

**Suicide following presentation to hospital for non-fatal self-harm in the Multicentre
Study of Self-harm: long-term follow-up study**

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Abstract

Background: Self-harm is the strongest risk factor for subsequent suicide but risk may vary. We compared the risk of suicide following hospital presentation for self-harm according to patient characteristics, method of self-harm and variations in area-level socioeconomic deprivation, and estimated the incidence of suicide by time after hospital attendance.

Method: All self-harm presentations (N=90,614, involving 49,783 individuals) to hospitals in the Multicentre Study of Self-harm in England (1/1/2000 to 31/12/2013) were included, with mortality follow-up from 1/1/2000 to 31/12/2015. Information on method of self-harm was obtained through systematic monitoring in hospitals. Level of socioeconomic deprivation was based on the Index of Multiple Deprivation (IMD) characterising the area where patients lived, grouping them according to IMD quintiles. We calculated incidence rates of suicide since first hospital presentation by follow-up period and estimated the association between individual factors (method of self-harm, IMD) and suicide using mixed effect models.

Findings: By the end of follow-up 703 patients had died by suicide. The highest incidence of suicide was in the first year after hospital discharge, particularly in the first month. Risk was three times greater in males than females [odds ratio (OR) 3.36, 95% CI 2.77-4.08, $p<0.0001$] and increased with age at hospital presentation (OR 1.03, 95% CI 1.03-1.04, $p<0.0001$). Relative to hospital presentations after self-poisoning alone, presentations involving both self-injury and self-poisoning were associated with higher suicide risk [adjusted odds ratio (aOR) 2.06, 95% CI 1.42-2.99, $p<0.0001$], as were presentations after self-injury alone (aOR 1.36, 95% CI 1.09-1.70, $p=0.007$). Similarly, attempted hanging or asphyxiation (aOR 2.70, 95% CI 1.53-4.76, $p=0.001$) and transport-related injuries (aOR 2.99, 95% CI 1.17-7.65, $p=0.02$) were associated with heightened suicide risk. Self-cutting combined with self-poisoning was also associated with increased risk (aOR 1.36, 95% CI 1.08-1.71, $p=0.01$). Patients from the least and 2nd least deprived IMD quintiles were more likely to die by suicide than patients in the most deprived IMD quintile (aOR 1.76, 95% CI 1.32-2.34, $p<0.0001$; aOR 1.64, 95% CI 1.20-2.25, $p=0.002$, respectively).

Interpretation: Patients attending hospital for self-harm are at high risk of suicide, especially immediately after hospital attendance. Certain patient characteristics and methods of self-harm, together with living in areas of low socioeconomic deprivation, may increase patients' subsequent suicide risk. However, while specific risk factors can be usefully integrated into the assessment process, since individual factors have poor utility in predicting suicide the needs and risks of *all* patients should be assessed to develop appropriate aftercare plan, including early follow-up.

Funding

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Research in context

Evidence before this study

Every year there are approximately 200,000 presentations to emergency departments in hospitals across England following acts of non-fatal self-harm. Self-harm is associated with excess mortality, especially by suicide. Risk of suicide has been shown to vary between patients who present to clinical services after self-harm in terms of gender, age, and, in some studies methods of self-harm, although it is increasingly recognised that the predictive value of such risk factors is low. Socioeconomic position has been linked to both self-harm and suicide but there are no published data on whether variations in socioeconomic deprivation are related to risk of suicide in individuals who self-harm. Repetition of self-harm is common and the methods tend to change between episodes. Other characteristics of the individual may also vary between episodes. This can be best captured by using presentations to hospital as the unit for analysis.

We searched PubMed up to May 3rd, 2019, with the terms “self-harm”, “self-injury”, “self-poisoning”, “suicide attempt”, “attempted suicide”, “suicide”, “method”, “socioeconomic deprivation”, “socioeconomic disadvantage” and “socioeconomic position”. We did not apply any language restrictions.

