RESEARCH ARTICLE

Women Of Lower Socio-Economic Status Have Worse Acute Medical Outcomes

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Abstract

Background: There are data that suggest that women hospitalised for a variety of medical conditions may have worse outcomes than men; there is a paucity of literature on hospital mortality outcome by gender and Socio-Economic status (SES) for unselected admissions.

Methods: Emergency medical admissions between 2002 and 2018 were examined. We assessed 30-day in-hospital mortality, by gender and SES, using logistic regression and margins statistics modelled outcomes against predictor variables.

Results: There were 113,807 episodes in 58,126 patients over the period, with known SES status. There were multiple admissions per patient; only 45.4% had a single admission with the percentage of patients with 1, 2, or 3 at 18.8%, 10.4% and 6.5%, respectively. The average per patient 30-day in-hospital mortality was 11.1% (95%CI:10.6%, 11.6%) for males and 11.0% (95%CI:10.5%, 11.6%) females (p = 0.84). Males from higher, 12.2% (95%CI:10.6%, 13.8%), or lower SES small areas, 12.6% (95%CI: 12.1%, 13.1%), had equivalent 30-day mortality outcomes. Females from higher SES had significantly better outcomes compared with females from lower SES small areas- 9.4% (95% CI:8.0%, 10.8%) versus 12.7% (95%CI:12.2%,13.2%).

Conclusion: 30-day in-hospital mortality adjusted for outcome predictors were similar for males and females; however, whereas the model-adjusted mortality for males was not different across SES, females of lower SES had significantly worse outcomes than those of higher SES.

Key Words: Emergency Medical Admissions, 30-day Mortality, SES, Gender

INTRODUCTION

Deprivation has previously been defined as a state of observable and demonstrable disadvantage relative to the local community to which an individual belongs. The Townsend Deprivation index, first described in 1988, is a measure of material deprivation within a population or small area, incorporating variables such as unemployment, car and home ownership, and household overcrowding (1-3). As such, Deprivation can be considered conceptually in terms of its aggregate community influence rather than personal disadvantage and may be employed to examine the impact of socioeconomic status (SES) on healthcare resources (1-3). SES has been considered a measure of an individual or family's economic and social position in relation to others, based on income, education, and occupation, and further, for low SES, has been shown to have a comparable health effect to that of major risk factors. It has been reported that individuals with low SES are 46% more likely to die early (4, 5). Such analysis has prompted that SES be a target for local and global health strategies, health risk surveillance, interventions, and policy. For most groups, causes of death show consistent trends of decreasing mortality with increasing socioeconomic status. This relationship has been confirmed for a number of individual diseases, such as myocardial infarction, heart failure and colorectal cancer (6-8). Furthermore, Deprivation is associated with death from suicide and accidental injury (9, 10), in addition to mortality from alcohol-related diseases (11).

For women, differences in mortality outcomes between the low and high socioeconomic strata has appeared highest for respiratory and cardiovascular diseases (12). Data on adverse outcomes for women has been investigated for specific diseases and conditions. For instance, after myocardial infarction, younger women had higher rates of death during hospitalization than men of the same age (13). Indeed, in the study the increased risk for women was higher only before the age of about 75. The explanations for the increased risk was only partially accounted for by differences in coexisting conditions, clinical characteristics, and early management. Outcomes by gender for coronary artery bypass grafting (CABG) and for percutaneous coronary intervention (PCI) indicate in-hospital mortality in women to be reduced after adjustment for comorbidities, procedural characteristics, and body habitus (14). For Sepsis cases, after multivariable adjustment for baseline characteristics and processes of care, women had a higher likelihood of hospital mortality than men (15). While, in the study, significant gender disparities were shown in some aspects of care delivery, these did not explain the higher mortality for female patients. Indeed, while Stroke is more common among men worldwide, women experience a higher prevalence of more severe Stroke with greater subsequent disability (16). Of particular interest to this current investigation, the worse outcome among elderly women was partially attributed to a combination of the severity of stroke on admission, lower SES, less social support and communication, a combination of which may result in less control of their stroke risk factors and an overall increase in depression and lower quality of life. In contrast, age-adjusted mortality after hip fracture surgery has been reported to be significantly higher in men than in women (17). There appears to be a paucity of literature on this topic for general medical admissions where the effect of Deprivation may need consideration.

