, gender and social fragmentation. Similarly, in one of the Northern Ireland studies (O'Farrell et al., 2016), self-harm remained significantly higher in the most deprived areas even after adjustment for other potentially explanatory variables (social fragmentation, population density and travel time to nearest hospital). Likewise, a study in Switzerland (Panczak et al., 2012) found that the association between area-level socio-economic deprivation and higher suicide rates remained significant even after adjustment for individual socio-economic characteristics and a study in the Netherlands (Kunst et al., 2013) found that after adjustment for marital status, neighbourhood social capital, population density, and neighbourhood religious activity, the association between area-level socio-economic disadvantage and suicide rates were attenuated but remained significant. Together, these studies suggest that socio-economic disadvantage has an independent effect on area-level suicidal behaviours.

4. DISCUSSION

The findings from this review provide strong evidence of increased risk of suicidal behaviours and self-harm in areas experiencing high levels of socio-economic disadvantage across Europe. 22/27 studies found a strong and positive association between area-level deprivation and suicidal behaviour and a further three studies found some evidence of an association: increased deprivation is associated with increased suicidal behaviour. This was consistent across different countries, all age groups and both genders, but was particularly the case for men. Even when there was adjustment for other explanatory factors, the majority of studies still found that there was a significant independent deprivation effect (Appendix 2). Unlike the previous review by Rehkopf & Buka (2006), there was no clear scale of association with significant deprivation effects from ward (small area) to large cities).

The evidence base reviewed here provides indicative evidence of potential suicidogenic pathways linking area-level socio-economic disadvantage with suicidal behaviours. Factors at both the compositional and contextual levels were all associated with suicidal behaviours. Socio-economic disadvantage itself was also found to have a *direct* and independent association with suicidal behaviours. Further, the review finds some tentative evidence to suggest that suicidogenic pathways might be gender specific. More research is required to further explore the pathways through which area-level deprivation is associated with suicidal behaviour and self-harm.

It is important that national suicidal behaviour strategies across Europe recognise the strong association with area-level deprivation. The evidence here suggests every local area should have a suicide prevention strategy (recommended by Public Health England for example (Abbott, 2014)) as suicide is present across the socio-spatial gradient. Further, it suggests that

socio-economically disadvantaged areas should have additional support: a *proportionate universalism approach* to reducing geographical inequalities in suicide (Marmot, 2010). Interventions, such as suicide prevention schemes, should be provided universally *'but with a scale and intensity that is proportionate to the level of disadvantage'* (p.15).

This review is subject to the usual limitations of observational research whereby we cannot claim that there is a causal relationship between area-level disadvantage and suicidal behaviour or self-harm. Only one study included in the review was longitudinal but a number of cross-sectional studies did include more than one time point. Additionally, six of the studies (Brock et al., 2006; Exeter & Boyle, 2007; Exeter et al., 2011; Green, 2013; Leyland et al., 2007; Platt, 2011) only undertook descriptive analyses of suicide rates meaning that we are unable to determine whether differences in rates are statistically significant and a number of studies did not make adjustments beyond age/sex so we cannot say the effect would remain if they had. That said, a number of studies did make further adjustments (n=11) and nine of these showed that deprivation had an independent significant effect on suicidal behaviour albeit a weakened effect in 2/9. Other limitations due to limited resources include not being able to search for grey literature and unpublished studies that may have examined the relationship between area-level deprivation and suicidal behaviour or self harm. The studies included were also limited to the English language.

5. CONCLUSION

The findings from this review provide strong evidence of increased risk of suicidal behaviours in areas experiencing high levels of socio-economic disadvantage across Europe. The review has also identified potential suicidogenic pathways operating at both the compositional and contextual levels. Suicidal behaviour prevention strategies should recognise this strong

association with area-level deprivation and, whilst providing universal support, also target those areas with the highest need more: a proportionate universalism approach to reducing geographical inequalities in suicidal behaviour.

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Appendix 1: Example Critical Appraisal

JBI Critical Appraisal Checklist for Analytical Cross Sectional Studies

Reviewer JC Date 27/07/16

Author Agerbo et al Year 2007

	Yes	No	Unclear	Not applicable
1. Were the criteria for inclusion in the sample clearly defined?	☒	☐	☐	☐
2. Were the study subjects and the setting described in detail?	☒	☐	☐	☐
3. Was the exposure measured in a valid and reliable way? **(ses)**	☒	☐	☐	☐
4. Were objective, standard criteria used for measurement of the condition? **(suicidal behaviour)**	☒	☐	☐	☐
5. Were additional confounding factors identified (not just age/sex)?	☒	☐	☐	☐
6. Were strategies to deal with these additional confounding factors stated?	☒	☐	☐	☐
7. Were the outcomes measured in a valid and reliable way?	☒	☐	☐	☐
8. Was appropriate statistical analysis used?	☒	☐	☐	☐