Added value of this study

While this study confirmed the high risk of suicide in the first year after presentation to hospital for self-harm, it showed that this risk was particularly elevated in the first month. The excess incidence of suicide mortality relative to the general population was greatest in patients 55 years and older at study entry. Presentations to hospital which involved both self-injury and self-poisoning were associated with the highest likelihood of subsequent suicide, followed by presentations involving acts of self-injury alone. Episodes involving self-cutting had equivalent risk of future suicide of those involving self-poisoning alone, while use of both

methods in the same episode indicated heightened risk. Presentations after traffic-related self-injury were associated with an almost three-fold risk of subsequent suicide relative to presentations involving self-poisoning alone. Individuals living in the least socioeconomically deprived areas at the time of self-harm had considerable elevated suicide risk relative to those living in the most deprived areas.

Implications of all the available evidence

Risk of suicide following hospital presentation for self-harm is very high immediately following hospital discharge, emphasising the need for provision of early follow-up care and attention to risk reduction strategies. Those living in areas of least socioeconomic deprivation appear to be at greatest risk. The reasons for this seemingly paradoxical finding merit further research. In conducting a psychosocial assessment of individuals who have self-harmed clinicians should be aware of characteristics which further increase risk of subsequent suicide, such as male gender, older age, method of self-harm and socioeconomic circumstances. However, it is also important to recognise the findings of other studies which show that individual factors have poor utility when evaluating the risk of suicide. This underscores the need for effective clinical management to include both a comprehensive assessment of patients' mental state, needs and risks, together with implementation of risk reduction strategies, including safety planning, for *all* patients.

Background

It has been estimated that every year there are approximately 200,000 presentations to emergency departments in hospitals across England following acts of non-fatal self-harm.^{1,2} Self-harm is associated with increased mortality, especially by suicide.³ Approximately 50% of individuals who die by suicide have a history of self-harm,⁴ hospital presentation for self-harm often occurring shortly before suicide.⁵

Risk of suicide may vary between patients who present to clinical services after self-harm. Certain methods of self-harm with high potential lethality may be associated with a particularly high risk of subsequent suicide. Studies have shown that, relative to patients who self-harm by poisoning, suicide risk is higher in patients whose self-harm involves attempted hanging or asphyxiation,⁶⁻⁹ self-drowning⁷ self-injury using firearm,¹⁰ and carbon monoxide poisoning.⁸ Presentation to clinical services after self-cutting has been associated with a higher risk of suicide in some^{6,7,9} but not all studies.¹⁰ Data from the Multicentre Study of Self-harm in England⁹ showed that traffic-related self-injury in the last presentation to hospital was associated with higher suicide risk relative self-poisoning. We are not aware of other reports on the risk of suicide following transport-related intentional self-injury.

The time closer to discharge from hospital after an episode of self-harm has been shown as a period of high suicide risk. Hawton et al., showed that 201 of 513 (39%) suicides in their study occurred in the first year after first hospital attendance, 149 (74%) of these occurring within the first six months.¹¹ In another study, the risk of *all-cause mortality* was highest during the first month after discharge from hospital following admission for self-harm,¹² although cause-specific mortality was not reported. Understanding how risk of suicide varies by time has important implications for the timing of post-discharge care.

Repetition of self-harm is common and may convey greater risk of suicide.^{13,14} In most studies of suicide risk after self-harm the analyses have been based on a single (index) episode, usually the first recorded hospital presentation for self-harm^{6-8,10} or the last recorded episode.⁹ However, with repetition of self-harm the methods tend to change

between episodes.¹⁵ Other risk factors, such as level of socioeconomic deprivation, marital status, and level of education, may also vary between presentations; this can be better captured by using presentations to hospital as the unit for analysis.

Socioeconomic position has been linked to self-harm and suicide. Numerous studies have shown that socioeconomic disadvantage is positively related to both self-harm and suicide.¹⁶ However, to the best of our knowledge, there are no data to date on how socioeconomic variation may influence the risk of suicide in individuals who self-harm.

