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The combined association of depression and socioeconomic status with length of post-operative hospital stay following coronary artery bypass graft surgery: Data from a prospective cohort study ☆

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ABSTRACT

Objective: To understand the association between pre-operative depression symptoms, including cognitive and somatic symptom subtypes, and length of post-operative stay in patients undergoing coronary artery bypass graft (CABG) surgery, and the role of socioeconomic status (SES).
Methods: We measured depression symptoms using the Beck Depression Inventory (BDI) and household income in the month prior to surgery in 310 participants undergoing elective, first-time, CABG. Participants were followed-up post-operatively to assess the length of their hospital stay.
Results: We showed that greater pre-operative depression symptoms on the BDI were associated with a longer hospital stay (hazard ratio = 0.978, 95% CI 0.957–0.999, p = .043) even after controlling for covariates, with the effect being observed for cognitive symptoms of depression but not somatic symptoms. Lower SES augmented the negative effect of depression on length of stay.
Conclusions: Depression symptoms interact with socioeconomic position to affect recovery following cardiac surgery and further work is needed in order to understand the pathways of this association.

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Introduction

Depression is prevalent among coronary artery bypass graft (CABG) patients with pre-surgery estimates ranging between 14.3% and 43.1% [1–5]. Patients with pre-operative depression have been found to experience a host of poorer surgical recovery outcomes including higher incidence of medical complications during the six months following surgery, and greater reporting of poor quality of life and worse recovery [2]. One important marker of surgical recovery is length of post-operative hospital stay. In recent decades length of post-operative hospital stay has reduced significantly after CABG. Many institutions in the UK apply an 'early discharge' protocol whereby the aim is to discharge elective patients within five days. While post-operative stay is a proxy

measure of acute physical recovery, it is also an important indicator of recovery in the longer term, as it has been found to be associated with hospital readmission [6] and recurrent cardiac events [7]. Many clinical risk factors are established predictors of prolonged length of stay [8], though interest is now being paid to psychosocial risk factors including the role of pre-operative depression [9]. This latter study found that greater pre-operative depression symptoms, in a sample of 117 elective CABG patients, were associated with longer hospital stays after controlling for demographic and clinical risk factors.

The type of depression symptoms experienced by patients has also been studied in CABG patients, but research has tended to focus on cardiac prognosis rather than acute recovery. For example, Connerney and colleagues [7] found cognitive/affective but not somatic symptoms to be predictive of cardiac mortality in models adjusted for confounders. These results have been supported by another recent study of CABG patients [10]. These findings are in contrast to data concerning acute coronary syndrome (ACS) patients [11–16] and therefore warrant further investigation. This issue is of particular salience to acute recovery endpoints since somatic symptoms of depression may overlap with the physical symptoms of illness; therefore by investigating the unique contribution of both depression symptom subtypes we may be able to tease out the effect of depression on cardiac health and minimise any residual confounding.

Socioeconomic status (SES) has been implicated in the link between depression and coronary heart disease. In a sample of 298 men and

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women low household income was associated with elevated depression symptoms at three weeks, six months and one year following ACS and this effect was independent of other demographic and clinical risk factors as well as history of depression [17]. In CABG samples, some investigators have used another marker of socioeconomic position, education, finding that low education is associated with greater risk of pre-operative depression [4,18], but others have not supported this effect [2]. However, educational attainment may not be the optimal marker of SES in this patient group, since most have completed formal education several years before the onset of cardiac disease. Therefore, measures of current socioeconomic resources may be more appropriate.

Little is known about the interaction between depression and SES for CABG recovery. However, population research has shown that low occupational status acts synergistically with psychological distress to impact cardiovascular mortality negatively [19]. The reason for this is not clear, but a biological mechanism is plausible in which depression and low SES act as stressors, leading to wear and tear on the body in line with the allostatic load model of stress [20,21]. This notion is particularly pertinent when one considers recent evidence of the distinct biological correlates of cognitive versus somatic depression, in which cognitive depression is thought to align itself with changes to the neuroendocrine system, whereas somatic depression is thought to be more closely related to inflammation [22]. Such a hypothesis would be consistent with the notion that somatic depression and the physical symptoms of illness are inextricably linked.

The aim of this study was to assess the relationship between preoperative depression symptoms and length of post-operative stay, and to examine the extent to which any association could be influenced by differences in SES. Specifically, we hypothesised that cognitive and somatic symptoms of depression would differentially be associated with length of hospital stay, and that the effect of depression symptoms on length of stay would be moderated by household income.