The catchment area of our hospital, St James' Hospital, is one of high Deprivation (18); socio-economic status (SES) has been shown to increase hospital utilization (19) and, hence, healthcare costs (20, 21), and has been reported to predict mortality in the general population (22, 23). Nevertheless, analysis of mortality outcomes may be complicated when considering catchment areas with a wide range of SES, as patients from low SES small areas are admitted to hospital more frequently with their age of admission over a decade younger than patients from high SES small areas (24, 25). This is the case for the catchment area under investigation in this work. A wider range of SES may thus complicate the analysis of mortality outcomes given that major predictors of outcomes tend to increase as a function of age (26). Accordingly, this paper aimed to compare 30-day mortality outcomes by gender for unselected admitted medical emergencies, having corrected for other major influencers such as Acute Illness Severity (27-29), Chronic Disabling Disease (30) and Sepsis status (31), in order to determine whether SES and gender interact.

METHODS

Setting

St James's Hospital, Dublin, serves as a secondary care centre for emergency admissions in a catchment area with a population of 270,000 adults. Emergency medical patients are admitted from the ED to a 59-bed Acute Medical Assessment Unit (AMAU) which was opened in 2003. The design philosophy was to retain the traditional team structure and continuity of care with a personal physician for each patient, but to underpin this with a nursing and allied support team dedicated to Acute Medicine. Patients remain under one of nine teams operating a 1:9 24 h 'on-call' roster and remain under the care of the same physician over the course of their admission. There were predicted logistic advantages of geographic location (proximity to the ED, intensive care and high dependency units, and radiology). Moreover, with the patients in one location, it was anticipated that the collaborative consultation process would be facilitated. The operation and outcome of the AMAU have been further described elsewhere (32-35).

Data collection

During emergency hospital admissions, core demographics were recorded on the Patient Administration System (PAS) while ED presentation clinical observations and subsequent post-admission parameters (haematology, biochemical, blood culture or transfusion data) were entered into the electronic patient record; these data were collated and downloaded together with the National Hospital In-Patient enquiry (HIPE) scheme ICD-10-CM codes or procedures. HIPE is a national database of coded discharge summaries from acute public hospitals in Ireland (36). HIPE initially utilized the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) for both diagnosis and procedure coding from 1990 to 2005 with ICD-10-CM used thereafter. In 2002 we implemented a database to prospectively capture this data to monitor the performance of the AMAU and it has been maintained and updated each year since. The downloaded data on our database is anonymised and consists of the unique hospital identifier, admitting consultant, date of birth, gender, area of residence, principal and up to nine additional secondary diagnoses, principal and up to nine additional secondary procedures, and admission and discharge dates. This study had no interventional component, used anonymised data, complied with data protection legislation and was approved by the local institutional review board.

Acute Illness Severity Score

Derangement of biochemical parameters may be utilised to predict clinical outcome. We derived an Acute Illness Severity Score (AISS) – this is an age adjusted 30-day in-hospital mortality risk estimator, derived from an aggregrate laboratory score of admission parameters (28, 29). This AISS is exponentially related to the 30-day in-hospital mortality with a range of model adjusted mortality outcomes from 2.5% (2.3% - 2.6%) to 32.1% (30.4% - 33.8%). The AISS has been externally validated (37).

