THE ROLE OF SUPPORT IN THE PHYSICAL AND PSYCHOLOGICAL HEALTH OF CORONARY ARTERY BYPASS GRAFT SURGERY PATIENTS AND THEIR PARTNERS

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I, Elizabeth Leigh, confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

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Abstract

Background: Treatment for coronary heart disease with coronary artery bypass graft (CABG) surgery provides benefits for physical and psychological health. Poor recovery and adjustment is experienced by some patients and their partners. Aspects of social relationships may be important psychosocial determinants of physical and psychological outcomes for both partners.

Methods: A longitudinal study of CABG patients and their partners was conducted with the aim of determining the role of social relationships for short-term recovery and adjustment from surgery. Participants completed measures of emotional adjustment, physical health status, support and caregiving (partners only), 4 weeks before and 8 weeks after surgery, and clinical data was obtained from medical notes. The trajectories of variables were analysed, and support variables were examined as predictors for emotional and physical outcomes. The provision of support (caregiver burden) was also assessed as a predictor for partner outcomes, as was its relationship with support.

Results: Patients experienced improvements to emotional variables after surgery but only anxiety improved for partners. Both spouses suffered reductions to physical health. After controlling for covariates social support predicted length of hospital stay in patients and marital functioning predicted depression symptoms and anxiety. Social support predicted mood disruption in partners and caregiver burden predicted emotional distress. Caregiver burden predicted decreasing social support, but support was not protective of distress in those with greater burden. Partners reported less favourable levels of emotional and support variables than patients.

Conclusions: Support influences the post-surgery adjustment of patients and their partners. The provision of care impacts the partner's emotional outcomes and their perceptions of support. Particular types of support and the provision of support are risk factors for worse psychological and physical outcomes in CABG patients and their partners, with implications for the development of interventions.

“Unhappy marriage is a disability, analogous to minority race, economic deprivation, or physical illness”

(Renne, 1970) p59

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Publications

Some of the research described in this thesis has been prepared or accepted for publication, or presented at conferences.

Publications

Leigh, E., Poole, L., Kidd, T., Ronaldson, A. and Steptoe, A. (Manuscript prepared). The consequences of caregiving: distress in coronary artery bypass graft surgery partners.

Poole, L., Kidd, T., **Leigh, E.,** Ronaldson, A., Jahangiri, M., Steptoe, A. (Manuscript Prepared). Measures of psychological distress and intensive care unit stay after cardiac surgery: the predictive role of illness perceptions.

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Conference presentations

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List of abbreviations

ARCS – Adjustment and Recovery after Cardiac Surgery

BDI – Beck Depression Inventory

BHF – British Heart Foundation

BMI – body mass index

CABG – coronary artery bypass graft

CHD – coronary heart disease

CI – confidence interval

CPQ – Close Persons Questionnaire

CS – cross sectional

DSM-IV – Diagnostic and Statistical Manual of Mental Disorders – 4th Edition

ENRICHD - The Enhancing Recovery in Coronary Heart Disease patients study

ESSI – ENRICHD Social Support Instrument

EuroSCORE – The European System for Cardiac Operative Risk Evaluation

GP – general practitioner

HADS – Hospital Anxiety and Depression Scale

HR – hazard ratio

HPA – hypothalamic pituitary adrenal

IBD – inflammatory bowel disease

IBM – International Business Machines corporation

ICU – intensive care unit

MF – marital functioning

MI – myocardial infarction

LVEF – left ventricular ejection fraction

MS – multiple sclerosis

NHS – National Health Service

OA – osteoarthritis

OCBS – Oberst Caregiver Burden Scale

PARCS – Partner Adjustment and Recovery after Cardiac Surgery

PES/NES – Positive Emotional Style/Negative Emotional Style

PCI – percutaneous coronary intervention

PCS – physical component score

PTSD – post traumatic stress disorder

RA – rheumatoid arthritis

RCT – randomised controlled trial

SD – standard deviation

SE – standard error

SF-12 – short form-12

SOC – standard occupational classification

SPSS – Statistical Package for Social Sciences

SS – social support

UCL – University College London

Chapter 1 Coronary artery bypass graft surgery

1.1 Introduction

This chapter describes the features and prevalence of coronary heart disease and coronary artery bypass graft surgery. The potential adverse physical and psychological outcomes of the surgery and their risk factors are described in relation to the methodological limitations of the literature, leading to the proposed intention of this PhD.

1.2 Coronary heart disease

Coronary heart disease (CHD) is the collective term for diseases that result from the narrowing of the coronary arteries, restricting the blood supply to the heart. CHD results from the build-up of fatty deposits in the walls of the arteries (atherosclerosis), which can occur over many decades before symptoms are experienced. Symptoms include angina - the chest pain associated with reduced amounts of oxygen reaching the heart, and breathlessness. A complete blockage of the coronary arteries manifests as a myocardial infarction (MI), when the lack of oxygen supply may result in damage to the heart.

CHD is the leading cause of death and of premature death (before the age of 75) in the UK. In 2010, CHD was responsible for over 80 000 deaths and 25 000 premature deaths in the UK, accounting for 17% of premature deaths in men and 8% in women. The overall cost to the UK economy is estimated at £6.7 billion a year, with 27% attributed to direct health care costs, 47% to productivity losses of those not able to work due to illness or death from CHD, and 26% to the informal care of CHD patients, resulting from the loss of income from unpaid caregiving. CHD is clearly a population health issue of considerable magnitude.

Risk factors for CHD include older age, being male, family history, and engaging in certain harmful health behaviours such as smoking, physical inactivity, poor diet and high alcohol consumption. Medical risk factors include obesity, high cholesterol, high blood pressure and diabetes. There is evidence of a social gradient in the risk of CHD, with more socially deprived people at greater risk for CHD and CHD mortality (Marmot, Rose, Shipley, & Hamilton, 1978). Lower socioeconomic groups have a greater prevalence of smoking, and those in higher groups have higher fruit and vegetable intake and participation in physical activity. These risk factors help to identify individuals at greater risk of suffering from CHD.

Fortunately, the rates of CHD are falling, most quickly in older age groups, and UK targets for premature mortality from CHD rates have now been met in England, Wales and Scotland. A concerted effort to tackle CHD in Britain has resulted in fewer cardiac events and less associated mortality (N. Townsend et al., 2012). Although the rates of CHD are decreasing, there is evidence of a stalling in the improvements to behavioural risk factors such as diet, exercise and smoking, and the decline of incidence and mortality from CHD is not guaranteed to persist without continued efforts to decrease risk.

Around 58% of the decline in deaths during the 1980s and 1990s has been attributed to population-scale reductions in risk factor behaviours. Over the past few decades, the incidence of regular smoking, and consumption of dietary fats have decreased, and the intake of fruit has increased (Unal, Critchley, & Capewell, 2004). The introduction of an NHS Health Check service has significantly reduced diastolic blood pressure, total cholesterol levels and lipid ratios in the last year alone (Artac, Dalton, Majeed, Car, & Millett, 2013).

The remaining 42% is explained by treatments for CHD. In the last decade the treatment for CHD has undergone a number of changes, with large increases in the prescription of drugs for lowering blood pressure and cholesterol, as well as increases in revascularisation procedures which have become more common place. The most common revascularisation procedures are percutaneous coronary intervention (PCI) and coronary artery bypass graft (CABG) surgery (Scarborough et al., 2010). PCI involves the widening of narrowed coronary arteries by a process of surgically inserting stents and inflating balloons. CABG surgery involves the grafting of blood vessels, typically from the chest and leg or arm, into the heart to bypass the coronary arteries which are severely narrowed or blocked.

1.3 Coronary artery bypass graft surgery

The first aortocoronary bypass was conducted by Sabiston in 1962, and since has become one of the most common procedures used to treat CHD in the UK. It is also one of the most frequently performed surgeries in the world (Roger et al., 2011). The number of procedures performed each year rose until plateauing in the 1990s. In 2008 over 22 000 CABG procedures were performed in the UK (Scarborough et al., 2010), and over 408 000 in the USA in 2007 (Roger et al., 2011). The numbers in the UK have since dropped as the quantity of PCIs continues to increase (N. Townsend et al., 2012), and in 2010, 17 822 CABG procedures (16 408 isolated first-time CABG) were performed in the UK (Bridgewater & Grant, 2012).

CABG is conducted in order to improve survival in patients with significant left main coronary artery disease (a blockage greater than or equal to 50%). CABG with the intent to improve symptoms is recommended for patients with significant blockage (≥70%) in one or more coronary arteries with unacceptable angina despite medication, and it is the treatment of choice for individuals who are at significant risk of MI as a result of the narrowing of their coronary arteries. Otherwise it is recommended for those within months of suffering MI or failed revascularisation by another method (Hillis et al., 2011). Almost 80% of patients selected for CABG surgery are men over the age of 60 (NHS, 2012).

1.4 Physical outcomes

The aims of CABG surgery are to relieve physical symptoms, increase life expectancy, prevent MI, restore blood flow to the heart muscle, improve functional capacity, and ultimately improve quality of life. It has been confirmed in a number of studies, including three large randomised controlled trials (RCTs), that CABG surgery is associated with increased longevity (Coronary Artery Surgery Study (CASS) Principle Investigators, 1983; European Coronary Surgery Study Group, 1982; Grover, Hammermeister, & Burchfiel, 1990). As the survival effects of CABG have been well established, improvements to health status, symptoms and functional status are now considered a primary goal of CABG surgery (Mallik et al., 2005). The three RCTs also found CABG to be more effective than medical therapy in reducing angina symptoms. In addition, CABG surgery has been shown to relieve breathlessness, as well as increase physical activity and mobility (Jenkins, Stanton, Savageau, Denlinger, & Klein, 1983). Whilst CABG surgery improves survival and symptoms, it does not cure the underlying disease so it is also important to consider outcomes other than mortality and morbidity.

1.4.1 Physical health status

Physical subscales of self-reported measures of health related quality of life have been used to study perceived health, and generally show overall improvements to physical functioning (Douki et al., 2010; Sahin, Wan, & Sahin, 1999) after CABG surgery. However, improvements have been seen to vary on the basis of illness severity, pre-operative scores and depression symptom levels (Hunt, Hendrata, & Myles, 2000; G. A. Lee, 2008; Mallik et al., 2005; Rumsfeld et al., 2001). Pre-operative self-reported physical health status has been shown to predict physical (Johnston, Goss, Malmgren, & Spertus, 2004; Rumsfeld et al., 1999), and emotional outcomes in CABG patients (Dickens, Cherrington, & McGowan, 2012; Lie, Arnesen, Sandvik, Hamilton, & Bunch, 2010). Some decreases in physical health status have been seen after surgery, particularly in patients who were angina free before surgery (Pirraglia, Peterson, Williams-Russo, & Charlson, 2003). However levels vary as a result of time, and following a decline, scores typically improve to a level comparable with general population norms in the years after surgery (Hanne Gjeilo, Wahba, Klepstad, Lydersen, & Stenseth, 2006; Krannich, Lueger, Weyers, & Elert, 2007).

1.4.2 Adverse physical outcomes

There are a number of potential adverse physical outcomes of CABG surgery, though the risks typically are small enough to justify continued recommendation of the procedure. Mortality rates are relatively low and were 0.8% for elective isolated first-time CABG in the UK in 2010/11 (Bridgewater & Grant, 2012). Rates of prolonged length of hospital stay of 14 or more days have been reported as approximately 5% (E. D. Peterson et al., 2002). Despite the use of antibiotics and other infection prevention techniques, in-hospital infections occur in up to 20% of CABG surgery patients (Hillis et al., 2011). Renal dysfunction occurs in up to 3% of isolated CABG cases, with approximately 1% requiring dialysis (Abraham & Swain, 2000). Atrial fibrillation occurs in up to 50% of patients immediately after CABG and is associated with increased risk of morbidity and mortality (Mariscalco et al., 2008).

1.5 Psychological outcomes

Since its inception, the success of CABG surgery has been quantified through the measurement of ‘hard’ endpoints such as mortality and adverse events. Softer endpoints such as psychological adjustment have more recently been considered an important aspect of the success of surgery. This is particularly the case where elderly patients are being referred for surgery, and improvements to quality of life are considered at least if not more important than increased longevity. A large number of studies have shown improvements to psychological health following CABG surgery, including health related quality of life and overall well-being (Johan Herlitz et al., 2001; Hunt et al., 2000; Jokinen, Hippeläinen, Turpeinen, Pitkänen, & Hartikainen, 2010; Währborg, 1999). For the most part, pre-surgical levels of distress such as depression and anxiety are seen to improve after surgery (McKenzie, Simpson, & Stewart, 2010). This is thought to arise from improvements to physical functioning and the alleviation of pain, cardiac symptoms and pre-surgery anticipatory stress (Ravven, Bader, Azar, & Rudolph, 2013).

However, it is widely reported that a proportion of CABG patients experience poor psychological adjustment or ‘psychological distress’ even after successful surgery, defined as symptoms of anxiety, depression and disrupted mood (Gardner & Worwood, 1997). Table 1-1 lists the studies I identified in the literature that assessed psychological adjustment before and after CABG surgery. I conducted a search of the electronic databases PubMed and Medline using multiple search terms including “cardiac surgery”, “coronary artery bypass”, “CABG” which were crossed with search words related to psychological adjustment, including the terms “psychological”, “adjustment", “emotion”, “mood”, “depression”, “anxiety”, “well-being”. This was followed by extensive cross-referencing and searching of reference lists of existing studies and reviews, as well as additional searches for papers by authors who had written several papers on the topic. The table includes studies with both pre- and post-operative assessments of emotional well-being. The table is limited to studies reporting the three outcomes of interest: depression, anxiety and mood. In the case of studies reporting separate results for CABG and other cardiac surgery patients, only the sample size and findings for CABG patients are included in the table. For intervention studies, data from only the non-intervention group are reported.

Table 1-1 Studies assessing depression/anxiety/mood before and after CABG

Study	**Sample; time-points**	**Outcomes/ Measure**	**Findings**
(Andrew, Baker, Kneebone, & Knight, 2000)	147 patients; 1 day pre (T1); 6.5 days post (T2)	Depression; Anxiety; Mood (DASS)	16% depressed T1 and remained stable T2; 16% stressed mood T1 and remained stable T2; 27% anxious T1 significant increase to 45% T2.
(Blumenthal et al., 2003)	817 patients; 1 day pre (T1); 6 months post (T2)	Depression (CES-D)	26% mild-moderate depressed and 12% moderate-severe depressed T1; 58% moderate-severe remained depressed T2.
(Borowicz Jr et al., 2002)	172 patients; 1 day pre (T1); 1 month (T2), 1 year (T3) and 5 years post (T4)	Depression (CES-D)	32% depressed T1; 28% T2; 21% T3; 16% T4.
(Boudrez & De Backer, 2001)	330 patients; 2-3 days pre (T1); 3-4 weeks (T2), 6 months (T3) and 12 months post (T4)	Depression (SCL-90); Anxiety (SCL-90, STAI)	Anxiety improved from T1 to T2; depression improved from T1 to T3; 15.5% poor score at T4 and negative change in depression; 19.7% in anxiety.