We aimed to examine the short and long-term incidence rates of suicide in persons presenting to hospital for non-fatal self-harm and compare the risk of suicide according to method of self-harm, area-level sociodemographic deprivation, and repetition of self-harm, with a focus on the implications of these for clinical practice.

Method

Study design and population

Consecutive presentations to the emergency department (ED) of five general hospitals in Oxford, Manchester and Derby after self-harm from the Multicentre Study of Self-Harm in England were used. In this ongoing study, information on demographic and clinical characteristics are collected through completion of psychosocial assessments (of the patient's mental state, risks and needs) by specialist psychiatric clinicians in the general hospital. Less complete data are extracted by trained staff from emergency department electronic databases for patients who do not receive a psychosocial assessment. Induction training of clinical staff is carried out to ensure consistency in data collection.

The analytic sample includes individuals aged 15 years and over who had attended the study hospitals after non-fatal self-harm between 1/1/2000 and 31/12/2013. If a person died as a direct result of the self-harm act they were removed from the multicentre study as these were suicides. Mortality follow-up was to 31/12/2015 resulting in up to 16 years of follow-up. Of the 92,177 hospital presentations by 51,108 persons, we excluded observations if patients had missing information on gender, age or mortality [2.6%, n=1,325 patients, involved in 1,563 self-harm episodes, the majority (77%, n=1,019 patients) because they could not be traced for mortality]. The resulting study sample comprised of 90,614 hospital presentations by 49,783 patients (Figure 1).

Measures

Self-harm. Refers to any act of intentional self-poisoning or self-injury, irrespective of the nature of the motivation including degree of suicidal intent.¹⁷ Self-poisoning includes the intentional ingestion of any drug in an amount that is more than that prescribed or the ingestion of non-ingestible substances, overdoses of 'recreational drugs', and severe alcohol

intoxication where clinical staff considered to be an act of intentional self-harm. Self-injury is defined as any injury that has been intentionally self-inflicted.

Method of self-harm. We distinguished between episodes which involved self-poisoning alone, self-injury alone or both self-injury and self-poisoning. We further divided self-injury into specific methods: self-cutting or stabbing, jumping from heights, hanging or asphyxiation, drowning, gunshot, traffic-related injury (by motor vehicles or railways), and other methods.

History of self-harm. Patients were assigned a positive status if they had a previous recorded presentation to hospital in the study database (applies to 2nd and subsequent episodes), reported previous self-harm during their psychosocial assessment, or were identified with a prior self-harm episode through the hospital electronic records (data collectors had access to hospital electronic records).

Socioeconomic deprivation. We used the English Index of Multiple Deprivation (IMD) - an official measure of deprivation of small geographical areas in England. IMD combines scoring from several domains, including income and employment, health and disability, education, skills and training, barriers to housing and services, living environment and crime, to derive a relative deprivation score. The 32,844 such areas across England are ranked from 1 (most deprived) to 32,844 (least deprived). Oxford, Manchester and Derby have distinctly different profiles in terms of the extent of deprivation. Based on the IMD 2015,¹⁸ Manchester was ranked 5th (worst), Derby 55th, and Oxford 166th. IMD score was derived from the patient's postal address at a given presentation to hospital using GeoConvert (<http://geoconvert.mimas.ac.uk/help/faq.html>). The IMD of patients with no valid address was recorded as missing. We classified the cohort into six categories based on national IMD quintiles: 1st (least deprived) ≤ 8.49 , 2nd 8.5-13.79, 3rd 13.8-21.35, 4th 21.36-34.17, 5th (most deprived) IMD score ≥ 34.18 (<https://tools.npeu.ox.ac.uk/imd/>), and a group comprised of individuals with no-valid IMD score.