Comorbidity Instrument

Hospital HIPE codes (36, 38) were used to construct a measure of comorbidity. To devise the score, we searched ICD9 hospital episode discharge codes (back-mapping ICD10 codes to ICD9 as appropriate) based on the definition proposed by the US Department of Health and Human Services for chronic physical or mental health disorders, that limit people 'in activities that they generally would be expected to be able to perform'. These ICD codes were similar to those proposed by the Canadian group for multi-morbidity (39) and the work of Quan (40, 41); they were grouped by system into the following ten groups: (i) cardiovascular, (ii) respiratory, (iii) neurological, (iv) gastrointestinal, (v) diabetes, (vi) renal, (vii) neoplastic disease, (viii) others (including rheumatological disabilities), (ix) ventilatory assistance required and (x) transfusion requirement. We have previously detailed the ICD9 codes utilized, based on the definition proposed by the US Department of Health and Human Services (42). In addition, we searched other hospital databases for evidence of diabetes (Diamond database), respiratory insufficiency based on Forced Expiratory Volume (FEV) (FEV1 <2 L from data pulmonary function laboratory), troponin status (high sensitivity troponin >25 ng/L) (29), low albumin (<35 G/dL) and anaemia (haemoglobulin levels <10 G/dL) or chronic renal insufficiency - MDRD < 60 mL/min*1.73 m^2 (43). The 'Comorbidity Score' for each individual's clinical episode during the study was weighted by its relative importance against the 30-day mortality outcome in the multiple variable regression analysis.

Deprivation Instrument

The Republic of Ireland census (Central Statistical Office) report small area population statistics (SAPS); the smallest reporting unit is the Electoral Division (ED). Of the total of 3409, 74 Electoral Divisions are in the hospital catchment area. The catchment area population, measured in 2006, was 210,443 persons, with a median population per ED of 2845 (IQR 2020, 3399). Deprivation metrics have been determined by the Small Areas Health Research Unit (SAHRU) of Trinity College Dublin using methodology similar to Townsend (1) and Carstairs (44) to derive a Deprivation Score using principle components analysis (PCA); a weighted combination of four indicators, relating to unemployment, social class, type of housing tenure and car ownership (45). We have previously demonstrated the utility of the SAHRU classification of Deprivation in terms of predicting acute 30-day acute hospital mortality (46), admission and readmission rate incidences (24) and hospital costs following an emergency medical admission (47). The assignment of patients to small area population area used the ArcGS Geographic Information System software implementation of a Point-in-Polygon algorithm as previously outlined (48).

Statistical methods

Descriptive statistics were calculated for demographic data, including means/standard deviations (SD), medians/interquartile ranges (IQR), or percentages. We examined 30-day in-hospital mortality as the primary outcome. We performed comparisons between categorical variables and 30-day in-hospital mortality using chi-square tests; multiple comparisons were adjusted for multiplicity using Scheffe's comparison statistic. Logistic regression analysis was employed to examine significant outcome predictors ($p<0.10$ by Wald test from the univariate analysis) of 30-day in hospital mortality to ensure that the model included all variables with predictive power. Adjusted Odds ratios (OR) and 95% confidence intervals (CI) were calculated for those significant model predictors. A stepwise logistic regression analysis examined the association between 30-day in-hospital mortality and the following predictor variables AISS (28, 29), Charlson Co-Morbidity Index (49) and Sepsis status (31).

We used the margins command in Stata to estimate and interpret adjusted predictions for sub-groups, while controlling for other variables such as time, using computations of average marginal effects. Margins are statistics calculated from predictions of a previously fitted model at fixed values of some covariates and averaging or otherwise over the remaining covariates. In the multivariable logistic model we adjusted univariate estimates of effect, using the previously described outcome predictor variables. The model parameters were stored; post-estimation intra-model and cross-model hypotheses could thereby be tested. Statistical significance at $p<0.05$ was assumed throughout. Stata v.15 (Stata Corporation, College Station, Texas) statistical software was used for analyses.

RESULTS

Patient Demographics

Over the 17-year study period from 2002 to 2018, there were a total of 113,807 admissions in 58,126 patients, admitted though the AMAU; the subset actually resident in the catchment (and classified by SES) consisted of a total of 83,736 admissions in 38,206 patients, which amounted to 72.5% of all admissions. These episodes represented all general medical emergency admissions, including patients admitted directly into the Intensive Care Unit or High Dependency Unit. The proportion of males was 48.8%. The median (IQR) LOS was 5.0 (2.1, 9.6) days. The median (IQR) age was 63.3 (43.3, 77.8) years, with the upper 10% boundary at 85.3 years.