(Burg, Benedetto, Rosenberg, & Soufer, 2003)	89 male patients; within 1 week pre (T1); 4 weeks (T2) and 6 months post (T3)	Depression (BDI)	28.1% depressed T1; 16.9% depressed T3, 20% of whom new onset depression.
(Burker et al., 1995)	141 patients; 1 day pre (T1); 1 day before discharge post (T2)	Depression (CES-D)	47% depressed T1; 61% depressed T2.
(Duits et al., 1998)	217 patients; 14 days (T1) and 1 day pre (T2); 7 days (T3)and 6 months post (T4)	Depression (HADS); Anxiety (STAI)	Anxiety decreased at T3 and stable at T4; depression decreased at T3 in women but stable in men; >65 increase in depression at T4.
(Eriksson, 1988)	101 patients; 9 days pre (T1); 1 month (T2) and 7.5 months post (T3)	Depression (BDI); Anxiety (HAM-A)	28.8% depressed T1; 10.3% depressed at T2 and stable at T3; 78% anxious T1; 44.8% at T2 and 30.2% T3; significant decreases from T1.
(Fráguas Júnior, Ramadan, Pereira, & Wajngarten, 2000)	50 patients; 1-3 days pre (T1); 1-3 days before discharge post (T2)	Depression (CIS, HAM-D)	22% depressed T1; 21% depressed T2; stable over time; 6% new onset.
(Gallagher & McKinley, 2007)	172 patients; pre (T1); 1-3 days before discharge (T2) and 10 days post (T3)	Anxiety (HADS)	40% anxious T1; 28% T2 and 40.6% at T3; scores stable over time.

(Gallagher & McKinley, 2009)	155 patients; pre (T1); 1-3 days before discharge (T2) and 10 days post (T3)	Depression (HADS); Anxiety (HADS)	38.7% anxious T1; 38.6% T2; levels low-moderate at all times; depression low at T1 then significantly increased at all time points; 16% T1; 18.2% T2 and 45% T3.
(Goyal, Idler, Krause, & Contrada, 2005)	90 patients; 6.6 days pre (T1); 2 months (T2) and 6 months post (T3)	Depression (BDI)	Depression scores significantly decreased at all time points; 23.3% depressed T1; 11.1% T2 and 15.6% depressed T3.
(Grossi, Perski, Feleke, & Jakobson, 1998)	52 patients; pre (T1); 1 year post (T2)	Anxiety (STAI); Mood (NHP)	Anxiety scores significantly improved over time; not stated T1 but 23% very anxious T2; no significant improvement to emotional reactions.
(Hallas, Thornton, Fabri, Fox, & Jackson, 2003)	22 patients; 1 week pre (T1); 2 months post (T2)	Depression (HADS); Anxiety (HADS); Mood (GMS)	40% depressed and anxious T1; 27% T2; 18% increased depression and anxiety; depression, anxiety, positive and negative mood significantly improved.
(Heijmeriks, Pourrier, Dassen, Prenger, & Wellens, 1999)	600 patients; 1 day pre (T1); 2 months (T2), 6 months (T3) and 31 months post (T4)	Depression (HADS), Anxiety (HADS), Mood (NHP)	Significant improvement in depression, anxiety and emotional reactions at T2; no further improvement at T3.

(Höfer, Doering, Rumpold, Oldridge, & Benzer, 2006)	121 patients; day of admission for angiography pre (T1); 1 month (T2)and 3 months post (T3)	Depression (HADS); Anxiety (HADS)	Anxiety significantly improved from T1 to T3 but not between each time point; depression remained stable.
(Horgan, Davies, Hunt, Westlake, & Mullerworth, 1984)	77 patients; pre (T1); 3 months (T2) and 12 months post (T3)	Depression; Anxiety	~50% depressed and anxious T1; ~33% (T2 or T3).
(Jenkins et al., 1983)	318 patients; pre (T1); 6 months post (T2)	Depression; Anxiety	Depression and anxiety declined.
(Jensen, Hughes, Rasmussen, Pedersen, & Steinbrüchel, 2006)	109 patients; 1 day pre (T1); 3 months post (T2)	Depression (MDI)	Depression scores and number of depressed patients stable over time.
(Keresztes, Merritt, Holm, Penckofer, & Patel, 2003)	80 patients; after admission pre (T1); 1 month (T2) and 3 months post (T3)	Mood (POMS)	Mood significantly improved from T1 to T2 and T3; only men reported reductions in anger.
(Khatri et al., 1999)	170 patients; 1 day pre (T1); 6 weeks post (T2)	Depression (CES-D); Anxiety (STAI)	30% depressed (T1); 25% depressed (T2); 49% of patients depressed at T1 were still depressed T2; 14% patients new onset depression; 43% anxious T1; 15% anxious T2; no significant changes except depression decrease in women only.

(Khoueiry et al., 2011)	50 patients; 1 day pre (T1); 1 (T2), 3 (T3), 6 (T4) and 9 months post (T5)	Depression (BDI); Anxiety (BAI)	Depression significantly increased at T2 then decreased by T5 to below T1; 60% depressed at T1 and T2, 40% at T4, 44% T5; low anxiety significantly decreased at T2 then stable.
(Knipp et al., 2004)	29 patients; 3 days pre (T1); 5 days (T2) and 3 months post (T3)	Depression (GDP); Mood (AMS)	Depression and mood significantly increased at T2 then decreased to T1 levels.
(Koivula, Tarkka, Tarkka, Laippala, & Paunonen-Ilmonen, 2002a)	171 patients; 1 week after scheduling of surgery (T1) and 1 day pre (T2); 3 months post (T3)	Anxiety (HADS)	State anxiety decreased over time; 49% med-high state anxiety at T1, 25% T2 and 19% T3; trait anxiety 57% at T1 then 39% T3; 3% increased to severe by T3 from T2.
(Krannich, Weyers, et al., 2007)	142 patients; 2 days pre (T1); 10 days post (T2)	Depression (HADS); Anxiety (HADS)	25.8% depressed T1; 17.5% depressed T2; 34% anxious T1; 24.7% anxious T2; depression and anxiety significantly decreased.
(Kustrzycki, Rymaszewska, Malcher, Szczepanska-Gieracha, & Biecek, 2012)	37 patients; after admission pre (T1); 7-10 days (T2), 3 months (T3) and 8 years post (T4)	Depression (BDI); Anxiety (STAI)	No change in depression over time; 37.8% depressed at T4; anxiety significantly reduced over time.

(Lindquist et al., 2003)	674 patients; pre (T1); 6 weeks (T2), 6 months (T3) and 12 months post (T4)	Depression (CES-D); Anxiety (STAI)	Anxiety and depression significantly decreased by T3 then stable.
(Lopez, Sek Ying, Poon, & Wai, 2007)	68 patients; 5 days pre (T1); 1 week (T2), 3 months (T3) and 6 months post (T4)	Depression (CES-D)	Depression increased at T2 then decreased significantly by T4.
(Magni et al., 1987)	44 patients; pre (T1); 1 year post (T2)	Depression (SDC); Anxiety (SDC)	Depression and anxiety significantly improved; 25% depressed or anxious at T2.
(Markou, Selten, Krabbe, & Noyez, 2011)	102 patients; pre (T1); 1 year post (T2)	Anxiety (EQ-5D)	Anxiety significantly improved.
(McCrone, Lenz, Tarzian, & Perkins, 2001)	31 patients; on admission pre (T1); 2-3 days (T2), 2 (T3), 4 (T4), 8 (T5) and 12 (T6) months post	Depression (CES-D); Anxiety (CES-D)	65% depressed T1; 65% T2; 29% T5; 26% T6; depression significantly increased by T2 then decreased at T3 then stable; 10% new onset depression; no significant changes to anxiety.
(McKhann, Borowicz, Goldsborough, Enger, & Selnes, 1997)	124 patients; pre (T1); 1 month (T2) and 1 year post (T3)	Depression (CES-D)	27.4% depressed T1; 32% depressed T2 or T3; 13% new onset T2; 9% T3; 53% still depressed at T2; 47% T3.

(Millar, Asbury, & Murray, 2001)	81 patients; 3 days pre (T1); 6 days (T2) and 6 months post (T3)	Depression (BDI)	28% depressed T1; 78% of whom still depressed at T2; 39% of whom still at T3; 14% new onset T2; 3% new onset T3.
(R. H. B. Mitchell et al., 2005)	137 patients; within month pre (T1); 6-12 weeks post (T2)	Depression (MINI, BDI)	28.2% major depressive disorder T1; 16.4% T2; 23% of men and 59% of women depression symptoms T1; 29% men 32% women T2; depression significantly decreased in women only.
(Murphy, Elliott, Higgins, et al., 2008)	184 patients; pre (T1); 2 (T2) and 6 months post (T3)	Depression (HADS); Anxiety (HADS)	Anxiety decreased; 72% minor depression decreased; 14% major depression persisted; 14% minor depression worsened.
(Nemati & Astaneh, 2011)	71 patients; pre (T1); 4 weeks post (T2)	Depression (HAM-D); Anxiety (HAM-A)	Depression and anxiety significantly decreased.
(Penckofer, Ferrans, Fink, Barrett, & Holm, 2005)	61 female patients; pre (T1); 3 months after (T2)	Depression (PGWBI); Anxiety (PGWBI)	Anxiety significantly decreased; depression remained stable; 25% depression/anxiety scores reflecting severe distress at T2.
(J. C. Peterson et al., 2002)	123 patients; pre (T1) ; 6 (T2) and 36 months post (T3)	Depression (CES-D)	18% new onset depression at T2; 68% of those depressed at T2 resolved by T3; 32% increased; 11% new onset at T3; 14% more depressed at T3 than T1.

(Phillips-Bute et al., 2003)	280 patients; 1 day pre (T1); 12 months post (T2)	Depression (CES-D); Anxiety (STAI)	Anxiety and depression decreased.
(Phillips-Bute et al., 2006)	551 patients; pre (T1); 6 weeks (T2) and 1 year post (T3)	Depression (CES-D); Anxiety (STAI)	Anxiety and depression decreased by T2.
(Phillips-Bute et al., 2008)	411 patients; 1 day pre (T1); 6 months (T2)and 1 year post (T3)	Depression (CES-D)	28% males/57% females depressed T1; 17%/33% at T2; stable at T3; 7%/6% new onset T2; 10%/6% T3.
(Pinna Pintor et al., 1992)	58 patients; pre (T1); 6-24 months post (T2)	Depression (SRS); Anxiety (STAI)	Depression significantly worsened; anxiety significantly improved.
(Pirraglia, Peterson, Williams-Russo, Gorkin, & Charlson, 1999)	218 patients; within week pre (T1); 6 months post (T2)	Depression (CES-D)	43.1% depressed T1; 23.4% T2; 5.5% new onset; 25.2% improved; 17.9% persisted.
(Rothenhäusler et al., 2005)	30 patients; 1-3 days pre (T1); before discharge (T2) and 1 year post (T3)	Depression (MADRS, SCID); Anxiety (SCID)	11.4% minor depressive disorder T1; 17.6% major at T2; 9.9% minor at T3; of major depressive 16.6% remitted, 50% improved; self-report depression significantly worsened at T2 then improved; 5.9% generalised anxiety disorder at T1; 6.6% at T2; 3.3% at T3.

(Ruiz, Matthews, Scheier, & Schulz, 2006)	111 patients; 1-20 days pre (T1); 18 months post (T2)	Depression (CES-D)	No significant change in depression at T2.
(Rymaszewska, Kiejna, & Hadryś, 2003)	53 patients; a few days pre (T1); a few days (T2) and 3 months post (T3)	Depression (BDI); Anxiety (STAI)	32% depressed T1; 28.3% T2; 26.4% at T3; 54.7% anxious T1; 34% T2; 32% at T3.
(Sorensen & Wang, 2009)	63 patients; pre (T1); 6 weeks post (T2)	Depression (GDS)	24% depressed T1; 16% depressed T2; low levels persisted.
(Stroobant & Vingerhoets, 2008)	37 patients; 1 day pre (T1); 6 days (T2), 6 months (T3) and 3-5 years post (T4)	Depression (BDI); Anxiety (STAI)	30.2% mild-moderate depression T1; 22.6% at T2; 22.2% at T3; 25.6% at T4; 2% new onset at T2; 5.5% at T3; 11.5% at T4; depression significantly decreased at T2 then returned to T1; 29.3% anxious at T1; 13.2% at T2; 2.7% at T3; 7% at T4; anxiety significantly dropped at T2 then stable.
(Szalma et al., 2006)	98 patients; pre (T1); 6 weeks post (T2)	Depression (BDI); Anxiety (STAI)	Depression did not change over time; anxiety decreased.
(Timberlake et al., 1997)	121 patients; pre (T1); 8 days (T2), 8 weeks (T3) and 12 months post (T4)	Depression (BDI)	37% depressed T1; 50% at T2; 24% at T3; 23% at T4; 40% new onset at T2; 13% at T3; 12% at T4; 52% remained non depressed at all times.

(Tully, Baker, Turnbull, & Winefield, 2008)	222 patients; pre (T1); before discharge post (T2)	Depression (DASS); Anxiety (DASS); Mood (DASS)	20.1% depressed at T1; 23.5% at T2; 31.4% anxious at T1; 45.5% anxious at T2; 21.7% stressed mood at T1; 19.4% at T2.
(Tully, Baker, Knight, Turnbull, & Winefield, 2009)	75 patients; within week pre (T1); 6 months (T2) and 5 years post (T3)	Depression (DASS); Anxiety (DASS); Mood (DASS)	6% depressed at T1; 6% at T2 and 12% and T3; 16% anxious at T1; 12% at T2; 15% at T3; 12% stressed at T1; 9% at T2; 7% at T3.
(Tully, Bennetts, et al., 2011)	226 patients; 2 days pre (T1); 6 days post (T2)	Depression (DASS); Anxiety (DASS); Mood (DASS)	Depression increased in patients with atrial fibrillation; anxiety increased; mood decreased.
(Vingerhoets, 1998)	80 mixed cardiac surgery patients; 1 day pre (T1); 7 days (T2) and 6 months post (T3)	Depression (BDI), Anxiety (STAI)	Depression significantly increased at T2 then significantly decreased at T3 below T1; anxiety significantly decreased at T2 then stable; 35% mild-severe depressed at T1; 47.9% at T2; 31.3% at T3; 32.5% anxious at T1; 47.9% at T2; 31.3% at T3.