Psychiatric care. Patients who were identified as having previous or current psychiatric treatment in a specific episode through either their psychosocial assessment or the hospital electronic records were assigned a positive status in this and all subsequent episodes. A negative status was assigned to patients who were identified as having no psychiatric treatment through both their psychosocial assessment and the hospital records. Otherwise this item was considered as not known.

Linkage with mortality register

Mortality and cause of death were ascertained through linkage with data from the Office for National Statistics data (through NHS Digital). Deaths are coded according to the International Statistical Classification of Diseases and Related Health Problems version 10 (ICD-10). ICD-10 codes of underlying cause of death which indicated intentional self-harm (codes X60-X84) or death due to undetermined intent (codes Y10-Y34) were defined as suicide deaths, in keeping with current practice in UK suicide research and policy.¹⁹ These deaths are subsequently referred to as 'suicides'.

Ethical approval

All three research sites have approvals to collect data on self-harm for their local monitoring systems of self-harm and for multicentre projects and separate agreement with NHS Digital to carry out the mortality linkage with respect to their cohort. The three monitoring systems are fully compliant with the Data Protection Act (1998) and have approval under Section 251 of the National Health Service (NHS) Act (2006) to collect patient-identifiable information without explicit patient consent.

Analysis

We estimated the incidence rates of suicide per 100,000 person-years in the study cohort, using each person's *first* recorded presentation to hospital (index episode) only, and the 95% confidence interval (CI). Incidence rates of suicide were estimated from the number of suicides (numerator) divided by the number of patients presenting to hospital (population at risk) each year. The CIs were estimated using the quadratic approximation to the Poisson log likelihood for the log-rate parameter. Time-to-Event after hospital discharge was estimated by length of follow-up from index episode and categorised into single years of follow-up (with years 14th-16th combined due to small numbers). For patients who died within a year of the index episode, Time-to-Event was further categorised into 1st month, 2nd month, 3rd month, 4-6 months, and 6-12 months. The time periods selected were based on previous research.^{6,8,9,20}

National annual incidence rates of suicide and CIs were estimated from the number of deaths by suicide in England each year between 2000 and 2013 (numerator)²¹ divided by the estimated population in England in each year during 2000-2013 (denominator)²² to derive the incidence of suicide per 100,000 person-years. CIs were estimated with the Poisson exact method. Analyses were run by gender and age group (15-24 years, 25-34 years 35-54 years, and 55 years and over). We also calculated the ratio of the total number of observed deaths in the 12-month after discharge from hospital to the number expected from gender and age-specific suicide rates in England during the study period (SMR). In a sensitivity analysis, we restricted the sample to presentations which occurred between 1/1/2003 and 31/12/2013 to investigate the possibility of falsely assigning an episode as the (first) index episode (in case a patient had a self-harm episode prior to study entry).

Pearson's χ^2 was used to assess differences in the proportion of patients who died by self-injury and self-poisoning in relation to the method they used in their last presentation to hospital for non-fatal self-harm.

Three separate mixed-effect logit regression models were run to examine the associations between three variables of interest [1. Overall method of non-fatal self-harm; 2. Specific method of non-fatal self-injury; 3. Index of Multiple Deprivation (IMD)] and subsequent suicide. *All* episodes of self-harm were used in these regression analyses with suicide as the dependent variable and random intercepts at patient level to account for clustering of episodes in patients.²³ Unstructured covariance of multiple episodes per patient was specified. Postestimation Intraclass Correlations Coefficient (ICCs) were used to estimate the amount of variation accounted for by the latent variable (patient). Likelihood ratio (LR) tests indicated that clustering of patients in hospitals was not required. Gender, age (in years), previous self-harm, psychiatric treatment, and hospital were included in the regressions as covariates unless otherwise specified. These covariates were selected a priori as they have been shown to influence suicide risk and were associated with the exposure variables of interest.²⁴ In a sensitivity analysis, we excluded patients from the fully adjusted models where their history of psychiatric treatment was unknown because this variable was missing in 20% of self-harm episodes. In the regression model with specific method of self-injury as the variable of interest, we excluded the data on presentations which involved both self-injury and self-poisoning to test if the specific method of injury in itself was related to the outcome. We subsequently conducted sensitivity analysis whereby we included also episodes involving both self-injury and self-poisoning (4.4% of episodes) in order to examine how this combination relates to suicide. We also re-ran the analysis using penalised maximum likelihood regression to explore a possible sparse data bias. Finally, we re-ran the models also adjusting for the year of presentation to hospital.