30-day Mortality Outcome between 2002 and 2018 between Genders (Fig 1)

Mortality results can be computed based on episodes (all admissions irrespective of no. of admissions per patient) or calculated on a single-episode only basis. Over a prolonged period, there is considerable scope for multiple admissions per patient; over the 17 years only 45.4% had a single admission, with the percentage of patients with 1, 2, 3, 4, or 5 admissions at 18.8%, 10.4%, 6.5%, 4.4% and 3.1%, respectively. The impact of repeated admission on the computed 30-day mortality is reflected in a lower per episodes rate of 4.5% (95% CI:4.3, 4.6) compared with a per patient rate of 8.9% (95% CI:8.7, 9.2). This difference is due to the inflation of the denominator (number of admissions) compared with the numerator (number of deaths) in an extended observation period. The denominator is obvious considerably lower if calculation (denominator) is with one admission only. Thus, computation over a shorter time frame is less problematic but still different. Over the final 3-year of the series (2016-18), for example, the 30-day mortality per episode rate of 3.8% (95% CI:3.6, 4.1) compared with the per patient rate of 5.8% (95% CI:5.4, 6.2). Further analyses has therefore been computed from both the raw (unadjusted) and model adjusted estimates (adjusted) on a per patient basis (last admission considered if > 1 admission).