(Yang et al., 2012)	232 patients; 3 days pre (T1); 6 months post (T2)	Depression (PHQ)	18.1% depressed T1 and T2; 9.1% new onset; 72.7% no depression at either time point; 9.1% persistent depression.
(Yin, Luo, Guo, Li, & Huang, 2007)	40 male patients; pre (T1); 7-10 days (T2) and 3 months post (T3)	Depression (SRS)	Depression increased at T2 then recovered by T2.

List of abbreviations: Adjective Mood Scale (AMS), Beck Anxiety Inventory (BAI), Beck Depression Inventory (BDI), Centre for Epidemiological Studies-Depression scale (CES-D), Clinical Interview Scale (CIS), Depression Anxiety Stress Scales (DASS), EuroQoL (EQ-5D), General Depression Scale (GDP [modified from HADS]), Geriatric Depression Scale (GDS), Global Mood Scale (GMS), Hamilton Rating Scale – Anxiety/Depression (HAM-A/D), Hospital Anxiety and Depression Scale (HADS), Major Depression Inventory (MDI), Mini International Psychiatric Interview (MINI), Montgomery–Åsberg Depression Rating Scale (MADRS), Nottingham Health Profile (NHP), Primary Care Evaluation of Mental Disorders Patient Health Questionnaire (PHQ), Profile of Mood States (POMS), Psychological General Well Being Index (PGWBI), Self-Rated Depression Scale (SRS) State Trait Anxiety Inventory (STAI), Structured Clinical Interview for DSM IV (SCID), Symptom Checklist (SCL-90), Symptom Distress Checklist (SDC)

1.5.1 Poor psychological adjustment

Depression

Depression is defined in the DSM-IV as the presence of symptoms of depressed mood and/or loss of pleasure or interest in daily activities. Additional depressive symptoms include loss of appetite, insomnia or hypersomnia, psychomotor agitation or retardation, fatigue or loss of energy, feelings of worthlessness or guilt, difficulty concentrating and thoughts of death. Depression is recognised as being associated with physical illness, and is particularly prevalent in patients with CHD (Dickens et al., 2012; Steptoe, 2007) with rates as high as 31% seen following MI (Thombs et al., 2006). The rates of depression in CABG patients on the whole are typical of the cardiac patient population, but are notably higher than the prevalence in the general population, so are a cause for concern (Lett, Sherwood, Watkins, & Blumenthal, 2006).

The studies in Table 1-1 most often assessed depression in the form of self-reported depressive symptoms as opposed to a diagnosed depressive disorder. A recent meta-analysis of CABG depression studies including 22 of the studies in Table 1-1 described the incidence of depression at different time points. Ravven and colleagues (2013) identified the rates of depression or depressive symptoms to be approximately 35.5% of patients within the 2 weeks after surgery, 24% from 2 weeks to 2 months, 22% from 2 weeks to 6 months, and 21.6% after 6 months, demonstrating a high but decreasing incidence at all time points. The authors calculated the increased relative risk of depression in the first two weeks after surgery compared to before surgery to be 1.27 (95% confidence interval [CI] 1.01-1.61). However, the relative risk from 2 weeks to 2 months was 0.78 (95% CI 0.67-0.90). There was another decreased risk of 0.64 (95% CI 0.58-0.70) from 2 to 6 months, and another reduction over 6 months of 0.68 (95% CI 0.58-0.79). This demonstrates an increased risk immediately after surgery but then a decrease in depression across all points of recovery. However whilst the risk does decrease, more than 20% of patients reportedly remain at risk of depression after 6 months.

The findings from the studies in the table for the most part match the findings from the meta-analysis, though with a great deal of variability in the rates of depression at different time points. For example, Andrew et al (2000) reported pre-surgery rates to be as low as 16% and McCrone et al (2001) reported rates as high as 65%. This disparity may be explained by the fact that these studies adopted different depression measurement tools, and the McCrone et al (2001) study included only 31 patients and thus was limited in terms of power and generalisability. Similarly, post-surgery rates range from 6% (Tully et al., 2009) to 65% (McCrone et al., 2001), most likely due to variation in timing of assessment and measurement tool.

While the majority of studies do show improvements in depression at the first assessment after surgery, approximately one-fifth of the studies in the table show that depression symptoms initially increase after surgery. For example, Khoueiry et al (2011) reported significant increases in depression in the week after surgery compared to the days before. However, the study had a small sample size (n=50) and depression was assessed only one day after surgery, possibly inflating the post-surgery scores due to the acute stage of physical recovery. In addition, some studies report approximately a 10% incidence of new onset depression (McCrone et al., 2001; McKhann et al., 1997; Millar et al., 2001; Phillips-Bute et al., 2008; Yang et al., 2012), where it is evident after surgery in patients who were not depressed before surgery. Reports of new onset or increasing depression have been attributed by some researchers to patients having perceptions that their illness will last a long time and be unlikely to be cured (Dickens et al., 2008), or having unrealistic expectations and misunderstandings regarding their disease and the procedure (Timberlake et al., 1997). In summary, in some cases depression incidence does increase after surgery, with some patients crossing the threshold for elevated depressive symptoms only after surgery.

Other studies report depression as remaining stable, for example Jensen et al (2006). However, their sample of older patients (mean 75 years) may have produced an underestimation of depression, and their post-surgery assessment was at 3 months, by which point other authors also report depression levels similar to pre-surgery (Knipp et al., 2004). Overall, the evidence for stable levels of depression is less strong.

In summary, the course of depression after surgery shows great variability across studies, most probably due to variation in methodology, to be discussed below. In general, it would appear that depression levels are high in the period immediately before and after surgery, but eventually decrease to levels lower than at baseline. However, studies report elevated levels of depression to be maintained for months and years after surgery in a proportion of patients. For example, Kustrzycki et al (2012) reported that rates of 37.8% were maintained up to 8 years after surgery, and Stroobant and Vingerhoets (2008) reported that 25.6% of their sample were depressed 3 to 5 years after surgery. Regardless of the heterogeneity in findings, depression is evidently an important and prevalent problem in some CABG surgery patients. However, the course over time remains in question due to the lack of consistency in methodology across studies.

Anxiety

Anxiety is defined by the DSM-IV as intense fear and worry (apprehensive expectation) that the individual finds difficult to control. It includes symptoms of restlessness or feeling on edge, being easily fatigued, difficulty concentrating, irritability, muscle tension and sleep disturbance, and causes significant distress or impairment in important areas of functioning (American Psychiatric Association, 2000). While the majority of the literature focuses on depression, anxiety is also recognised as a feature of CHD. A meta-analysis of anxiety disorders in CHD patients revealed rates of approximately 11%, and confirmed anxiety to be conceptually separate from depression (Tully & Cosh, 2013), and therefore is likely to be a relevant issue to be addressed in CABG surgery patients.

Levels of anxiety are typically elevated before CABG surgery, characterised by a fear of dying before surgery (Fitzsimons, Parahoo, Richardson, & Stringer, 2003). The rates of pre-surgery anxiety range from 5.9% (Rothenhäusler et al., 2005) to 78% (Eriksson, 1988). However, Rothenhäusler et al (2005) used diagnostic interviews to report clinical generalised anxiety disorder while Eriksson employed a self-report anxiety scale, partly explaining the disparity. Rates around 50% are frequently reported when measured by self-report in the days before surgery (Khatri et al., 1999; Koivula et al., 2002a; Rymaszewska et al., 2003), and the studies reporting low rates before surgery are in the minority (Khoueiry et al., 2011). Evidently anxiety is elevated in the run up to surgery, though many studies do not report the exact timing of their pre-surgery assessment (Gallagher & McKinley, 2009; Höfer et al., 2006; Jenkins et al., 1983; Lindquist et al., 2003; Murphy, Elliott, Higgins, et al., 2008; Nemati & Astaneh, 2011; Penckofer et al., 2005; Pinna Pintor et al., 1992; Szalma et al., 2006). Similarly, only one study reported pre-surgery anxiety at more than one time point, and found that rates decreased from one week after the scheduling of surgery to one day before surgery (Koivula et al., 2002a), suggesting that some studies may under- or overestimate the rates of pre-surgery anxiety depending on at what point it was measured.

The large majority of studies reveal that anxiety improves after CABG surgery compared with pre-surgery rates. Often studies then show that anxiety levels remain stable rather than continue to decrease (Khoueiry et al., 2011; Lindquist et al., 2003). A minority of studies show anxiety not to improve, for example McCrone et al (2001) and Gallagher and McKinley (2009) did not report any notable changes in anxiety following surgery. However post-surgery assessments took place before discharge from hospital, so anxiety may not yet have been alleviated at this acute stage of recovery. Similarly, studies showing increases to anxiety after surgery were often measured very soon after surgery (Andrew et al., 2000; Rothenhäusler et al., 2005; Tully et al., 2008; Tully, Bennetts, et al., 2011). Evidently, while the majority of patients experience significant decreases to their levels of anxiety following surgery, for some patients the period immediately after surgery remains an anxious time. While levels typically do improve at a later stage of recovery, some studies report approximately 30% of their sample to still have elevated levels at later time points, long after their physical symptoms are expected to have improved. While the course of anxiety over time shows more consistency in the literature than depression, the variability due to timing and measurement method maintains the confusion regarding the course of anxiety over time in CABG surgery patients.

Mood

In addition to consideration of specific symptoms of depression and anxiety, general mood has been revealed as relevant to CABG surgery. In this PhD, mood refers to moods or affective states that are not specified as symptoms of depression or anxiety. Due to the limited number of studies addressing everyday mood states in CABG samples, studies assessing stress and emotional reactions to surgery have also been included under the heading of mood. Andrew et al (2000) found that stressed mood remained stable after surgery, with no changes at 6.5 days from 1 day before surgery, implying that stress levels remain high immediately after surgery. However, only 16% were reported to be stressed before surgery, and the short follow-up time limits this study's usefulness in showing the course of mood over time. The large study of 600 patients by Heijmeriks et al (1999) reported initial improvements to emotional reactions 2 months after surgery, but levels remained stable after 6 months from surgery, suggesting that emotional reactions do not necessarily consistently improve over time, though only one high powered study is not sufficient to draw firm conclusions from.

Studies that adopted measures of everyday mood state found that the incidence of moods such as anger, confusion, fatigue, tension and hostility decreased from pre-surgery to 3 months later (Keresztes et al., 2003), positive moods increased and negative moods decreased 2 months after surgery (Hallas et al., 2003), or negative mood initially increased 5 days after surgery and then decreased by 3 months (Knipp et al., 2004). The effect that CABG surgery has on mood remains an unclear picture due to variation in conceptualisation and measurement of mood. Generally mood improves eventually after surgery, though too few and underpowered studies have been conducted, and this area needs further investigation.

Summary

In summary, depression, anxiety and disrupted mood have been studied to varying degrees in the past with mixed findings. Depression levels are seen to fluctuate at different points in the recovery process. Anxiety is most often seen to improve on average. However, inconsistencies are seen, possibly through the choice of timing of measurement. Mood is relatively under studied and in a heterogenic fashion, so it is premature to form conclusions on the course of mood over time in CABG patients. The inconsistencies in the literature, as well as the high prevalence reported in several of the studies and implications for later health highlight the importance of measuring these aspects of the patient's adjustment surrounding the time of their surgery, and prompted my PhD research.

1.5.2 Methodological issues

A number of methodological issues may explain the inconsistencies in the prevalence and even direction of changes in psychological adjustment following surgery across the literature, and the following issues render it difficult to compare their findings.

Definition and measurement

Authors' choice of measurement tool of psychological adjustment determines their definition of the construct. Certain measures allow for distinction of subtypes of psychological adjustment, such as the Beck Depression Inventory (BDI – (Beck, Steer, & Carbin, 1988)), but findings are often not presented according to these subtypes, so like-for-like comparisons between studies are not always possible. Definitions of the terms ‘new onset’ and ‘persistent’ depression are not always sufficiently described, and thus the movement of patients between groups of depression severity is not always clear. The terminology of ‘major’ and ‘minor’ depression is possible only after diagnostic interview, which was used by only a minority of researchers (Fráguas Júnior et al., 2000; R. H. B. Mitchell et al., 2005; Rothenhäusler et al., 2005). The self-report measures adopted by the remaining studies which did not use diagnostic interview are not substitutes for psychiatric measures, and are subjected to the problems associated with self-report measures of distress. Self-report anxiety is usually measured in a general way and does not reflect the characteristics of a particular anxiety disorder. However, Tully and Penninx (2012) found that low positive affect and somatic anxiety detected clinical depression and panic disorder, respectively, in CABG patients. Therefore self-report distress measures are implied to have some diagnostic power and usefulness for screening, and have value by detecting sub-clinical levels of psychological distress. I would argue that self-reported adjustment is important to research in its own right, though it is important to take into account that scores are likely to be inflated over those determined by clinical interview (Thombs et al., 2006).

Rates of depression, anxiety and mood disturbance are most often based on the number of patients with scores that cross a particular threshold. However, different cut-off points may not be comparable across measures, and not all researchers adopt the same cut-offs. For example, Timberlake et al (1997) used the cut-off of ≥9 for depression scores on the BDI, and Erikkson (1988) used a cut-off of ≥14, when most of the remaining studies used the generally accepted cut-off of ≥10. Consequently, prevalence figures in the Timberlake et al study are relatively high, and in the Eriksson et al study are relatively low. As a result, findings from these studies cannot accurately be compared to those from the other BDI studies, and non-recommended cut-offs are arguably arbitrary.

Studies reporting prevalence are typically dichotomous and do not report mean scores or the significance of the change across time points. The studies which report both often reveal prevalence to change but mean scores not to significantly differ over time. For example, Gallagher and McKinley (2007) reported anxiety prevalence of 40% before, 28% immediately after and 40.6% 10 days after surgery, but scores were in fact stable over time. The minority of studies report continuous data, and these are the studies with the greatest heterogeneity between them (Ravven et al., 2013). Thus, an increase in studies reporting mean scores as opposed to prevalence may clarify some of the disparity in the literature.

Most studies in the table adopted popular, well-validated measures of psychological adjustment though these are not without their problems. The HADS has recently undergone a great deal of criticism in terms of distinguishing depression and anxiety conceptually (Cosco, Doyle, Ward, & McGee, 2012), and poor psychometric properties limit the usefulness of the findings. Variety and choice of measure may explain some disparities in the findings.