A logistic regression model (performed at patient level) was used to estimate the likelihood of subsequent suicide in patients with single versus multiple self-harm episodes, adjusting for relevant confounders (as above).

Analyses were carried out using Stata 14.1.

Role of the funding source

The views expressed are those of the authors and not necessarily those of the Department of Health and Social Care (DHSC). The funder of the study had no role in study design, data collection, data analysis, data interpretation, or writing of the report. The corresponding author (GG) had full access to all of the data and took final responsibility to submit the report for publication.

Results

During 1/1/2000-31/12/2013, there were 90,614 presentations to the study hospitals by 49,783 individuals (57.4% females) (Table 1). Patients presented to the EDs for self-harm between once and 239 times during 2000-2013: 73.6% (n=36,624) presented once. The majority of presentations (80%; n=72,108) of presentations involved an act of self-poisoning, while 25% (n=22,445) involved self-injury. Self-poisoning alone was slightly more common in females than in males (77% versus 73%). Self-poisoning alone was also more common with increasing age group (15-24 years, 71%; 25-34 years 72%; 35-54 years 80%; 55 years and over 82%).

Overall, 4,058 (8.2%) patients died, 703 (17.3%) of whom died by suicide. Most suicides occurred by self-injury (64.9%, n=456), mainly by hanging or asphyxiation (63.2%, n=288). Other self-injury deaths involved traffic-related injury (6.4%, n=29), jumping from a high place (5.9%, n=27), drowning (5.3%, n=24), and use of a sharp object (4.4%, n=20). The remaining 14.9% (n=68) died by other means of injury, including firearm, smoke and flames, and unspecified means of injury. Of the 247 suicides by self-poisoning, commonly used substances included psychotropic drugs or sedatives 27.5% (n=68), narcotics or psychodysleptics 22.7% (n=56), analgesics 8.9% (n=22), and unspecified substances 28.7% (n=71). More than ¾ of patients whose *last* episode had involved self-injury also used self-injury when they died by suicide. More than three-quarters (77.5%) of patients whose *last* episode had involved self-injury also used self-injury when they died by suicide, whereas almost 60% of patients (59.2%) whose last presentation to hospital had been due to self-poisoning alone switched to self-injury in their suicide deaths (see appendix, p. 1) ($\chi^2=30.8$ df (2) $p<0.0001$).

The incidence rate of suicide was 163.1 per 100,000 person-years [95% confidence interval (CI) 151.5-175.6], in males it was 260.0 (95% CI 237.4-284.8), and in females 94.6 per 100,000 person-years (95% CI 83.3-107.4). The incidence of suicide in the first 12 months following the *index* presentation to hospital for self-harm was approximately 55.5 times (95%

CI 49.2-62.8) that expected in the general population in England (2000-2013) (53 and 62 times in males and females, respectively). The highest inflation in 12-month suicide rates relative to the general population was observed in adults aged 55 years and over (Table 2). Similar findings were obtained from the sensitivity analysis in which presentations between 1/1/2000 and 31/12/2002 were excluded.

Overall, 252 of 703 (35.9%) suicides occurred within a year from the patient's *index* presentation to hospital. The incidence of suicide was the highest in the year following discharge from hospital [incidence rate (IR) 511.1 per 100,000 person-years; 95% CI 451.7-578.2], which then declined markedly (although it remained high relative to the general population for the following 15 years) (Figure 2a). The pattern was similar for males and females although the heightened risk earlier on was more pronounced in males (Figures 2b and 2c). Almost 30% (n=74) of the deaths in the first year occurred in the first month; (IR 1787.1, 95% CI 1423.0-2244.4) (Figure 2d).