Overall appraisal score (number of 'yes' scores): **8/8**

Appendix 2

Study	Design	Year(s)	Scale	Outcome(s)	Methodological quality	Deprivation effect (S=significant, NS= Not significant, N = N/A*)
England (n=9)						
Bergen (2012)	Longitudinal cohort	2000-2009	Cities	Mean years of life lost to external causes (aged 15 years plus)	6/8 (medium)	N/A
Brock (2006)	Cross-sectional (repeated cross sectional 1991-2004 for other analyses but not deprivation)	1999-2003	Local authorities	Suicide rates (aged 15 years plus)	5/8 (medium)	N/A
Congdon (2011)	Cross-sectional	1999-2007	CAS wards	Suicide and self-harm rates	7/8 (high)	S (men & women)
Congdon (2012)	Cross-sectional	2007	CAS wards	Suicidal thoughts, suicide attempts and self-harm	7/8 (high)	S (weakened after adjustment for individual and area characteristics)
Congdon (2013)	Cross-sectional	2006-2007 & 2010-2011 (years pooled)	Middle super output areas	Self-harm related hospital stays	7/8 (high)	S (men only after adjustment for area confounders)
Coope (2014)	Repeated cross-sectional	2001-2011	Lower super output areas	Suicide rates	6/8 (medium)	N/A
Green (2013)	Repeated cross-sectional	2002-2004 & 2008-2010	Lower super output areas	Self-harm related deaths (in 16-21 year olds)	5/8 (medium)	N/A
Harriss & Hawton (2011)	Cross-sectional	2001-2005 (years pooled)	Wards	Deliberate self-harm (aged 15 years plus)	8/8 (high)	S (independent effect as adjusted for individual and area confounders)

Rezaeian (2005, 2006a&b)	Cross-sectional	1996-1998 (years pooled)	Local authorities	Suicide rates	8/8 (high)	S (remained after adjustment for age/gender)
Scotland (n=6)						
Boyle (2005)	Repeated cross-sectional	1980-1982 & 1999-2001	Census Areas Through Time	Suicide rates (below 45 years versus above 45 years old)	6/8 (medium)	S (particularly men)
Exeter (2011)	Repeated cross-sectional	1980-1982 & 1999-2001	Census Areas Through Time	Premature deaths from suicide (under 75 years)	5/8 (medium)	S
Exeter (2007)	Repeated cross-sectional	1980-1982, 1990-1992 & 1999-2001	Census Areas Through Time	Suicide rates (15-64 year olds)	5/8 (medium)	N/A
Leyland (2007)	Repeated cross-sectional	1980-1982, 1991-1992 & 2000-2002	Postcode sector	Suicide rates	5/8 (medium)	N/A
Platt (2011)	Repeated cross-sectional	1989-1995 & 1996-2002	Census Areas Through Time	Suicide rates	5/8 (medium)	N/A
Stark (2007)	Repeated cross-sectional	1981-1999	Postcode sector	Suicide rates (aged 15 years plus)	7/8 (high)	N/A
Ireland (Northern and Republic, n=3)						
Corcoran (2007)	Cross-sectional	2002-2004 (years pooled)	Electoral divisions	Deliberate self harm (15-64 year olds)	8/8 (high)	S (effect remained after adjustment for individual and area confounders)
O'Farrell (2015)	Cross-sectional	2009-2011 (years pooled)	Electoral divisions	Deliberate self-harm (15-64 year olds)	8/8 (high)	S (effect remained after adjustment for area confounders)
O'Reilly (2008)	Cross-sectional (but individual data from 5 year longitudinal study)	2001	Census Output Area	Suicide rates (16-74 year olds)	8/8 (high)	S (but disappeared after adjustment for individual confounders)

Spain (n=2)						
Gotsens (2011)	Cross-sectional	2000-2008 (years pooled)	Cities	Suicide rates	6/8 (medium)	S (men & women, particularly aged under 45 years)
Gotsens (2013a)	Repeated cross-sectional	1996-2001 & 2002-2007	Cities	Suicide rates	6/8 (medium)	S (only for larger cities but decreased over time except in Las Palmas)
Finland (n=1)						
Huikari and Korhonen (2015)	Cross-sectional	1991-2011 (years pooled)	Region	Suicide rates	8/8 (high)	S (men only)
Denmark (n=1)						
Agerbo (2007)	Cross-sectional	1982-1997 (years pooled)	Municipality	Suicide rates (25-60 year olds)	8/8 (high)	S (men only but disappeared after adjustment for individual confounders)
Sweden (n=1)						
Reimers & Laflamme (2006)	Cross-sectional	1999-2003 (years pooled)	Parishes	Deliberate self-harm hospitalisations (12-19 year olds)	8/8 (high)	NS
Portugal (n=1)						
Santana (2015)	Repeated cross-sectional	1989-1993, 1999-2003 & 2008-2012	Municipality	Suicide rates	6/8 (medium)	S (men & women, but men at multiple time points)
Netherlands (n=1)						
Kunst (2013)	Cross-sectional	1995-2000 (years pooled)	Neighbourhoods defined using postcodes	Suicide rates	7/8 (high)	S (remained after adjustment for individual and area confounders)
Switzerland (n=1)						
Pancazak (2012)	Cross-sectional	2000	Census	Suicide rates	8/8 (high)	S (remained after adjustment for individual confounders)

Multi-country (n=1)						
Gotsens (2013b)	Cross-sectional	2000-2008 (varied according to country)	Cities	Suicide rates	8/8 (high)	S (men & women)

1

Table 1: Search terms

[(suicid* OR self-harm) **AND** (socioeconomic OR SES OR education* OR employment OR income OR occupation* OR poverty OR class OR depriv* OR disadvantage* OR social class OR social factors OR economic OR unemployment) **AND** (area* OR geo* OR place OR neighbourhood OR region* OR county OR ward OR city OR district OR country)]

Figure 1: PRISMA flow diagram