These issues with measurement guided my selection of tools for my research. I chose widely-used measures of self-reported depression symptoms and anxiety, well-validated for use in CABG surgery patients. Also I chose a mood scale which assesses a range of positive and negative everyday moods not specific to depression or anxiety. Self-report measures as opposed to diagnostic interview will be used for ease of use as they determine important outcomes, but the term 'depression symptoms' will be used throughout to stress the distinction. In this PhD I will use continuous data, report means as well as prevalence before and after surgery, and use recommended cut-offs to enable comparisons with other studies.

Sampling

Discrepancies in the literature are likely to be explained in part by the participants included in study samples. Many studies do not clearly report details regarding the inclusion of patients undergoing specific types of surgical procedure, and most are also inconsistent in their ratios of male to female patients, making it difficult to form conclusions regarding sex differences. These inconsistencies, as well as those in the age ranges of samples may explain some disparity in the findings, as age and sex are hypothesised to influence surgical outcomes (see section 1.6 below). Many studies have small sample sizes, and as well as having the issue of lack of generalisability, there are often too few patients with significant levels of distress to be powered to detect any further associations. These sampling limitations were of concern, particularly the small sample sizes (25 studies [45%] had samples smaller than 100), and given the variability in emotional responses, these numbers may not be sufficient to characterise the range of possible emotional reactions. I will address some of these concerns in my research by aiming for a powerful sample size, and attempting to recruit as wide a range of patients as possible in terms of demographics, within the limits of the research site; the sample will be described in detail to ensure transparency.

Timing

The key point to come from the studies in the table is that inconsistencies in the time points of psychological assessments are the cause of wide variation in the pattern of these outcomes over time. Post-surgery assessments range from 1 day (Fráguas Júnior et al., 2000) to 8 years (Kustrzycki et al., 2012), with wide variability in time points in between. In their meta-analysis, Ravven et al (2013) stated that recovery to full function is expected to be 1 to 2 months after surgery, and so named the different stages of recovery the following: 'early recovery' – first two weeks after surgery, 'recovery' – 2 weeks to 2 months, 'mid-recovery' 2 to 6 months, and 'late recovery' after 6 months (summarised in Table 1-2). Levels of psychological adjustment measured in these different stages will vary partly as a result of the physical aspects of recovery. Ravven et al (2013) argued that assessments made in the week running up to surgery reflect anticipation of surgery and worsening physical symptoms. Thus they might overestimate pre-surgery levels of psychological distress and therefore are not valid. The vast majority of studies made their assessments within this window, and therefore changes in distress levels after surgery may not be accurately represented. Similarly, measurements made within the two weeks after surgery might reflect the known consequences of surgery rather than poor adjustment, thus the findings from many studies in the table should be interpreted with caution. Without a clear understanding of the time points at which changes in psychological adjustment occur, it is difficult to know when might be important to intervene, and what might be responsible for those changes. Short-term poor adjustment may improve spontaneously due to changes in circumstances which would imply no intervention is necessary. For these reasons, I selected to assess emotional distress prior to (several weeks, not immediately before) surgery and close to two months after surgery, reflecting the end of the ‘recovery’ and the beginning of the ‘mid-recovery’ stage (Ravven et al., 2013), in an attempt to measure a more representative level of distress.

Table 1-2 Stages of recovery - adapted from (Ravven et al., 2013)

Recovery stage	Time after surgery
Early recovery	First two weeks
Recovery	Two weeks – two months
Mid-recovery	Two months – six months
Late recovery	After six months

Somatic symptoms

In patients with physical illness, some symptoms of depression and anxiety in particular (such as fatigue, loss of appetite and breathlessness) may overlap with somatic symptoms of illness that are reported to significantly increase in the first month after CABG (Contrada, Boulifard, Idler, Krause, & Labouvie, 2006). While some depression measures such as the BDI do allow affective symptoms to be distinguished from somatic symptoms, authors do not necessarily present these subscales separately (e.g. (Khoueiry et al., 2011; R. H. B. Mitchell et al., 2005; Timberlake et al., 1997)), and anxiety is generally measured non-specifically. In my study, distinctions between somatic and affective symptoms of depression will be distinguished using the BDI by conducting supplementary analyses with only the affective symptoms of depression.

Other issues

Self-report distress scores may be confounded by pre-existing clinical mood disorders and by treatment for these conditions. Pre-existing disorders may inflate self-report scores and might indicate a tendency for emotional distress. Only a small minority of studies take treatment for pre-existing conditions into consideration; from the table only Blumenthal et al (2003) excluded patients treated with anti-depressants from their sample. With the absence of control groups in nearly every study (only Bruce et al (2013) were the exception), it is difficult to know whether the levels of distress are beyond those of the normal population. In response to these limitations, I selected to conduct supplementary analyses for the models predicting post-surgery depression symptoms by controlling for anti-depressant use (to account for both pre-existing conditions and treatment).

In summary, methodological diversity is likely to account for a great deal of the variation in psychological adjustment following surgery reported in the literature. My review is limited by including only studies with pre- and post-surgery assessments, as it accounts for only elective surgeries, and studies with only post-surgery assessments may have relevant contributions. These methodological issues and others are an inevitable part of research of this kind, and guide future research in terms of issues to be taken into consideration, as in the case of my PhD. Regardless of limitations, it is clear that symptoms of depression, anxiety and disrupted mood are prevalent in this patient population, and this PhD in part aims to clarify the changes that occur following surgery.

1.5.3 Physical consequences of poor psychological adjustment

Poor psychological adjustment following surgery is problematic in itself, but has also been found to predict worse physical outcomes of surgery.

Depression

There is a substantial body of research associating psychological distress, particularly depression with cardiac outcomes. The risk of CHD mortality and morbidity is reported as being increased approximately two-fold in patients with depression (Nicholson, Kuper, & Hemingway, 2006; van Melle et al., 2004). Regarding CABG surgery, psychological distress both before and after surgery has been associated with worse physical outcomes. A key study of 309 CABG patients indicated that major depression disorder measured 4-10 days post-operatively increased the risk of cardiac events at one year including MI, PCI, cardiac arrest, rehospitalisation for angina, chronic heart failure or need to redo the procedure by 2.31 times (95% CI 1.17 – 4.56)(Connerney, Shapiro, McLaughlin, Bagiella, & Sloan, 2001). When the same sample was followed up at 10 years, both depressive symptoms and clinical depression increased the risk of cardiac (hazard ratio [HR] 1.78, 95% CI 1.04-3.04) (Connerney, Sloan, Shapiro, Bagiella, & Seckman, 2010), suggesting that post-surgery depression has different implications for morbidity and mortality in the short and long term. Other cardiac outcomes have been predicted by post-operative depression, such as surgery-related readmission in the study by Oxlad et al (2006) in 119 patients, though no adjustments were made apart from duration of cardiopulmonary bypass.

A greater number of studies have shown pre-operative depression to increase the risk of morbidity and mortality. Blumenthal et al (2003) found in a sample of 817 patients that moderate-severe depression symptoms measured one day before surgery increased the risk of mortality 5.2 years after surgery by 2.37 times (95% CI 1.40-4.00) (based on the 15% of their sample who had died) after adjusting for clinical, demographic and health behaviour variables. Other studies have found pre-operative depression to increase the risk of hospitalisation for MI or unstable angina at 6 months (Burg et al., 2003), and repeat CABG, PCI, MI and cardiac arrest at 2 years (Phillips-Bute et al., 2008), though both these studies used small samples and Phillips-Bute et al (2008) did not adjust for any other risk factors. Consequently, there is stronger evidence of pre-operative depression increasing the risk of mortality than morbidity.

Depression has also been shown to predict post-surgery pain, quality of life, failure to return to previous activity, lack of functional improvement and angina symptoms, graft disease progression and number of days of rehospitalisation (Borowicz Jr et al., 2002; Burg et al., 2005; Mallik et al., 2005; Wellenius, Mukamal, Kulshreshtha, Asonganyi, & Mittleman, 2008). It also predicts the likelihood of attendance and the success of cardiac rehabilitation better than a number of functional cardiac variables (Blumenthal, Williams, Wallace, Williams Jr, & Needles, 1982; Martin, 2006; Whitmarsh, Koutantji, & Sidell, 2003). However, all these studies vary in their length of follow-up, sample size, the incidence of these outcomes and covariates that were adjusted for, thus their findings have varying degrees of validity. In all, though depression has been assessed in studies of varying quality in terms of design, it has been indicated as having an important association with worse outcomes after CABG surgery.

Anxiety

Anxiety has also been associated with worse outcomes in CHD patients (e.g. (Frasure-Smith & Lespérance, 2008)). A study by Rosenbloom et al (2009) showed that pre-operative anxiety increased the risk of death and MI 1.55 times (95% CI 1.01-2.36) at 4.3 years in 1 317 patients in a dose-response relationship, though control variables did not include clinical severity.

Post-operative anxiety has been found to increase the risk of readmission two-fold, occurring in 32% of 226 patients after controlling for covariates. It has also been found to increase the risk of MI, unstable angina, revascularisation, cardiac mortality and other events at 5 years 1.36 times (95% CI 1.02-1.82) occurring in 28.8% of those patients after controlling for covariates (Tully, Winefield, Baker, Turnbull, & de Jonge, 2011). Post-operative anxiety is also associated with poorer achievement of knowledge, use of self-care behaviours, management of symptoms and pain (Fredericks, Sidani, & Shugurensky, 2008; Nelson, Zimmerman, Barnason, Nieveen, & Schmaderer, 1998). However, these anxiety studies are at risk of the same methodological limitations as the depression studies. In general, the studies linking anxiety and poor outcomes are well-designed and show significant increases in mortality and morbidity after CABG surgery.

Mood

Little research has assessed the links between disturbed mood and CABG surgery outcomes, though negative moods outside of depression and anxiety have been associated with adverse symptoms of recovery (Fukuoka, Lindgren, Rankin, Cooper, & Carroll, 2007; Utriyaprasit & Moore, 2005), and to predict diastolic blood pressure (Hallas et al., 2003). However, the focus rests on depression and anxiety, and their associations with increased mortality and morbidity risk are better established.

Summary

These studies have demonstrated that depression and anxiety increase the risk of worse recovery outcomes. It is hypothesised that the links between psychological distress and worse physical outcomes in these examples occur through physiological pathways. These include inflammatory processes (Appels, Bär, Bär, Bruggeman, & De Baets, 2000), platelet activation (Musselman et al., 1996), and autonomic dysregulation characterised as reduced heart rate variability (Carney et al., 2001), insulin resistance, high body-mass index and hypertension (Deedwania, 1998). They may also be linked through increased levels of health risk behaviours such as low physical activity and poor diet (Pignay-Demaria et al., 2003), smoking (Kubzansky, Kawachi, Weiss, & Sparrow, 1998), poorer medication adherence (Gehi, Haas, Pipkin, & Whooley, 2005) and alcohol use (Green & Pope, 2000). These processes can be thought of as mediating variables between a patient's emotional state and subsequent health.

The studies in this section indicate the importance of assessing psychological adjustment both before and after CABG surgery, which is often recommended by researchers (Charlson & Isom, 2003). It will enable identification of patients who are at greater risk of worse outcomes, who can be targeted for intervention to decrease the risk of continuing distress and poor physical recovery. However, unless the inconsistencies in the literature regarding the physical outcomes of depression and anxiety are made clearer, it may be premature to recommend screening (Tully & Baker, 2012).

1.6 Risk factors for poor physical and psychological outcomes

It is therefore important to understand how to identify which individuals will be at risk of poor psychological adjustment from surgery. In addition, it is critical to be able to recognise why some patients are at risk of poorer physical recovery, as there is evidence of individual difference in how patients recover from surgery which is not explained by their pre-surgery physical health (Horgan et al., 1984). A number of risk factors for poor physical recovery and psychological adjustment have been identified in the literature.

1.6.1 Clinical risk factors

Repeat CABG, CABG in conjunction with another cardiac procedure and emergency CABG are risk factors for worse outcomes than first-time, isolated, and elective CABG surgery. Comorbidities such as respiratory disease, renal failure, diabetes, and also the length of time since MI have been identified as risk factors for prolonged length of stay, readmission and mortality (Bottle et al., 2013). The

European System for Cardiac Operative Risk Evaluation (EuroSCORE) (Nashef et al., 1999) is a scoring system that calculates the risk of early mortality in cardiac surgery patients, and includes a number of these risk factors in addition to recent MI, reduced left ventricular ejection fraction, unstable angina, chronic pulmonary disease and being over the age of 60.

Physical factors may also explain poor psychological adjustment, as the period after surgery is likely to involve feelings of extreme pain and fatigue, and short hospital stays mean patients are at home at a more acute stage of their recovery. Poor physical health and functioning, and the presence of comorbidities is linked to 6-month depression (Mallik et al., 2005), and length of stay is a predictor of 8-year depression (Kustrzycki et al., 2012), though this study had a sample size of only 37. Thus, physical health is thought to be an important factor for both physical recovery and psychological adjustment after surgery.

1.6.2 Psychosocial risk factors

Sociodemographic risk factors

Poor psychological adjustment following CABG surgery is frequently reported as worse in younger patients (Cheok, Schrader, Banham, Marker, & Hordacre, 2003; Mallik et al., 2005), and age differences are hypothesised to result from differences in concerns and expectations. Younger patients may be more distressed due to greater concerns of needing to return to work and resume social activities (Koivula et al., 2002a), or because physical health problems are conceived as more threatening than for older patients (McCrone et al., 2001). However, regarding physical recovery, there is evidence of higher mortality and worse morbidity including complications (B. H. Scott, Seifert, Grimson, & Glass, 2005) in older than younger patients. This may be explained by the fact that older patients are more likely to have more severe cardiac disease and comorbid conditions. However, there are some studies reporting worse psychological outcomes in older patients (Duits et al., 1998; Gallagher & McKinley, 2007) and some studies show that older and younger age groups report similar levels of angina relief and quality of life after CABG (Conaway et al., 2003). Ambiguities may arise from inconsistencies in how age is categorised and measures used, but the risk of age is not yet certain.

There is little evidence of the impact of sex on physical recovery from CABG due to the overriding majority of research on male patients. However, morbidity and mortality rates after CABG surgery are higher in women than men in the short term, but not significantly so in the long term (Alam et al., 2013; Brandrup-Wognsen et al., 1996). This increased risk may be explained by the fact that women typically present with cardiac problems at a later age, possibly due to the loss of the protective effects of female hormones. Women are also more likely to have MI and therefore need emergency CABG, have more comorbid conditions, smaller body surface area and coronary arteries, and are less likely to be completely revascularised (Hillis et al., 2011).