Patients who presented to hospital for self-harm more than once were more likely to die by suicide than those with a single presentation, including after adjusting for gender, age, previous self-harm, psychiatric treatment and hospital (2-9 presentations: aOR 1.23, 95% CI 1.04-1.46, $p=0.020$; 10 presentations or more: aOR 1.57, 95% CI 0.99-2.50, $p=0.060$).

Based on all presentations to hospital, males were three times more likely than females to die by suicide after self-harm [odds ratio (OR) 3.36, 95% CI 2.77-4.08, $p<0.0001$]. Age was positively related to suicide risk in both genders with a 3% increase in risk for every one-year increase in age at hospital presentation (OR 1.03, 95% CI 1.03-1.04, $p<0.0001$).

Self-injury at hospital presentation for self-harm was associated with greater risk of subsequent suicide relative to self-poisoning alone controlling for covariates as above [adjusted OR (aOR) 1.36 95% CI 1.09-1.70, $p=0.007$] (Table 3). For the associations between the covariates and suicide see appendix, p. 2. Presentations to hospital involving both self-injury and self-poisoning were associated with greater risk of suicide relative to

both presentations after self-poisoning alone (aOR 2.06, 95% CI 1.42-2.99, $p < 0.0001$), and presentations after self-injury alone (aOR 1.52, 95% CI 1.02-2.27, $p = 0.042$).

Relative to self-harm by self-poisoning alone, attempted hanging or asphyxiation were associated with greater risk of suicide (aOR 2.70, 95% CI 1.53-4.78, $p = 0.001$) as also were traffic-related acts of self-injury (aOR 2.99, 95% CI 1.17-7.65, $p = 0.022$). There was no evidence of excess risk of suicide in patients who presented to hospital after self-cutting (aOR 1.21, 95% CI 0.93-1.56, $p = 0.16$). These models were adjusted as above and were based on a sub-sample resulting from excluding episodes that involved self-injury and self-poisoning ($n = 86,675$ presentations). Intraclass correlation coefficient (ICC) 0.63, 95% CI (0.57-0.69) indicating strong correlation between episodes within the cluster variable 'patient'.

A subsequent analysis including presentations which involved both self-poisoning and self-injury produced consistent results with respect to self-injuries by hanging and asphyxiation and also self-harm by traffic-related injuries but showed that a self-cutting was associated with increased likelihood of death by suicide (aOR 1.36 95% CI 1.08-1.71, $p = 0.010$), which suggests that the use of self-cutting in combination with self-poisoning may signal increased suicide risk.

In terms of socioeconomic deprivation, 42.5% of the cohort were living in areas in the most deprived category at the time of their self-harm episodes ($n = 38,518$ episodes) (Table 4). Compared to these patients those who lived in the *least* deprived areas (1st national IMD quintile) had a greater risk of dying by suicide (aOR 1.76, 95% CI 1.32-2.34, $p < 0.0001$), after adjusting for gender, age (in years), previous self-harm, and psychiatric treatment, as also did those living in the 2nd least deprived areas (aOR 1.64, 95% CI 1.20-2.25, $p = 0.002$). This excess risk was not found for individuals living in areas characterised by the 3rd and 4th quintiles of socioeconomic deprivation, and in those with no information on IMD (who most likely had no fixed address at their hospital attendance) (ICC 0.63, 95% CI 0.58-0.69).

The results from the sensitivity analyses in which episodes with missing information on psychiatric treatment were excluded from the regression models were similar to the results reported above. Further adjustment of all models for the year of hospital presentation for self-harm resulted in similar point estimates (see appendix, p. 3-4). The results of the penalised maximum likelihood regression were consistent with those of the main analysis.