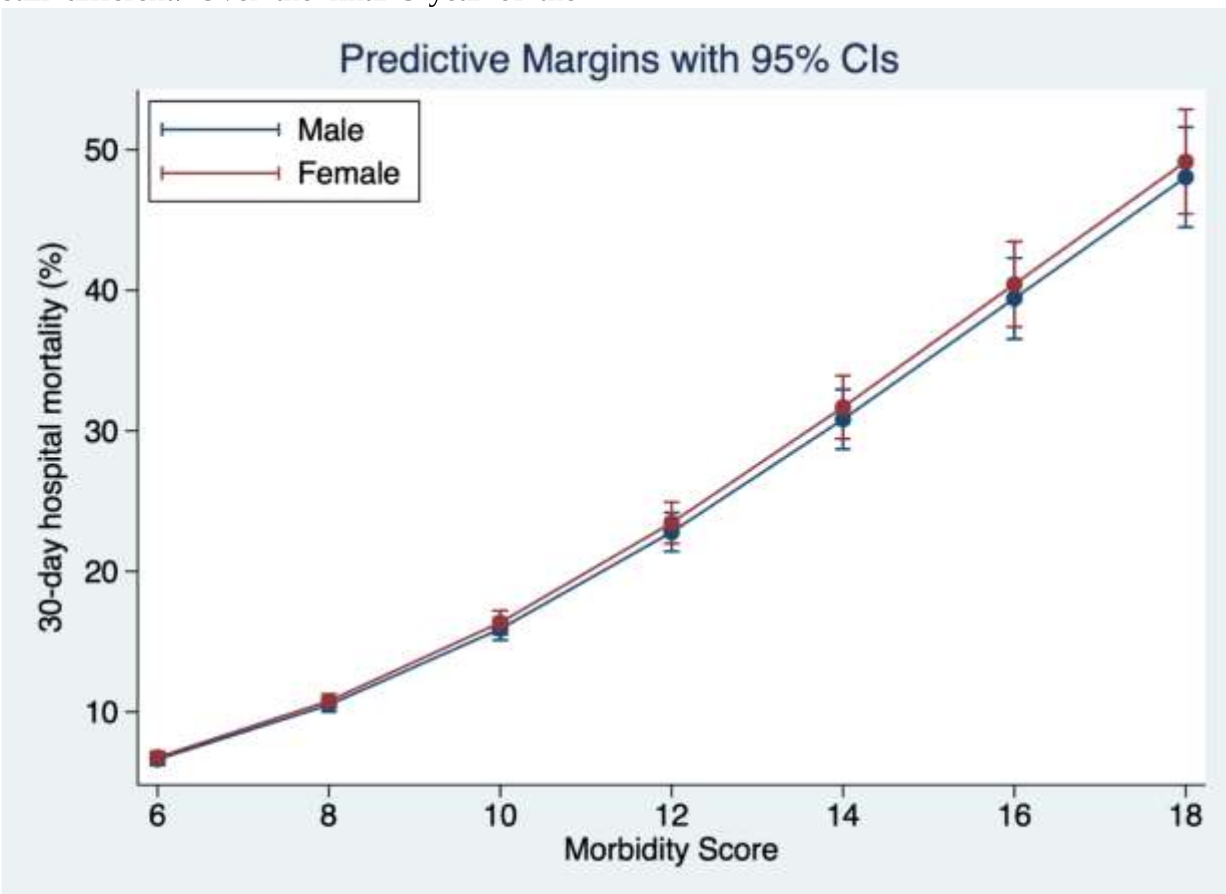

Figure 1: The 30-day hospital episode mortality outcome was linearly related to the Co-morbidity Score. The predicted probabilities were derived from the multiple variable logistic model; the effect is plotted based on the latter prediction. At any Comorbidity Score, the 30-day mortality outcome for males and females was equivalent.

The analysis of SES was based on area of residence; the catchment population of the hospital contains many small areas characterised by a high deprivation status (18). Persons with higher levels of comorbidity have shorter life expectancies, contrasting with those without comorbid conditions, including very elderly persons, who can have good life expectancies relative to an average person of the same chronological age (50). The Republic of Ireland smallest reporting unit is the

Electoral Division (ED). There are 74 such units within the hospital catchment area, with a median population per ED of 2845 (IQR 2020, 3399). High SES (1,2) and low SES (3-5) were set at a cut-point of 3 (SES Quintile).

The per patient 30-day in-hospital mortality over the 17-year period averaged 11.1% (95% CI:10.6%, 11.6%) for males and 11.0% (95% CI:10.5%, 11.6%) females (p = 0.84). The model adjusted figures, although somewhat higher, were not different between genders - 12.3% (95% CI:11.8%, 12.8%) for males and 12.6% (95% CI:12.1%, 13.1%) females. Thus, overall the adjusted or unadjusted figures did not suggest that either gender was at higher risk following an emergency medical admission.