Female sex has also been identified as a risk factor for worse emotional outcomes (Johan Herlitz et al., 2001; Phillips-Bute et al., 2003). Rates of depression are reported to be higher in female cardiac patients than in men (Burker et al., 1995; Mallik et al., 2005; R. H. B. Mitchell et al., 2005) and it has been proposed that women are more likely to report depression based on somatic symptoms (K. B. King, 1997; Rankin, 1990). This reflects a gender difference in the general population, and within the chronically ill population, as women are reported as having greater difficulty adjusting to illness. This may be attributable to gender-related personality traits or differences in the involvement in social relationships (de Ridder, Geenen, Kuijer, & van Middendorp, 2008). Other theories include gender bias in terms of reporting psychological distress (Rankin, 1990). Ambiguity in the literature, particularly regarding gender and anxiety, have been attributed to methodological limitations such as small numbers of female participants, and a socio-culturally driven gender bias in reporting emotional distress (McKenzie et al., 2010). However, the literature implies female gender is a risk factor for at least poorer emotional outcomes after CABG surgery.

Socioeconomic status has implications for psychological and physical outcomes of surgery. To name just a few examples, lower education level and unemployment increase the risk of post-surgery depression (Burker et al., 1995; Cheok et al., 2003). Few studies have focused on these issues explicitly, but concur with studies suggesting social gradients in health.

Pre-operative mood

A number of studies reveal the patient's mood before surgery to be predictive of post-surgery distress (Burg et al., 2003; Duits, Boeke, Taams, Passchier, & Erdman, 1997), and patients are typically most distressed in the run up to the surgery (Koivula, Paunonen-Ilmonen, Tarkka, Tarkka, & Laippala, 2001; Koivula et al., 2002). A systematic review concluded that post-surgery anxiety and depression symptoms are best predicted by pre-surgery scores (McKenzie et al., 2010). In cases where pre-operative distress levels are low, there is the possibility that the positive effects of the surgery on anxiety and depression are masked, as these patients may not show such drastic improvements. Pre-operative distress is consistently implicated as a predictor of later distress, so it is necessary to consider pre-operative distress levels when considering adverse outcomes of surgery.

Illness perceptions

Patients' illness cognitions have been identified as risk factors for poor psychological adjustment in cardiac patients (Dickens et al, 2008). CABG patients' illness perceptions regarding their family history of cardiac disease and their own disease severity have been found to influence their psychological adjustment to surgery (Murphy, Elliott, Higgins, et al., 2008). Interventions to optimise pre-surgery expectations are currently being examined for their influence on post-CABG outcomes (Laferton, Shedden Mora, Auer, Moosdorf, & Rief, 2013). Therefore, illness perceptions may be a relevant and modifiable influence on primarily psychological outcomes of surgery.

Personality

Personality factors such as optimism and control have also been found to be predictors psychological outcomes (Duits et al., 1997). Folks et al (1988) found that denial was associated with psychological adjustment to CABG surgery at 6 but not 12 months. Type-D has been found to predict health related quality of life above anxiety and clinical risk factors (Al-Ruzzeh et al., 2005). Optimistic CABG patients are less depressed two weeks after discharge than pessimistic patients, and of those who are depressed, the optimistic respond better to depression treatment and are less likely to be hospitalised (Tindle et al., 2012). Consequently, different personality styles are implicated for CABG surgery outcomes, though studies rarely take clinical risk factors for outcomes into account.

Social factors

Social factors such as social isolation, the size of the social network, perceived social support and partner factors including their personality and own psychological distress are found to predict post-surgery outcomes in several studies (e.g. (Burker et al., 1995; Ruiz et al., 2006)) and will be discussed in more detail in Chapter 2. Thus there are a number of psychosocial as well as sociodemographic risk factors for poor outcomes after CABG surgery.

In an attempt to identify important risk factors and examine how they connect to outcomes, a comprehensive, longitudinal study was devised, and my PhD formed an integral part. The research identifying the risk factors for poor outcomes is limited in ways similar to those outlined in section 1.5, and how they are addressed in my research is described in the chapters which follow.

1.7 This PhD

This introduction to adverse physical recovery and psychological adjustment outcomes and their risk factors has revealed several methodological issues. These issues create difficulty for understanding the incidence, trajectory and causes of adverse outcomes from surgery. These problems inspire research to identify who is at risk of worse outcomes and what form they take. Certain physical and psychosocial risk factors have been identified as important predictors of adverse physical and psychological outcomes from surgery. In this PhD I am eager to both determine the prevalence and changes over time of poor physical recovery and psychological adjustment, and delineate the relationship between one particular category of psychosocial risk factors and these outcomes. This category, henceforth referred to as 'support factors' are introduced in Chapter 2.

Chapter 2 Social relationships

2.1 Introduction

This chapter focuses on the relevance of social relationships for health. It introduces various conceptualisations of social support including distinctions between social support and marital functioning, and theoretical models and mechanisms linking relationships with health. The literature relating social support to cardiac health is then described, followed by an evaluation of the studies linking support with CABG surgery outcomes.

2.2 Social predictors of health

The previous chapter described a range of potential psychosocial influences on recovery and adjustment from illness, in this case, following coronary artery bypass graft (CABG) surgery. According to the widely-accepted biopsychosocial model of health (Engel, 1977), there are social, psychological and behavioural dimensions of health, therefore interpersonal relationships may be important determinants of adjustment and recovery from illness. Thus, there is a large and continuing research interest in the association between interpersonal relationships and the development, progression and recovery from both physical and psychological illness (Cohen & Syme, 1985). Seminal studies (Berkman & Syme, 1979; House, Landis, & Umberson, 1988) and many more summarised in recent reviews (Cacioppo, Hawkley, Norman, & Berntson, 2011; Holt-Lunstad, Smith, & Layton, 2010) (and a recent study from our group (Steptoe, Shankar, Demakakos, & Wardle, 2013)) concluded that social isolation increases the risk of mortality to a comparable extent as established risk factors such as smoking and physical inactivity, and the positive effects of social relationships on mental health are well-established (Alloway & Bebbington, 1987; Cohen & Syme, 1985). 'Social support' is a crucial element of health research, emphasising that social involvement is central to human adaptation to illness and general well-being (Coyne & DeLongis, 1986).

Consequently, there is an extensive literature addressing social support and its relationship with both physical health and emotional well-being (hereafter referred to as ‘health’), which has driven my research interests for this PhD.

2.3 Defining social support

There are a number of different ways that social support has been defined and there is little agreement on a precise definition. Cohen and Syme (1985) used “the resources provided by other persons” (p4); a definition which allows for numerous different conceptualisations and the possibility of each having different influences on health. Various ways of defining social support are reflected in the tool chosen to measure it, and include the number of available social contacts, the types of available support, the appraisal of the support, and the processes by which interpersonal relationships impact health, to name a few. As it is such a broad and complex construct, it is important to research the different ways of describing social support and identify which are beneficial for health. Much research oversimplifies social support and greater clarification of the concept is needed (Coyne & DeLongis, 1986), so I hope my research will in part contribute towards this. A number of key distinctions have been made within social support depending on the way it is measured.

2.3.1 Structural vs. functional social support

A primary distinction made in the literature is in the measurement of ‘structural’ vs. ‘functional’ social support (Cohen & Syme, 1985; Cohen & Wills, 1985). This distinguishes support on the basis of the structure of interpersonal relationships and the functions the relationships provide. Structural support describes the extent of an individual’s integration within a social network and refers to the existence, size, density and frequency of contact with the network. Key studies using structural measures have linked greater social integration with a lower risk of early death (reviewed by (House et al., 1988)), as well as more recent studies (e.g. (Barger, 2013) (n = 30 574)), identifying social isolation as a common source of chronic stress in adults (Steptoe & Kivimäki, 2013). However, the availability alone of potential support from the social network is not sufficient to provide benefits of support (Penninx, Kriegsman, Van Eijk, Boeke, & Deeg, 1996). An individual living alone may still be part of a supportive network, or an individual's network may be more burdensome than supportive (Coyne & DeLongis, 1986).

The alternative is functional support, which is a description of the functions that the relationships with members of the social network provide. Functional measures capture a subjective perception of the types of support available from the network. A number of different functions or sub-types of support are defined and measured in the literature. Most researchers list *emotional/affective support*, which refers to the love, sympathy, understanding and caring received from others (Thoits, 1995), *instrumental/functional/aid support* which refers to tangible support with every day or health-related tasks (Berkman & Glass, 2000), and *informational/cognitive support* which provides the knowledge needed to make sense of a circumstance and respond (Caplan, 1964). House (1981) and others consider emotional support to be the primary component of social support, and it is thought that it is needed initially to reduce distress levels enough to be able to make use of other types of support (Sirles & Selleck, 1989). Researching individual support functions gives indications of the types of social support that are important for health, assists in understanding the mechanisms that link them, and advises in the designing of interventions. Also, on the basis that psychological processes may be part of the link between social support and health, functional support may be a more useful construct to research (Cohen & Syme, 1985), and has been positively associated with positive psychological and physical health outcomes (Penninx et al., 1996). Mortality studies using more subjective measures of social relationships show an even greater benefit for survival than those using structural indices, indicating that the quality of relationships have more explanatory value for health outcomes (Holt-Lunstad et al., 2010). For these reasons, in my PhD I elected to focus on functional measures of social support and their associations with health.

2.3.2 Perceived vs. received social support

The importance of the individual's appraisal of the support over the mere presence of relationships within the social network is reflected in the distinction between 'perceived' and 'received' social support. Received support refers to the support actually received by an individual, where perceived support is their appraisal of the availability, adequacy and satisfaction with the support. Across the literature, perceived support has been found to be more influential on well-being and health than received support (Penninx et al., 1996; Wethington & Kessler, 1986). In fact, in many cases the perception of support being available can be beneficial even in the absence of the support being received (Cohen, Kaplan, & Manuck, 1994). Consequently, measuring received support is not necessarily reflective of how supported an individual feels, as support may be received at a time it is not needed or benefit not derived from it. Thus, I selected perceived support measures in self-reported questionnaires over indicators of received support in my research.

2.3.3 Positive vs. negative aspects of social relationships

An important, yet relatively under-discussed distinction in the social support literature is between positive and negative aspects of social relationships. The research linking social support and health primarily focuses on the benefits of support for health, but again there is a risk of the assumption that all relationships are beneficial. There is an important distinction to be made between the absence of support being disruptive for health and negative aspects of interpersonal relationships which can be disruptive. The components of functional support described above can be understood as constituting positive aspects of relationships. However, negative aspects include difficulties such as that support attempts may fail, social relationships come with obligations which may be perceived as negative, there are potential negative effects of attempting to obtain support, and the provider of the support may also be a source of conflict and stress (Schuster, Kessler, & Aseltine, 1990). In addition, support may be delivered in a way that is unwanted, resented, inappropriate or disabling and consequently harmful (Moser, 1994), and negative relationships may limit the individual's ability to seek support elsewhere (Coyne & DeLongis, 1986). Consequently, it is important to consider both positive and negative aspects of social relationships in their links to health, and these issues informed my choice to do so.

Thus some sources of support may be a source of stress in themselves and more detrimental than helpful, and social relationships may be problematic even if they are not related to low levels of support. Relationships characterised by low levels of support may in fact be a reflection of individuals deliberately avoiding social relationships which may be a source of stress, perhaps explaining why in some studies more support is related to worse outcomes (Revenson, Wollman, & Felton, 1983). Thus, negative aspects of relationships have been shown in some studies to be strong independent predictors of physical and psychological health, independent of baseline levels of illness (Stansfeld, Bosma, Hemingway, & Marmot, 1998). Study findings have revealed negative aspects of relationships to be distinct from merely the absence of positive aspects, and the two have been found to have little or no relation to each other (Ruehlman & Wolchik, 1988; Stephens, Kinney, Norris, & Ritchie, 1987). Some studies have shown negative aspects to be stronger predictors of health than positive aspects (Rook, 1984; Schuster et al., 1990), while others have found them to make equal contributions (Holahan, Moos, Holahan, & Brennan, 1997) suggesting they may influence health via a common mechanism. Some findings have shown negative and positive aspects to make independent contributions to health, in some cases with negative aspects outweighing the benefits of support (Coyne & Bolger, 1990; Schuster et al., 1990), but not others (Revenson, Schiaffino, Majerovitz, & Gibofsky, 1991). Others have found negative aspects such as overprotection to be associated with *better* emotional outcomes and faster recovery (Riegel & Dracup, 1992).

Thus the distinction between positive and negative aspects is not entirely clear; some of the focal studies base their conclusions on only cross-sectional analyses

(Rook, 1984; Schuster et al., 1990), and this distinction is not often the focus of support research. In the case of illness, negative events would be particularly unexpected and so may have a greater impact on well-being. However, the strength of the relationship between negative aspects and poor well-being may be due to the valence of the constructs. Negative social variables may correlate most strongly with negative health outcomes such as depression symptoms and anxiety due to similarly toned items in measurement tools. I addressed these inconsistencies in the evidence for the distinction between positive and negative aspects in my research by testing their independent contributions to health, and increasing the profile of research which takes negative aspects of relationships into consideration.

2.3.4 Social support vs. marital functioning

The final important distinction is between social support received from the social network in general, and the relationship with the spouse or partner in particular, and their implications for health. The perceptions of the types and functions of support will vary on the basis of the support provider and a clear distinction is made between support from the family and other members of the network (D. E. Jacobson, 1986). This is because the family is the social system which is most integral in promoting health, validating the sick role and helping to find and use care (Sirles & Selleck, 1989). The support is likely to differ because the risk of negative social interactions is greater in family members than friends (O'Reilly & Emerson Thomas, 1989; Rook, 1990), and as friends are voluntary they may be more appreciated than family (Crohan & Antonucci, 1989). In the case of illness, patients may be significantly restricted in their ability to operate in social and occupational settings due to physical disability, so members of the social network outside of family are likely to become peripheral (Elizur & Hirsh, 1999).

Within the family, the spouse or partner is identified as being particularly relevant at the time of illness, as they will have an important role in the patient’s adjustment as well as being affected by the illness themselves. According to the concept of 'dyadic coping' (defined as dealing with stress within a couple), during a time of an individual's illness, the adjustment and stress management process is activated in both the patient and their partner, so the marriage becomes a focal part of the illness (Berg & Upchurch, 2007). Marriage is the primary social relationship for the majority of adults, with marital happiness contributing more to overall happiness than friendships or other major aspects of life (Glenn & Weaver, 1981). Spousal interactions are more frequent and intense than those with other members of the social network, and the provision of support from the spouse during illness is associated with better adjustment in the patient (Berg & Upchurch, 2007). The couple both draw on the quality of their marital relationship to enable them to effectively cope with the illness (Coyne & Smith, 1991). Love within the marriage may also play a role in promoting happiness and well-being, and possibly therefore better health. Conversely, unhappily married people are likely to be stressed in their marriage, and this would be expected to be exacerbated when stress occurs in other parts of their lives, such as their health (Coyne & DeLongis, 1986).[1] For many, marriage is the most salient source of support and stress (Walen & Lachman, 2000). Evidence that a positive marital relationship has an effect on mortality that is above that of high levels of social support (Kimmel et al., 2000) implies that marriage may link to health through mechanisms beyond those of increased support (Rosland, Heisler, & Piette, 2012).