Discussion

The highest incidence rates of suicide following self-harm were observed in the 12 months after discharge from hospital, when these were more than 50 times the suicide rate in the general population in England. After the first year suicide rates declined but remained markedly higher than the general population throughout the follow-up. The excess in incidence of suicide mortality relative to the general population was highest in patients 55 years and older at study entry. Previous research,^{8,9,25} has shown that the 12-month risk of suicide is 37-131 times greater in patients who present to clinical services for self-harm than that expected in the general population. We have further shown that the incidence of suicide is extremely high in the month following discharge from hospital.

Hospital presentations which involved both self-injury and self-poisoning were associated with the highest likelihood of subsequent suicide, followed by presentations after self-injury alone. We have confirmed previous studies that have shown that attempted hanging or asphyxiation are associated with greater risk of subsequent suicide than self-poisoning in patients presenting to clinical services.^{6-9,20} Our finding that non-fatal traffic-related injuries are associated with almost three times the risk of suicide than self-poisoning alone has not been shown before, apart from in an earlier report using data for 2000-2007 from the same study.⁹ Although a less commonly encountered method of non-fatal self-injury, the results highlight a group of patients with a risk of suicide which is comparable to that of patients presenting to hospital after hanging or asphyxiation.

Presentations following self-cutting or stabbing were associated with heightened suicide risk only after also including patients who also self-poisoned in the same episode. Several studies have found an increase in suicide risk after self-cutting relative to self-poisoning^{6,7,9} but not all.^{10,20} It is conceivable that certain types of self-cutting or the involvement of other methods, as well as differences in data analysis, could explain these inconsistencies.

Interestingly, Haw and colleagues found that suicide intent scores of patients who presented to hospital after self-injury and self-poisoning in the same episode were higher than those of

patients who presented with either self-poisoning or self-injured alone.²⁶ Nevertheless, we have previously shown that self-cutting in the *last* presentation to hospital was associated with increased suicide risk relative to self-poisoning,⁹ a finding which we replicated in this study, also after excluding episodes which involved both self-poisoning and self-injury. These findings underscore the importance of providing a comprehensive psychosocial assessment, including of risk of suicide, for patients who present to hospital after self-cutting or stabbing as well as those who present following other methods of self-harm. This needs emphasising because self-cutting is often associated with discharge from hospital without a psychosocial assessment being conducted.²⁷

We further showed that patients living in areas considered least socioeconomically deprived were more likely to die by suicide following presentation to hospital for self-harm relative to patients from highly deprived areas. This finding may seem to contrast with a large body of research showing that socioeconomic deprivation is positively related to risk of self-harm and suicide in the general population.¹⁶ Indeed, the finding that 42% of our cohort were living in neighbourhoods ranked nationally as most deprived socioeconomically. While patients from low socioeconomically deprived areas may be more likely to receive a psychosocial assessment after hospital presentation for self-harm,²⁸ and one might expect that psychosocial assessment might be associated with reduction in adverse outcomes, engagement in self-harm by individuals from low deprivation areas, where there may be greater access to protective factors (e.g. healthcare, housing), may point to other factors which may influence the risk of self-harm and suicide risk following self-harm, such as severe psychiatric or substance use disorder. Indeed, over 30% of patients from the two least deprived areas in this study were in current psychiatric treatment (in- or out-patient) at the time of hospital presentation compared to under 20% of patients living in the most deprived area, although this might also reflect access to care rather than illness severity per se. Martin et al.²⁹ examined cause-specific mortality in patients with schizophrenia and bipolar disorder relative to the general population and, consistent with our finding, showed