Methods

Participants

The study uses data collected in the Adjustment and Recovery after Cardiac Surgery (ARCS) study which was designed to investigate the causes and consequences of poor emotional adjustment following cardiac surgery and was powered to assess the importance of a broad range of psychological, behavioural and social factors. The recruitment and retention of participants into the ARCS study is displayed in Fig. 1. Briefly, out of the 347 participants who completed valid baseline questionnaires, those participants included in these analyses were the 310 CABG surgery patients (mean age: 67.76 ± 9.17 years, 14.8% females) with complete data for all variables at baseline and follow-up, including covariates. Compared to the participants who were included in these analyses, the excluded participants were more likely to be female ($x^2(1) = 5.34, p = .021$), but otherwise did not differ on any other clinical or demographic variable. Participants were recruited consecutively from a pre-surgery assessment clinic at St. George's Hospital, London, between January 2010 and July 2012. The baseline assessment took place on average 29 days before patients' surgery when they came to the hospital for their pre-assessment clinic appointment. Inclusion criteria permitted only patients who were undergoing elective CABG surgery or CABG plus valve replacement to participate. CABG surgery was defined to include both on-pump and off-pump surgical procedures. In addition, participants had to be able to complete the questionnaires in English, and be 18 years or older. All procedures were carried out with the written consent of the participants. Ethical approval was obtained from the South West London research ethics committee.

Measures

Predictors: depression and SES measures

The Beck Depression Inventory (BDI) [23] was used to measure depression symptoms at baseline. It is a 21-item questionnaire which asks the respondent to reflect on how they have been feeling over the past two weeks. Ratings were summed, with higher scores indicating greater emotional disturbance, with a range of 0 to 63 (Cronbach's $\alpha = 0.85$). A severity categorical variable was generated according to accepted cut-offs: a score of 0 to 10 indicating no depression, 11 to 20 mild depression, and 21 and above moderate to severe depression. We also generated two symptom subtype scores as described by Beck and Steer [24]. The cognitive depression symptom score was the sum of items 1 to 13 and the somatic depression symptom score was the sum of items 14 to 21. SES was assessed using yearly household income divided into five categories ranging from <£10,000 per year to >£40,000 per year.

Outcome: length of stay measure

Length of post-operative hospital stay was collected from clinical records. The discharge policy at St. George's Hospital is to discharge all patients within 7 days of CABG providing there are no complications; there were no changes to this discharge policy during the period of data collection. Length of stay is a marker of clinical recovery, with those participants experiencing the poorest recovery and the greatest in-hospital complications, expected to have the longest hospital stays after CABG.

Covariates: clinical and sociodemographic measures

Clinical risk was assessed using the European System for Cardiac Operative Risk Evaluation (EuroSCORE) [25]. EuroSCORE is a composite measure of procedural mortality risk based on 17 factors comprising patient-related factors (e.g. age, sex), cardiac-related factors (e.g. unstable angina, recent MI) and surgery-related factors (e.g. surgery on thoracic aorta). Items were scored in accordance with the 'logistic EuroSCORE' method to generate a percentage mortality risk estimate; further details of the scoring method can be found on the EuroSCORE website (www.euroscore.org/logisticEuroSCORE.htm) [26]. In addition, the number of grafts a participant received and whether they underwent cardiopulmonary bypass (yes/no) were also recorded. History of diabetes was also taken from medical notes, with participants being categorised according to their treatment status: none, diet, oral hypoglycaemic drugs or insulin. Cardiovascular history, clinical factors during admission and management were also obtained from clinical notes.

Participants were asked to self-report any longstanding illnesses prior to surgery; responses were counted to compute a chronic illness burden variable to capture the number of illnesses a participant had in addition to their coronary artery disease. Prescribed medication use was recorded, including use of antidepressants. Smoking was measured as a binary variable (current smoker/non-smoker). Body mass index (BMI) was assessed at the pre-operative clinic appointment and calculated using the standard formula (kg/m^2).

The Hospital Anxiety and Depression Scale (HADS) is a self-report measure of anxiety and depression for use in outpatient clinical settings [27]. Only the 7-item anxiety scale was administered at baseline, capturing the extent to which each symptom had been experienced over the past two weeks. Items were summed to generate an overall score, with higher scores indicating greater anxiety (Cronbach's $\alpha = 0.89$).

Statistical analysis

Associations between variables were assessed using Pearson's correlations for continuous data and one-way ANOVAs for categorical variables. To test the association between baseline depression and length