The question then arises whether married individuals obtain benefits from their marital relationship that are distinct from general social support. There is the possibility that the measurement of support from the social network is a reflection of the relationship the individual has with their spouse. Therefore, regardless of whether an item on a social support questionnaire refers explicitly to marriage, whether or not someone is married will be an important determinant of the

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[1] Interestingly, the co-authors of this paper divorced shortly after it was published (Coyne, 2013).

response (Coyne & DeLongis, 1986). Alternatively, it might be important to measure the relationship with the spouse separately.

Support from the spouse has been distinguished from general emotional support, as the intimacy and proximity factors of marriage might have either greater benefits or worse implications for health (Kulik & Mahler, 1993). Problems in an individual's closest relationship are more detrimental to how much support is received compared to those in a less close relationship (Abbey, Abramis, & Caplan, 1985), but the advantages of marriage for health are not necessarily purely down to social support. A good quality marriage might be more to do with social control than closeness and intimacy. Individuals in a better quality marriage may be more sensitive to the impact of their adjustment on the partner, and be at smaller risk of exposure to situations that would result in poor health. Those in poor quality marriages may cope worse with stressful situations, and therefore the amount of support provided is secondary to how well the couple can cope (Coyne & DeLongis, 1986).

It has been suggested that those in good quality marriages are at a better advantage for their psychological health than those in poor quality marriages, regardless of whether they have supportive relationships outside of marriage (Lieberman, 1982). Thus supportive relationships inside and outside of the marital context may be conceptually separate. Thus, social support and marital functioning should be perceived differently (Coyne & DeLongis, 1986), and if the marriage is the social relationship which may give the most benefits but also be the greatest source of stress, it deserves individual focus. Consequently, I thought it important in my research to address the conceptual distinction of marital functioning from social support in their relation to health. I wanted to test whether the benefits of marriage are merely a reflection of high levels of social support, or the possibility that the relationship with the spouse is more complex and distinct from social support.

2.4 Marital functioning

In this thesis, ‘marital functioning’ is used as an umbrella term for variables of the marital relationship, including marital quality, satisfaction, adjustment and others mentioned in this chapter. Other forms of committed romantic relationships are also considered under this heading as they are thought to be influenced by the same factors contributing to marital functioning (Wickrama, O'Neal, & Lorenz, 2013). Adults in middle to later adulthood undergo emotional, cognitive and health changes as a result of ageing, and at this stage, the marital relationship often becomes the primary role for older adults (Silverstein & Giarrusso, 2010). My study focused on adults in this age group, so it is expected that this will be the case for the majority of the married patients.

2.4.1 Marital status vs. marital quality

Marital status

Being married has been associated with better health in terms of lower levels of mortality, morbidity and better psychological well-being than being unmarried (Burman & Margolin, 1992; House et al., 1988; Hu & Goldman, 1990; Verbrugge, 1979). Proposed explanations for this association include that being unmarried places an individual at greater risk for ill health. This is due to the likelihood that they will have less access to the social support that encourages healthy behaviour and seeking treatment, fewer feelings of overall well-being, and that they will be at increased risk of social isolation and stress (Burman & Margolin, 1992).

However, an alternative to this theory that marriage is protective for health is the marriage selection hypothesis, whereby people with poor mental or physical health are less likely to become or remain married. Similarly, people with, for example, affective disorders are more likely to marry others with affective disorders (Mathews & Reus, 2001), which suggests that marital status may not be a reliable correlate of health. As with structural social support, considering marital status alone assumes that all marriages are equal, and implies that simply being married has health protective effects (Doherty & Campbell, 1988). Instead, there are examples of studies which do not show a link between marital status and mortality, perhaps due to the social structures of small communities whereby all members are supported regardless of marital status (Berkman, 1984; House et al., 1988). The advantages of being married may be limited just to those in good quality marital relationships, to the point that individuals in unhappy marriages may have worse well-being than those who are unmarried (Gove, Hughes, & Style, 1983). Consequently, marital status alone is not informative of the links between support and health, and it is necessary to take into account that some marriages may not provide benefits for health. Rather it would be more informative to consider the quality of marriage, rather like the functions of social support, and the implications for health. Consequently, marital status did not form the focus on my PhD, but rather the quality of the marital relationship and its associations with health.

Marital quality

Marital quality is a subjective evaluation of marriage, generally measured by self-report (Burman & Margolin, 1992). The independent effects of marital quality on mortality have been found to be comparable to those of other significant risk factors such as age, gender and treatment compliance (Rosland et al., 2012). A number of large scale nationally representative studies have shown better quality marriages to be associated with better psychological and physical health (Bookwala, 2005; Ren, 1997; Umberson, Williams, Powers, Liu, & Needham, 2006). In a recent growth curve analysis study spanning 20 years (n=1 681), initial values of marital quality were significantly associated with self-reported physical health, and the slope of one was associated with the slope of the other (R. B. Miller, Hollist, Olsen, & Law, 2013). The longitudinal Study of Marital Instability over the Life Course of almost 2000 adults established links between marital quality and psychological health across the life span, including depression symptoms and life happiness (Kamp Dush, Taylor, & Kroeger, 2008). There is also evidence throughout the literature of high quality marriages being associated with better coping with stress (Bodenmann, 2005), better psychiatric health (Whisman, 2007), and better adjustment to illness (Pistrang & Barker, 1995).

However, the findings relating marital quality to health outcomes are not always consistent, and studies are not without their limitations. Like marital status, it cannot be excluded from possibility that selection effects result in individuals with better health to have better quality marriages (Renne, 1971). Illness may impact finances, distribution of responsibilities, and the way spouses perceive one another which may influence marital quality. In addition, it is difficult to determine the direction of causality unless marital variables are measured before the onset of a health problem (Burman & Margolin, 1992). Even in studies which take these issues of temporality into account, it is difficult to isolate marital quality as the factor responsible for the health outcomes. Instead, another factor may affect both marital quality and health outcomes, such as depression symptoms or baseline levels of health. Consequently, my research aimed to address these issues by measuring aspects of the quality of marital relationships prior to a health event, also controlling for baseline levels of health, in an attempt to delineate the relationship between the marital relationship and health outcomes.

Marital quality may be considered as a global construct, the core of which is feelings of being loved and valued (Cohen & Wills, 1985). Marital functioning measures typically measure overall marital ‘satisfaction’ or ‘adjustment’, which distinguishes between individuals in good or poor quality marriages. However, whilst global marital quality may be the key to the health benefits, the assessments are limited to the point that it is unclear what is being measured (Gottman & Krokoff, 1989), and the two concepts are highly intercorrelated and therefore probably share a dominant underlying dimension (Heyman, Sayers, & Bellack, 1994). Consequently, it is more informative to measure individual features of the marital relationship with measures that differentiate between various aspects. As few studies measure multiple features of marital functioning, it is difficult to know whether there are links between individual features and health, or whether they are reflective of a global marital quality (Kiecolt-Glaser & Newton, 2001). The assessment of separate domains is also limited by an absence of norms data for measures, and the lack of distinction between positive and negative aspects of the relationship makes the links harder to elucidate. I aimed to address many of these issues in my research, by assessing individual elements of the marital relationship as opposed to global marital quality, with standardised measures with known norms and disinguished between positive and negative aspects.

Although there are components of the marital relationship which are distinct from social support (see section 2.3.4), ultimately, the marriage is a primary source of support for an individual. Of the components of the marital relationship, support is thought to make a greater contribution to adaptation to illness than other aspects of marital quality, such as feeling close and spending time together (Elizur & Hirsh, 1999; Rutter, 1987). Thus the provision of different functional subtypes of social support is an important contributory factor of marital functioning. This PhD takes these points into consideration, measuring separate components of the marital relationship, and including support within the marriage in the assessment of the links with health.

As stated earlier (section 2.3.3), negative aspects of relationships are an important influence on well-being. Due to the centrality of the marital relationship in general and particularly at the time of illness, a marriage characterised by negative aspects may have a particularly deleterious effect on health. Consequently, negative features of the marital relationship such as conflict have been shown to be associated with objective indications of worsening health in those with chronic disease (Greene & Griffin, 1998; Hibbard & Pope, 1993). They have also been associated with worse self-rated health in healthy adults (Ganong & Coleman, 1991; Levenson, Carstensen, & Gottman, 1993; Ren, 1997), worse general mental health (S. R. H. Beach, Fincham, & Katz, 1998), and psychological maladjustment to illness (Manne & Zautra, 1989; Waltz, Badura, Pfaff, & Schott, 1988). It has been indicated that a lack of spousal involvement in the patient's coping with illness is associated with worse adjustment and recovery (Helgeson, 1991), and the partner may intend to be supportive but this is not necessarily successfully perceived by the patient (Pistrang, Barker, & Rutter, 1997). In the case of illness, there is a risk that the patient's spouse will engage in unhelpful supporting strategies. Overprotection occurs when the partner underestimates the ability of the patient so provides more support than required, and protective buffering is the partner's hiding of their own concerns and complying with the patient in order to avoid conflict. Both have been associated with slower recovery and worse adjustment (Berg & Upchurch, 2007). However, as previously suggested, the possibility of selection effects, a common determinant and reverse causality may be relevant to this research, and should be taken into account in the interpretation of these findings. I aimed to address the issue of the potential importance of negative aspects of the marital relationship for health in my study, while attempting also to address the potential caveats of this research. The failure to take negative aspects into account may be an important explanatory factor for inconsistencies in research linking marital quality and health.

Summary

On the basis of the issues surrounding defining and conceptualising aspects of social relationships, this PhD aims to clarify some of the questions which arise. Firstly, the distinctions between positive and negative aspects of relationships remain under studied, and whether they have independent associations with health is unclear. Secondly, within this field it is important to address the differences between general social support and marital functioning, and their individual relationships with health. In addition, the role of various types of support within the marital relationship and how these differ from negative aspects are areas in need of clarification. Many studies in this literature are limited by fundamental methodological limitations which are present in other literatures, and are discussed in detail in Chapter 1. These limit the certainty of the observed associations and the possible conclusions to be drawn from this literature, and will be addressed in this PhD as described.

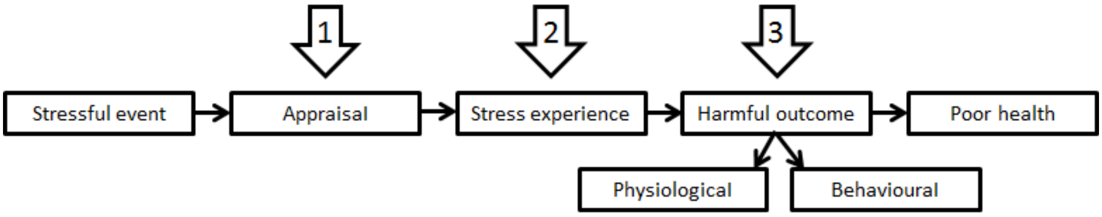
2.5 Models of support and health

A number of studies in the preceding sections indicated that social relationships may have some important links with health outcomes including mortality and morbidity, physical recovery, psychological health, and overall adjustment to illness. There are a number of different proposed conceptual models used to understand the relationship between social support and health; a summary of the models described in this section is presented in Table 2-1. None of these models completely explains the associations so it is likely they work concurrently with each other (Cohen, 1988). However, there are two widely-discussed models of social support affecting health proposed by Cohen and Wills (1985), which together form the '*stress/social support model*' (Berkman, 1984):

The '*main/direct-effect model*' states that support is directly related to well-being, and that a greater amount of support equates to better well-being. Social networks promote positive affect, self-esteem, and control over the environment. They also enable social interactions which allow the individual to adopt roles which give meaning to their life, and reduce the chance of emotional distress (Cohen & Syme, 1985). Benefits to physical health occur either directly or indirectly through the effects of emotional well-being or behaviours on biological mechanisms that are linked to physical health (to be discussed in section 2.6). This model is consistent with the concept of structural support, whereby merely being integrated within a social network promotes health and well-being. Individuals have a perception that they are cared for so benefits occur in everyday situations, not just those involving stress (Oxman & Hull, 1997).

The alternative '*stress-buffering model*' states that positive social relationships buffer, reduce or protect the individual from the adverse effects of stress on health, moderating the relationship between them. The concept of buffering is embedded in the stress/coping framework (Lazarus & Folkman, 1984) and House (1981) suggested three ways in which social support may buffer the effects of stress on health (Figure 2-1): support may cognitively alter the appraisal of the stressful event, reducing the potential for harm or increasing the resources of dealing with the problem, thereby reducing or removing the stress experience (1)[2]. Alternatively, support itself may reduce or remove the stress experience, and consequently the harmful consequences (2); or it may directly reduce the harmful physiological response or facilitate healthy behaviours, which in turn benefit health (3). Therefore, this model is more consistent with the concept of functional support, as it is mainly through perceiving the support that it can act as a buffer to stress.

Figure 2-1 Stress-buffering model; adapted from (House, 1981)



Cohen and colleagues (1994) proposed four additional models through which social support may influence health either directly or through a stress-buffering process: *information-based models*, *self-esteem models*, *social influence models* and *tangible-resource-based models*, which are summarised in Table 2-1.

The evidence for the direct-effects and stress-buffering models are mixed, with buffering effects generally found to be weak and inconsistent and direct effects occurring more consistently (Alloway & Bebbington, 1987; Gore, 1985). Although conceptually different, there is evidence for both models to be relevant for linking support and health (Cohen & Wills, 1985), and Cohen and Syme (1985) argued that

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[2] Numbers in parentheses correspond with the numbered arrows in the diagram.

attempting to compare the two models will not significantly increase the understanding of the links between support and health.

Together the direct-effects and stress-buffering models do not completely explain the mechanisms which link support and health, and the important issue of negative aspects of relationships (see section 2.3.3) are not clearly addressed. Rook's (1990) '*social strain model*' accounts for the negative aspects, stating that negative relationships are characterised by more than a lack of support, and may worsen health by increasing stress. These three key models of social support (direct-effect, stress-buffering, social strain) are captured within a broad conceptual framework which accounts for direct and buffering effects, positive and negative aspects of support for health entitled the '*social strain-social support model*' (Burman & Margolin, 1992). According to the model, the main-effect element means that those with a small support network are likely to be lacking in support, the stress-buffering aspect implies that individuals in supportive relationships will have better health, and the social strain element suggests that poor quality relationships will be related to poorer health.