that in these patients the incidence of suicide was highest in those residing in the most affluent quintiles (but that their risk of death by other causes was lower relative to the most deprived group). Further examination of the patients' method of self-harm according to level of deprivation in our study showed only small differences, suggesting that this is not an obvious contributing factor. It is also possible that the problems which led to self-harm and subsequently to death by suicide vary by level of socioeconomic deprivation. Our previous work on problems precipitating presentation to hospital for self-harm identified some differences in problems between sub-groups of patients who self-harm,³⁰ but we did not examine associations with socio-economic deprivation. In another study, problems which precipitated presentation to hospital for self-harm were found to vary by socioeconomic deprivation, with young males from less socioeconomically deprived areas more likely than those from more deprived areas to experience financial difficulties.³¹ This suggests that inconsistency between area-level and individual-level characteristics may have contributed to our finding. In keeping with this suggestion, Neeleman and Wessely,³² observed that suicide rates in ethnic minority groups in areas of London were inversely related to local density of ethnic minority populations. This line of research in relation to self-harm merits further work. Information on the socioeconomic circumstances of patients who engage in self-harm may have implications for their treatment needs and prevention.

This study spanned over 14 years and involved a large number of patients, which allowed us to accrue sufficient data on the relatively rare outcome of suicide and to investigate the risks associated with specific and less commonly observed methods of non-fatal self-harm. Furthermore, our approach to data analysis enabled us to use the wealth of available data by including all hospital presentations for self-harm rather than a single (index) episode and accounting for variations in methods used by patients who present to hospital more than once. This analytical approach also allowed further reduction of missing data on two important covariates (history of self-harm and psychiatric treatment). This was done by using data collected at any given time point during the observation period to inform these

variables. However, it was not possible to eliminate this entirely for patients who had self-harmed once during the observation period and where they did not receive a psychosocial assessment or where this information could not be extracted from hospital electronic records although this was further addressed through a sensitivity analysis.

One limitation of this study is that the data were collected from three research sites in three cities, so generalisability from these data to the population of England as a whole should be treated with caution. Nevertheless, the study population is socioeconomically diverse (see Methods for IMD ranking of the three cities involved in the study). Furthermore, information on IMD is based on the scoring system which was available closest to the time of presentation to hospital. The IMD scoring system changes to some extent every few years meaning that some small areas may have 'moved' in their rating between different episodes of the same person. However, this risk is mitigated in our episode-based analytical approach that accounted for this variation. Sparse data bias may be another limitation of the study. However, the results of the penalised maximum likelihood regression indicated little impact of this bias on the results. It should also be noted that our measure of socioeconomic deprivation is based on the characteristics of the locality where an individual lives, which may differ from their personal characteristics. Finally, at the time of this analysis, information on mortality was not available beyond 2015 due to delays in obtaining linked data following the enactment of the recent General Data Protection Regulation (GDPR).³³

Findings from this and previous reports show that individuals who present to clinical services for self-harm are at considerable risk of subsequent death by suicide. Presentation to hospital for self-harm offers an opportunity for intervention. A comprehensive assessment of patients' mental state, needs and risks, as specified in national guidance,^{2,34} is essential for devising a potentially effective plan for their follow-up care. The peak in risk of suicide which follows immediately after discharge from hospital underscores the need for provision of early and effective follow-up care.

Awareness of characteristics which further increase the risk of subsequent suicide, including male gender, older age, method of self-harm and area of residence can assist in understanding risk of suicide as part of a comprehensive assessment after an episode of self-harm. However, previous studies have shown that individual factors have poor utility when evaluating the risk of suicide at the time of hospital presentation for self-harm.³⁵ This highlights the importance of comprehensive assessment followed by risk reduction strategies, including safety planning,³⁶ for *all* patients.

Contributions

KH and GG were responsible for study conception and design, and interpretation of the results. GG was responsible for data analysis. KH, DC, LB, FB, NK, CC, JN, and KW acquired the data. AT contributed substantially to the development of the analytic strategy and interpretations of the manuscript. BF contributed to the interpretation of the paper. GG drafted the report, which all authors critically revised for intellectual content. All authors approved the final report and are accountable for all aspects of this work. KH supervised the study and is the guarantor.

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