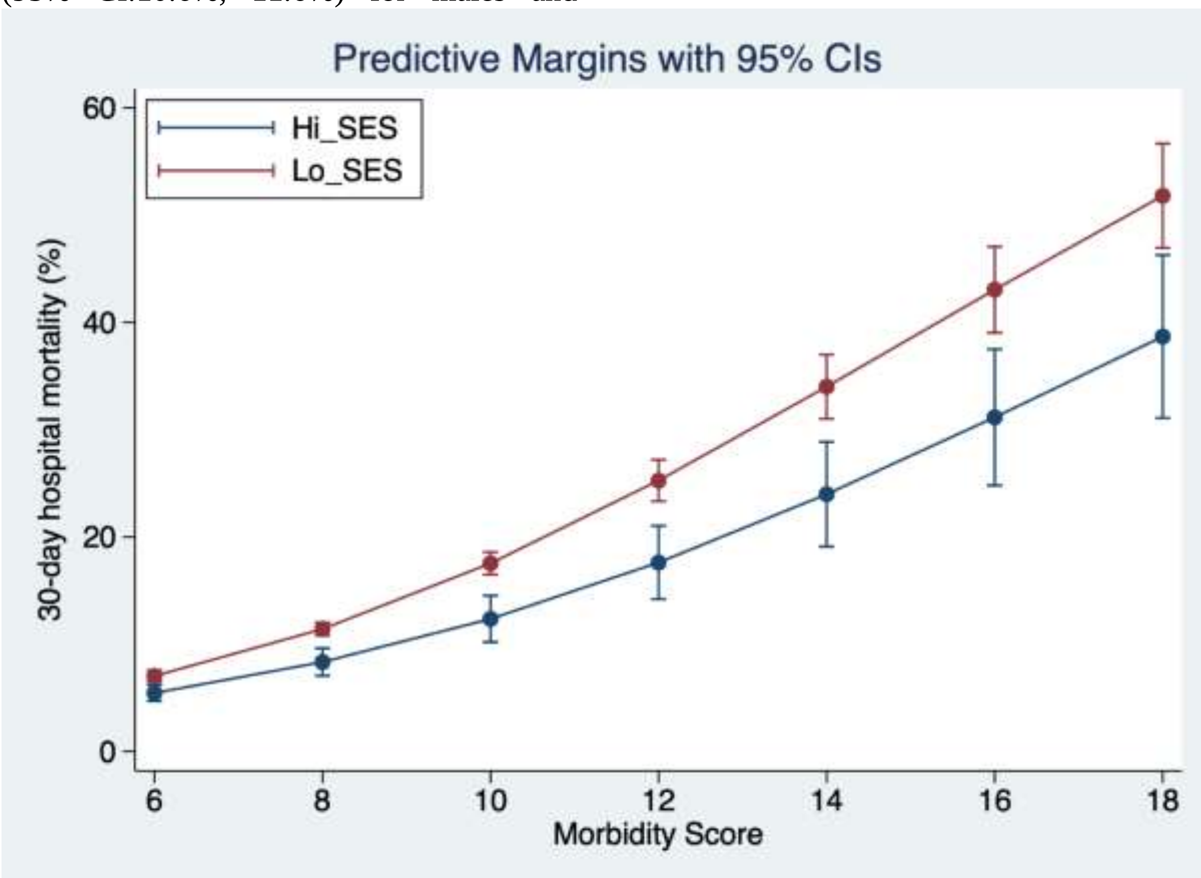

Figure 2: The 30-day hospital episode mortality outcome was linearly related to the Co-morbidity Score. The predicted probabilities were derived from the multiple variable logistic regression model; the effect is plotted based on the latter prediction. Women from lower SES small areas fared worse at any given level of Comorbidity Score.

30-day Mortality Outcome for Males by Socio-Economic Status (SES)

For male admissions, related to SES, there was an apparent difference in outcome related to Socio-Economic status (SES). The per patient unadjusted 30-day in-hospital mortality for male admissions of higher SES averaged 14.3% (95% CI:12.3%, 16.4%) compared with the 10.8% (95% CI:10.3%, 11.3%) for those of lower SES status (p = 0.004). Thus, the primary analysis suggested that males from Higher SES were at a major disadvantage in terms of mortality outcomes. It should be noted that they were much older at 76.4 years (IQR: 59.8, 83.7) compared with male admissions from low SES at 61.9 years (IQR: 44.9, 75.4). Males from the Higher SES areas were also much sicker AISS (Group V/VI: 88.8% vs 52.6%) with a somewhat higher Comorbidity Burden (Score > 10 points; 16.2% vs. 14.3%). However, in the full multiple variable logistic model, adjusted for Acute Illness Severity (28, 29), Charlson Co-Morbidity Index (49), Sepsis status (31) and Multi-morbidity Score, males from higher - 12.2% (95% CI:10.6%, 13.8%) or lower SES small areas 12.6% (95% CI:12.1%, 13.1%) appeared to have equivalent 30-day mortality outcomes.

30-day Mortality Outcome for Females by Socio-Economic Status (SES)

For female admissions, a real (post-full adjustment) difference in outcome related to Socio-Economic status (SES) was apparent. The per patient 30-day in-hospital mortality for admissions of higher SES averaged 10.5% (95% CI:8.9%, 12.1%) appeared equivalent to the 11.0% (95% CI:10.5%, 11.5%) for those of lower SES status (p = 0.39); however, in the full model, adjusted for Acute Illness Severity (28, 29), Charlson Co-Morbidity Index (49), Sepsis status (31) and Multi-morbidity Score, females from higher – 9.4% (95% CI:8.0%, 10.8%) had significantly better outcomes compared with those from lower SES small areas 12.7% (95% CI: 12.2%, 13.2%).