The '*specificity model*' of support (Cohen & Wills, 1985; House, 1981) presents the idea that the perception of support as beneficial is dependent on a match between the type of support and the support needs in the context of a given situation. Consequently, there is research linking different types of functional support with particular outcomes, suggesting that certain types of support will be beneficial in a given situation (Shumaker & Brownell, 1984). However, Cohen and colleagues (1994) suggested that some types of support may aid coping with many types of stressor, such as appraisal and self-esteem support. Similarly, it has been suggested there may be generalised, non-specific effects of support for health, and it may not be necessary to consider individual types (Penninx et al., 1996). So there are different arguments for measuring global social support or individual functions (Cohen & Syme, 1985).

The idea of specificity is extended to a greater number of factors (Cohen & Syme, 1985): the perceived benefits of the support may depend on who it is received from (*source*), in terms of the perception of the role of the individual, the expectations, the reciprocity in the relationship and the characteristics of the support giver. Characteristics of the individual (*recipient*) such as their personality, ability to attract support and the access to other sources of support will influence the perception of the benefits. The timing of the support (*time*) is particularly relevant in the case of illness, where the context and related stressors, needs and priorities are likely to change over the course of the disease or recovery (D. E. Jacobson, 1986). These issues of specificity go some way in explaining why greater amounts of support do not necessarily equate to better outcomes. They also illustrate the complexity of social support in its relation to health, and emphasise the importance of accounting in research for various aspects of the context in which support is given. It also suggests that no one model of social support will be relevant to all situations, and how support relates to health in one situation may not be applicable in another (Oxman & Hull, 1997).

Summary

In this PhD, the links between social relationships and health will be examined in a number of ways, so several of the models described here may be relevant. I hypothesise that good quality social relationships will be associated with better physical and emotional outcomes after CABG surgery. Cardiac surgery is a stressful life event, for which positive aspects of relationships may reduce the negative emotional outcomes that may occur (*stress-buffering model*), and any of the four explanatory models (*information-based, self-esteem, social-influence and tangible-resource-based models*) may play a part, indicating that *direct effects* are also plausible. The *social strain model* was particularly influential in the formation of my study, and encouraged me to investigate the independent role of negative elements of relationships for recovery and adjustment. Consequently, the *social strain-social support model* accounts for both the positive and negative aspects of relationships so is a useful framework for understanding how a range of support factors may relate to surgery outcomes. The *specificity model* influenced my choice to assess individual aspects of support within the particular context of recovery from CABG surgery. In particular, the relevance of support at a particular *time* and from a particular *source* were tested.

Table 2-1 Summary of social support models

Model	Summary
Stress/social support model	The combination of the two most widely-discussed models: the main/direct-effects model and the stress-buffering model
Main/direct-effects model	Social support is directly related to well-being in that a greater amount of support is related to better well-being, regardless of the presence of stress; consistent with concept of structural support
Stress-buffering model	Social support buffers the negative effects of stress on well-being by altering the stressful event, appraisal of the event or reaction to the event; consistent with concept of functional support
Information-based models	Larger networks provide more sources of information about health and influence health behaviours (direct-effects); information about stressful events or how to cope with them reduces impact on well-being (stress-buffering)
Self-esteem models	Social integration provides feelings of positive affect increasing the motivation to improve health (direct-effects); perception of available support enhances coping which results in increased self-esteem to act healthily or reduce physiological responses to stress (stress-buffering)

Social-influence models	Social integration exposes one to social pressures regarding health behaviour (direct-effects); perception of support affects peer pressures influencing one to cope with stress in a particular way impacting well-being (stress-buffering)
Tangible-resource-based models	The social network provides tangible aid which promotes better health and health-care (direct-effects); the perception of tangible support reduces the probability of events being appraised as stressful influencing health (stress-buffering)
Social strain model	Negative aspects of social relationships are harmful to well-being by increasing stress; accounts for more than the harmful effects of lack of social support
Social strain-social support model	Framework combining stress/social support model and social strain model, accounting for direct, buffering and negative effects of social relationships on well-being
Specificity model	The benefit of social support for health is dependent on a matching of the type, timing, source and recipient of the support and the individual's particular needs in the context of the situation

Within this PhD I do not aim to test the viability of these various models in the context of my particular study, but instead used several of these models to inform the design of my research, and will use them later to inform discussions of the findings. None of these models explicitly describes the mechanisms linking support and health, though a number of possible pathways have been discussed.

2.6 Mechanisms

Social relationships may influence health in a number of different ways, and positive and negative aspects may act via different mechanisms. Positive aspects may influence health via physiological, psychological and behavioural pathways (House et al., 1988; Uchino, Cacioppo, & Kiecolt-Glaser, 1996), and it is likely that these pathways are influenced and interact with each other. Negative aspects may also influence health through these pathways. In particular, negative aspects may be perceived as stressors, which directly promote physiological stress reactions.

2.6.1 Physiological pathways

Cassel (1976) was the first to emphasise the importance of physiological processes mediating the relationship between social relationships and health. He stated that because social relationships are related to such diverse health outcomes, there are probably multiple pathways linking them.

Endocrine function

The most commonly measured hormones in stress research are catecholamines (epinephrine and norepinephrine) and cortisol which regulate cardiovascular, metabolic and immune functions. In the particular case of cardiac disease, these hormones are relevant as they act by increasing oxygen consumption, heart rate and myocardial contractility, and cause changes in vascular resistance. Thus, endocrine function is particularly useful to measure as it affects other physiological systems that are relevant to health and disease. There is some early evidence linking social support with endocrine function. For example, Fleming et al (1982) found that of people exposed to chronic stress, those with low levels of social support had higher uniform levels of norepinephrine. More recent studies linking social support and endocrine function include those of Eisenberger et al (2007) and Cole et al (2007), who reported important links between low social support and increased endocrine responses. Endocrine research is limited by methodological constraints such as the timing of assessments over the course of the day, combined with all the limitations of social support research, and is thought to be relatively under studied compared with immune and cardiovascular mechanisms (Uchino et al., 1996; Uchino, Uno, & Holt-Lunstad, 1999).

Stressful social interactions stimulate the release of stress hormones. Marital conflict has been found to account for variance in the rate of cortisol change (even in happy marriages) (Kiecolt-Glaser et al., 1997), hostile behaviour significantly predicts changes in epinephrine and norepinephrine levels (Malarkey, Kiecolt-Glaser, Pearl, & Glaser, 1994) and marital conflict predicts cortisol response in couples with otherwise positive interactions (Fehm-Wolfsdorf, Groth, Kaiser, & Hahlweg, 1999). The chronic stimulation of stress hormones is associated with cardiovascular pathology (Kuhn, 1989) and immunological dysregulation (Glaser & Kiecolt-Glaser, 1994), so negative relationships (characterised by more than just the absence of support) may have influences on health via endocrine pathways.

Immune function

The link between personal relationships and immune function is one of the most robust findings in the psychoneuroimmunology literature (Kiecolt-Glaser, Gouin, & Hantsoo, 2010). Inflammation, one aspect of immune functioning, is central to many diseases, and is a reliable predictor of all-cause mortality (Reuben et al., 2002). Social support has been shown in a meta-analysis to be significantly related to enhanced immune function (Uchino et al., 1996) For example in one study, emotional support from the spouse was associated with greater natural killer cell action in cancer patients (Levy et al., 1990).

Negative aspects, such as marital stress, alter immune function which puts individuals at increased risk of illness by reducing the speed of wound healing and creating a poorer antibody response to vaccination. For example, negative behaviour during marital conflict is associated with increases in numbers of biomarkers of immune function (Kiecolt-Glaser et al., 1997; Kiecolt-Glaser et al., 1996; Malarkey et al., 1994). Consequently, individuals in a stressful marriage are at greater risk of infectious disease and of slower healing, and changes in the course of chronic diseases, which is particularly relevant for physical recovery following surgery (Broadbent, Petrie, Alley, & Booth, 2003; Kiecolt-Glaser & Newton, 2001) and therefore this PhD. There is a great deal of evidence linking social conflict and inflammatory processes, and even small increases in inflammatory biomarkers may have health implications, even in the absence of disease (Kiecolt-Glaser et al., 2010).

Cardiovascular function

The majority of studies linking social support to physiological pathways consider aspects of cardiac health. Blood pressure is considered a particularly important indicator as it is widely accepted to predict cardiovascular disorders (J. J. Smith & Kampine, 1990). A meta-analysis of 21 correlational studies found a significant association between social support and blood pressure (Uchino et al., 1996). Kasl, Gore and Cobb (1975) found social support was negatively associated with blood pressure changes in response to job loss, and Dressler (1980) found that an interaction between social support and levels of life stress predicted blood pressure, though there are a number of other studies which did not find associations.

It is widely acknowledged that stress results in cardiovascular reactions. The reactivity hypothesis states that excessive cardiovascular reactivity to stress is a risk factor for the development of hypertension and cardiovascular disease, especially if it is frequent and at high intensity (Lovallo & Gerin, 2003; Schwartz et al., 2003). There is a large literature demonstrating that social support attenuates the reactivity to psychological stress (Gerin, Pieper, Levy, & Pickering, 1992; Thorsteinsson & James, 1999; Uchino, Carlisle, Birmingham, & Vaughn, 2011). Similarly, there are a number of studies which show negative aspects of relationships (the marital relationship in particular) to predict clinically relevant cardiovascular reactivity (Broadwell & Light, 1999; Flor, Breitenstein, Birbaumer, & Fürst, 1995; Kiecolt-Glaser & Newton, 2001; Mayne, O'Leary, McCrady, Contrada, & Labouvie, 1997). Even recall of conflict alone, or increased spousal contact in couples with low cohesion has been seen to produce cardiovascular responses

(Baker et al., 1999; Carels, Sherwood, & Blumenthal, 1998). However, Uchino et al (2011) argue that as a result of their being based in the laboratory, these findings are reflective of received rather than perceived support.

Summary

There is sufficient evidence to suggest that social support and negative aspects of relationships may link to health via endocrine, immune and cardiovascular functioning. A number of studies provide evidence suggesting that individuals in relationships characterised by low support or chronic conflict are exposed to larger and more frequent immunological, endocrinological and cardiovascular changes; consequently they could be at greater risk of health problems.

2.6.2 Psychological pathways

Another way in which social support is thought to be related to better health is through improving psychological well-being. Social support may increase feelings of belonging, self-esteem and motivation to enhance health, which may promote better physical and psychological health directly or indirectly via behavioural or physiological processes (Cohen & Syme, 1985). Positively perceived social support may improve affective state which then results in better adjustment to illness (Berg & Upchurch, 2007; Penninx et al., 1996). Poor quality marriages reduce psychological well-being and increase psychological distress (C. E. Ross, Mirowsky, & Goldsteen, 1990), which are important health outcomes in themselves. Following from evidence relating social support with psychological health, as mentioned in the previous chapter (Chapter 1), psychological health also has implications for physical health. For example, there is a field of literature linking clinical depression and depression symptoms with physical health, and cardiac health in particular (Steptoe, 2007).

2.6.3 Behavioural pathways

Another pathway hypothesised to link social support and health is through health behaviours. Supportive relationships are likely to encourage healthy behaviours such as compliance to medication (Trevino, Young, Groff, & Jono, 1990), and healthy eating and sleeping (Wickrama, Conger, & Lorenz, 1995). In addition, they may provide practical and informational help and increase feelings of belonging, and an individual's perceived ability and incentive to improve their health. There is evidence of marital quality linking to health via behavioural pathways (Wickrama, Lorenz, Rand, & Elder, 1997). Supportive relationships influencing health behaviours are particularly relevant for recovery from illness where behaviour change is recommended, such as CABG surgery.

Conversely, relationships characterised by conflict are associated with riskier lifestyle behaviours, primarily alcohol and substance abuse (Kiecolt-Glaser & Newton, 2001). Risky health behaviours in turn are associated with physical and emotional health problems (Kiecolt-Glaser et al., 2010). However, the evidence of behavioural mechanisms linking support variables and health outcomes is not consistent. For example, Dickens et al (2004) found that while MI patients with low support were more likely to smoke and drink heavily, these behaviours were not associated with cardiac mortality or morbidity, and were unlikely to explain variance in these outcomes.

Summary

To conclude, the relationship between supportive or negative features, stress appraisal, and pathways to physical and psychological health, is likely to be a complex one, influenced by specific factors of the context of the relationships and life events. In the case of my PhD, with an illness event such as CABG surgery, social support may buffer the effects of the stressful illness event on adjustment and recovery. Negative relationships may stimulate physiological processes harmful to health, and interpersonal relationships may impact surgery outcomes via their influence on emotional health and behaviour change.

2.7 Support and cardiac health

Within this vast literature, it is interesting and beneficial to restrict the focus to cardiac health and disease, due to its status as a leading cause of death. Also, it has a direct relationship with physiological mechanisms known to be influenced by support, an association with psychological health (in particular depression and anxiety have been linked with disruptions to cardiac health as a cause and outcome) and with health behaviours (acknowledged risk factors for cardiac disease and integral to recovery). Of a range of chronic diseases including cancer, diabetes, renal, lung and arthritic disease, the links between support and disease outcomes are consistently favourable for cardiac disease only (Penninx et al., 1996). A number of prospective studies have associated a range of structural and functional constructs of social support including marital functioning variables with the development, survival, recovery and emotional adjustment to cardiac disease and acute cardiac events.

2.7.1 Support and CHD incidence

Lack of social support has been increasingly recognised as a risk factor for the development of CHD that is comparable to other well-established risk factors (see (Hemingway & Marmot, 1999; Kuper, Marmot, & Hemingway, 2002; Lett et al., 2005; Rozanski, Blumenthal, & Kaplan, 1999; Steptoe & Kivimäki, 2013; Strike & Steptoe, 2004) for reviews). For the majority, it is structural measures of support which have been linked with CHD incidence in individuals without established CHD. For example, Kuper and colleagues (2002) reported that almost all the prospective studies they reviewed found a positive association between social isolation and CHD incidence. Similarly, Rozanski et al (1999) found that a relatively small social network increased the risk of developing CHD between 2 and 3 times, after controlling for alternative cardiac risk factors. As well as CHD incidence, studies have demonstrated significant associations between support factors and first occurrence of a CHD episode (Orth-Gomér, Rosengren, & Wilhelmsen, 1993; Vogt, Mullooly, Ernst, Pope, & Hollis, 1992); a recent meta-analysis found social isolation increased the risk of a first cardiac event by 1.5 times (Steptoe & Kivimäki, 2013). Other studies show associations with the severity of CHD. For example, in an early, large-scale prospective study of 10 000 men, those who perceived the support from their family as adequate had significantly fewer angina episodes than those with little or no support, even in the presence of other risk factors (Medalie et al., 1973). Recently, negative aspects of close relationships were found to increase the risk of hospitalisation for a first incidence of ischaemic heart disease two-fold (Lund, Rod, Thielen, Nilsson, & Christensen, 2013).