DISCUSSION:

In this study we sought to compare 30-day mortality outcomes by gender for unselected admitted medical emergencies, in order that we could determine whether SES and gender interacted. We report that the mortality rates for males by socioeconomic status, adjusted for AISS and Comorbidity, were equivalent. While those of the higher SES were much older with more acuity and comorbidity, as compared with those in the lower SES, the 30-day mortality of the respective groups were equivalent. Of particular interest was the contrast noted for females where, after adjustment for AISS and morbidity, those from High SES had much better outcomes than those from lower SES small areas. While it might not be unsurprising that a high SES group would have relatively better outcomes than those of a lower SES group, what is unexpected is the differences within female and male groups, particularly for such a general emergency medical admission take.

There are some studies which support that there are worse outcomes in women following hospital admission (13-16). In the case of myocardial infarction, overall hospital mortality was 16.7% for women but 11.5% for men, with the mortality difference reportedly varying with age. For a younger age group (those <50 years), women displayed mortality rates twice that of men, with this difference decreasing for older persons (13). In our work, there was no significant difference in the overall mortality rates when comparing males and females, with the contrasts becoming evident on examination of how mortality within a gender changed with SES. The literature explanations have offered that a combination of increased Comorbidity and/or disease complexity and also Socio-Economic differences are to be considered as factors (14), however, these factors had not fully explained the mortality differences between genders. Indeed, the relatively limited literature on this topic has focussed on either specific cohorts or particular disease types. With our work, we add to the literature by presenting analysis for all emergency medical admissions, and offering an insight into how SES interacts with mortality for women, and its contrast with that of men. There were acuity differences for women, with the lower SES group showing relatively fewer of the highest AISS score patients than the higher SES group, who were also older. Nevertheless, having accounted for the comorbidity and complexity, lower SES was identified as a significant predictor of mortality. The literature has suggested that a lower quality of life for women of lower SES, particularly driven by less social support structures, social interaction and consequential depression may possibly explain such mortality differences (16). This may be the case for our cohort; however, the data was unavailable for such investigations.

Indeed, the challenge in assessing mortality outcomes following a hospital admission is that, as a generality, it is not possible to ensure that the nature of the comparison is equivalent, given that the data has not been randomised. Our primary outcome of interest in this work is the 30-day hospital mortality outcome; over the 17-year period between 2002 and 2018 the latter mortality (essentially a linear trend over time) fell by 31.9% from 5.5% to 3.7% (per episode) and by 61.1% from 12.4% to 4.8% (per patient) (51). The fall in mortality was not due to a change in admission policy or lower risk categories, but represented the outcome figure adjusted for major risk factors (27). It is mirrored by reductions in mortality over time reported elsewhere (52), where it was reported that UK mortality rates fell between 2003 and 2008 from 14.9% to 11.4%; our comparable per patients figures were from 12.3% to 9.5%. Another such study estimated that per admission mortality fell between 2002 and 2014 from 5.7% to 3.9% (53); our comparable admission statistics were from 5.5% to 3.8%. This thus highlights the first consideration of attempting to detail the impact on predictive variables on an outcome figure that has been continuously improving over time.

Once admitted, then factors such as the Acute Illness Severity (27, 28) and Comorbidity burden, as calculated from Charlson Co-Morbidity Index (49) or Disability measures (30), may be fundamental predictors of 30-day mortality outcomes. The latter imply an embedded risk that is present at the time of admission, rather than being predicated by the clinical decisions made after the event. The AISS is based on the principle of homeostasis in a counter-regulating system, where the extent of the failure to restore balance predicts the outcome. There have been various admission laboratory data Illness Severity Score constructs published (54-56). In terms of Comorbidity measures, population-based or health-related databases have been employed to derive metrics of risk such as the Charlson (49) or Elixhauser (57) Comorbidity parameters; the latter are the two most commonly used in health research with both identified as providing adequate discrimination for in-hospital mortality (57). In this work, we utilised a system screening methodology applied to a Chronic Disabling Disease classification method (30, 58), as defined by US Department of Health and Human Services for chronic physical or mental health disorders (42). This Comorbidity Score appeared to predict overall 30-day in-hospital mortality; however, the caveat is that the underlying relationship in this study, has been adjusted for the AISS (27, 59) and without such there would be an absence of such a powerful adjustor (2, 3).

Our data, therefore, demonstrates the potential for data that have been competently collected over many years, to result in completely different conclusions. The expectation that individuals from Deprivation areas, who place more demands on healthcare resources (3), might have worse outcomes could have formed a primary hypothesis. In this work, the crude outcomes for males suggested that older, High SES admissions were more at risk, 14.3% vs. 10.8%: p = 0.0004), unlike females by SES status (10.5% vs. 11.0%: p = 0.3); however, the subsequent multiple variable model adjustment, indicated that the crude analysis would have led to an very different conclusion about the relative influence of gender and Deprivation interaction on mortality outcomes.

As with any study, it is necessary to note the strengths but, more importantly, highlight the limitations. The strengths lie in the comprehensive and extensive dataset available for analysis and for the employed correction for confounding factors that may affect mortality in medical admissions. The limitations of this study include that while the study includes a large general "take", it is a single centre study and, as such, the findings may not translate to other sites. Furthermore, there was a lack of infectious disease pandemics data which, as a result, were not corrected for and, given the length of the study period, therapy changes for patients have not been accounted for. Furthermore, we have not investigated trends across specialties, which may be of interest in future work.

To conclude, in-hospital mortality, when adjusted for outcome predictors, was indicated to be similar for males and females. That said, when considering the effect of Deprivation, as accounted for by SES, the model-adjusted mortality for males was not different across SES. In contrast to this, females of lower SES had significantly worse outcomes than their counterparts from areas of higher SES.

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Table I: Demographics of emergency medical admissions – Females by socioeconomic status (SES).

	High SES (N = 2,245)	Low SES (N = 50,093)	p-value
Age (years)			
Mean (SD)	73.4 (18.2)	61.2 (21.6)	<0.001
Median (IQR)	79.4 (66.2, 86.1)	65.8 (42.9, 79.8)	
Length of Stay (days)			
Mean (SD)	7.8 (7.0)	7.0 (6.4)	<0.001
Median (IQR)	5.4 (2.4, 11.1)	5.0 (2.1, 9.7)	
30-day In-hospital Mortality			
Alive	2103 (93.7%)	47867 (95.6%)	<0.001
Dead	142 (6.3%)	2226 (4.4%)	
Acute Illness Severity Score			
1	33 (1.7%)	1427 (3.3%)	<0.001
2	69 (3.6%)	3361 (7.7%)	
3	148 (7.7%)	5224 (11.9%)	
4	223 (11.6%)	7117 (16.2%)	
5	384 (19.9%)	8668 (19.7%)	
6	1072 (55.6%)	18107 (41.2%)	
Morbidity Score			
< 6	1134 (50.5%)	26682 (53.3%)	0.16
6	856 (38.1%)	17944 (35.8%)	
10	201 (9.0%)	4309 (8.6%)	
13	38 (1.7%)	829 (1.7%)	
16	15 (0.7%)	309 (0.6%)	
Charlson Index			
0	1023 (50.0%)	22085 (47.1%)	0.04
1	539 (26.3%)	12865 (27.4%)	
2	485 (23.7%)	11936 (25.5%)	
Sepsis Group			
1	1761 (78.4%)	38932 (77.7%)	0.23
2	403 (18.0%)	9571 (19.1%)	
3	81 (3.6%)	1590 (3.2%)	

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