A causal relationship has been suggested by some authors (Rozanski et al., 1999), as not only are the effects of social factors on CHD strong and consistent, but there is evidence of an inverse gradient between amount of social support and CHD incidence (Berkman, Leo-Summers, & Horwitz, 1992; Berkman & Syme, 1979; Orth-Gomér et al., 1993). However, the evidence is also compatible with the theory that CHD and the stress hypothesised to result from social isolation develop from similar physical, behavioural or environmental sources (Kivimäki et al., 2006) and are not causally linked. The literature indicates that social relationships, primarily in the structural sense, i.e. the presence of social relationships, prospectively predict CHD incidence in healthy adults. This suggests that a lack of support may act as a chronic stressor influencing processes associated with the development of CHD such as atherosclerosis.

2.7.2 Support and CHD prognosis

As well as incidence, there is prospective evidence linking support aspects with outcomes in individuals with CHD. A number of the reviews listed in section 2.7.1 (and others (Mookadam & Arthur, 2004)), also found a lack of social support, particularly social isolation to predict worse morbidity and mortality in CHD patients.

Studies of CHD prognosis include evidence of low support predicting cardiac recurrence, rehospitalisation and mortality following an acute cardiac event. For example, Dickens et al (2004) found that having a close confidant approximately halved the risk of further cardiac events at 12 months in MI patients after controlling for demographics and severity of the MI. Aspects of the marital relationship have also been linked to CHD outcomes. For example, Coyne et al (2001) found marital quality predicted survival 4 and 8 years after diagnosis with congestive heart failure, and marital stress increased the risk of recurrent cardiac events by 2.9 times (Orth-Gomér et al., 2000). In general, and in contrast to CHD incidence, functional rather than structural social support is more consistently associated with prognosis in CHD patients (Lett et al., 2005). However, some studies do support an association with, for example, marital status (Chandra, Szeklo, Goldberg, & Tonascia, 1983). The stress associated with social relationships is seen in a number of studies to be a stronger predictor than work stress for CHD outcomes (e.g. (Orth-Gomér et al., 2000)), suggesting that support variables are independent factors in the relationship with CHD prognosis.

2.7.3 Support and emotional adjustment to CHD

Finally, associations between support and emotional adjustment in CHD patients, particularly following a cardiac event, are seen in the literature. Some early reviews report associations between social support and aspects of adjustment such as mood and self-esteem in CHD patients (Riegel, 1989; Wortman & Conway, 1985), but unfortunately no recent systematic review of this literature exists. There is also mixed evidence linking social support and quality of life and depression in patients with heart failure (Luttik, Jaarsma, Moser, Sanderman, & van Veldhuisen, 2005). In addition there are studies showing relationships between low social support and higher depression symptoms in community residents with cardiac illness (Holahan et al., 1997) and major depression in CHD inpatients (Bosworth et al., 2000).

There are also a number of individual studies which generally report positive associations between social support and better psychological adjustment, including fewer depression symptoms after cardiac events such as MI (e.g. (Ell & Haywood, 1985)), with some specifying the marital relationship as important (Ben-Sira & Eliezer, 1990; Brecht, Dracup, Moser, & Riegel, 1994; Waltz, 1986; Waltz et al., 1988; Yates, Kosloski, Kercher, & Dizona, 2010). For example, Frasure-Smith and colleagues (2000) found in a prospective study of 887 MI patients that those with lower social support 7 days after MI had higher depression symptom scores cross-sectionally and 1 year later.

So the evidence linking support variables with emotional adjustment in CHD patients is generally positive, though many use small sample sizes and short follow-up periods; consequently, issues of causality remain unclear. The use of larger scale prospective studies is almost exclusive to studies examining associations between support and CHD incidence, mortality and morbidity rather than emotional outcomes. The emotional adjustment literature is rather inconsistent in the strength of the methodological designs, such as length of follow-up and sample size. There is wide variability in the use of measurement tools, even in this literature restricted only to cardiac health (Lett et al., 2005). These limitations encourage research to further clarify the relationship between different aspects of support mentioned in section 2.3 and specific factors of cardiac disease.

This discussion suggests that support factors are implicated in better recovery and adjustment following a cardiac event, and this is particularly interesting because of the potential involvement of all three (physiological, psychological and behavioural) types of mechanisms in recovery. While this PhD is not directly intending to test these pathways, it is useful to discuss plausible frameworks which might explain how support is related to health outcomes. Support may influence physical recovery from CHD via physiological pathways, with relationships characterised by conflict activating, or low levels of perceived support lacking the stress-buffering benefits on immune, cardiovascular and endocrine pathways. Psychological adjustment may be affected by the links between inadequate support or negative relationships on emotional well-being and mood. And finally, patients' recovery will be influenced by their health behaviours, which are likely to be impacted by support factors.

2.7.4 Support and CABG

The existing literature addressing recovery and adjustment from CABG surgery has identified a possible relationship between structural indices of support and CABG surgery outcomes. For example, there is evidence that being married is associated with physical recovery indices such as a shorter length of stay (Cwynar, Albert, Butler, & Hall, 2009), less mortality (Oxman, Freeman, & Manheimer, 1995) and better functional outcomes (Allen, Young, & Xu, 1998) and adjustment, including better quality of life (Eales, Noakes, Stewart, & Becker, 2005; Lie et al., 2010), and less anxiety (Koivula et al., 2002a) after CABG surgery. Living alone is associated with a 3.42-times increased risk of 30-day hospital readmission (Murphy, Elliott, Le Grande, et al., 2008), worse chest pain (Okkonen & Vanhanen, 2006) and depression symptoms (Murphy, Elliott, Higgins, et al., 2008; Okkonen & Vanhanen, 2006) after CABG surgery. However, structural indices of support alone do not consistently show positive relationships with surgery outcomes, and do not account for the individual's perception of support from their spouse or social network. There is some evidence that functional indices of support are associated with important recovery outcomes. In the first study of its kind, King and Reis (2012) recently found that those is good quality marriages have a 3.2-times higher chance of survival 15 years after CABG surgery than those in low quality marriages, and feeling lonely prior to surgery is a significant predictor of 5 year survival (J. Herlitz et al., 1998).

For the reasons described in section 2.3, perceived functional types of support have a greater capacity than structural indices for capturing the complexities of social support in its relation to health. The following is a review of the studies associating functional support with recovery and adjustment outcomes of CABG surgery in the form of self-reported emotional and physical outcomes (Table 2-2). I conducted a search of the electronic databases PubMed and Medline using multiple search terms including “cardiac surgery”, “coronary artery bypass”, “CABG” which were crossed with search words related to social relationships, including the terms “social” and “marital” linked to words including “relationship”, “support”. This was followed by extensive cross-referencing and searching of reference lists of existing studies and reviews, as well as additional searches for papers by authors who had written several papers on the topic. Studies were included if they reported support data together with emotional and/or physical health outcomes in CABG surgery patients. The only objective outcome to be included is post-operative length of stay, as an early proxy of prognosis of recovery. Quality of life data supplemented the three emotional outcomes of interest in this PhD (depression symptoms, anxiety and disrupted mood) to provide additional information regarding physical functioning. Of studies that included non-CABG patients and reported separate findings for CABG patients, only the CABG data were reported.

Table 2-2 Studies of social support/marital functioning and CABG outcomes

Study	Sample; time-points	SS/MF	Emotional outcomes	Physical outcomes
(Barry, Kasl, Lichtman, Vaccarino, & Krumholz, 2006)	1164 first time CABG; pre-discharge (T1) and 6 months (T2) post-surgery	SS (ESSI)	Instrumental support predicted positive change in mental health after controlling for demographics, previous MI, comorbidities and baseline; greater improvement for those with low support at T1; emotional support did not predict.	Neither type of support predicted physical functioning.
(Burker et al., 1995)	141 CABG patients; 1 day pre- (T1) and 1 day before discharge (T2) post-surgery	SS (PSSS)	Less social support associated with more depression symptoms at T1.	

(Con, Linden, Thompson, & Ignaszewski, 1999)	90 CABG patients; 3 days (T1) post-surgery (CS)	SS (ISEL)		Pain and functional impairment associated with less SS; SS and depressive symptoms predicted pain in women after controlling for age and illness severity and predicted functional impairment in men.
(Dantas, Motzer, & Ciol, 2002)	84 isolated CABG patients; 1-2 years (T1) post-surgery (CS)	SS (PSSS)	Social support predicted QoL after controlling for demographics and illness severity.	
(Elizur & Hirsh, 1999)*	84 CABG patients; 1 week before (T1) and 8-10 weeks (T2) post-surgery	SS; MF (NSSQ; MACES; KMSS)	Social support not associated with mental health or psychosocial adjustment; T1 marital satisfaction and adaptability predicted T2 mental health, satisfaction, marital support and adaptability predicted adjustment after controlling for demographics; adaptability predicted change in mental health; adaptability and marital support predicted change in adjustment.	

(Fontana, Kerns, Rosenberg, & Colonese, 1989)	73 male CABG/MI patients; during hospitalisation (T1), 3 (T2), 6 (T3) and 12 months (T4) post-surgery	SS (UCLA)	Support (low levels of loneliness) ameliorated symptoms of stress (threat) and psychological distress; support was more influential on distress at 6 months; stress was more influential at 12 months.	
(Hämäläinen et al., 2000)	151 isolated CABG patients; during hospitalisation (T1), 3 months (T2) and 1 year (T3) post-surgery	SS (SSQ)	Psychological distress associated with more use of social services and instrumental support, more support from family and others, but less contact with relatives and friends and less confidant availability/reciprocity.	Recovery associated with less SS from family and others and less instrumental support; SS added 6-8% explanatory power to model predicting recovery.
(Husak et al., 2004)	994 first-time isolated CABG patients; before discharge (T1), 6 weeks (T2) and 6 months (T3) post-surgery	SS (ESSI)	Low T1 social support group had lower mental health status.	Patients who had participated in cardiac rehabilitation at T3 more likely to be in high T1 SS group; low SS group had 11% less participation;T1 SS predicted participation but not after adjustment for demographic and clinical factors; same results for T2 SS.

(Jenkins, Stanton, & Jono, 1994)*	463 first-time CABG and valve patients; pre-surgery (T1) and 6 months (T2) post-surgery	SS (SSQ)		High T1 social support and social participation predicted fewer cardiac symptoms at T2.
(Karlsson, Berglin, Pettersson, & Larsson, 1999)*	111 CABG under 61 years CABG patients; pre-surgery (T1) and 12 months (T2) post-surgery	SS (MSPSS)		T2 chest pain group had significantly lower T1 SS for significant other and friends but not family; SS not an independent predictor in controlled analyses.
(K. B. King, Reis, Porter, & Norsen, 1993)*	155 CABG patients; pre-surgery (T1); 1 month (T2), 4 months (T3) and 1 year (T4) post-surgery	SS (ISEL)	Esteem support significantly predicted mood cross-sectionally controlling for appraisal, group-belonging, emotional closeness and tangible support; all but appraisal support significant in univariate models; unadjusted longitudinal regressions were significant.	Esteem support significantly related to physical functioning cross-sectionally at T3 and T4; group-belonging support associated with angina at T1, T2 and T4; longitudinal models were significant for T3 controlling for T2 and T4 controlling for T3.

(Koivula, Tarkka, Tarkka, Laippala, & Paunonen-Ilmonen, 2002b)	193 CABG patients; 1 day (T1) pre-surgery (CS)	SS (SSNurS; MCS)	Emotional support from nurses and multidisciplinary support associated with less fear after controlling for demographics and support from other sources; info support from nurses associated with significantly lower fear; association between fear and info support and multidisciplinary support not linear; high overall support from nurses and emotional support predicted less anxiety; support from pre-operative support group predicted anxiety if remove other support from model.
(Koivula, Halme, & Åstedt-Kurki, 2010)	170 CABG patients; 9 years (T1) post-surgery (CS)	SS (SSNetS)	Low emotional and informational support significantly associated with depressive symptoms; emotional support independent predictor in women only after controlling for gender, health and exercise.

(Kulik & Mahler, 1989)	56 male CABG patients; 1-2 days (T1) pre-surgery (CS)	MF (SSQ)	No findings for anxiety.	Higher spousal in-hospital support (more visits) associated with less pain medication and faster discharge from ICU and shorter post-op hospital stay; marital quality associated with ICU stay; no findings for ambulation.
(Kulik & Mahler, 1993)	85 male CABG patients; 1 (T1), 4 (T2) and 13 months (T3) post-discharge	SS (SSQ)	High emotional support predicted lower anxiety and depression and higher quality of life after controlling for demographics and cardiac illness; increase in support predicted improvements to outcomes over time.	High emotional support predicted better compliance with walking and smoking recommendations; increases in support do not significantly predict change in compliance.
(Kulik & Mahler, 2006)	296 first-time isolated CABG patients; 3 days (T1) pre-discharge (CS)	MF (ADAS; PSSUS)		Poor marital quality predicted increased length of stay in women only after controlling for diabetes history; in-hospital marital support did not predict length of stay.

(Lindsay, Hanlon, Smith, & Wheatley, 2000)*	183 CABG patients; 1 month (T1) pre-surgery and 16 months (T2) post-surgery	SS (SNS)	T1 social network support associated with T2 QoL and was a significant predictor after controlling for demographics, health behaviours and baseline levels of outcome.	
(Lindsay, Smith, Hanlon, & Wheatley, 2001)*	183 CABG patients; 1 month (T1) pre-surgery and 16 months (T2) post-surgery	SS (SAQ)		T1 satisfaction with social network support associated with T2 breathlessness and predicted T2 breathlessness in multivariate analyses; not associated with T2 angina.
(Mallik et al., 2005)	1168 isolated CABG patients; 1 month (T1) pre-surgery and 6 months (T2) post-surgery	SS (ESSI)	Low social support at T1 was associated with T1 depressive symptoms.	
(Okkonen & Vanhanen, 2006)*	279 CABG patients; pre-surgery (T1) and 6 months (T2) post-surgery	SS (FSM)	Lower family support associated with more depressive symptoms, anxiety and hopelessness at T1 and T2 after controlling for demographics.	Family support not associated with chest pain or dyspnoea.

(Oxlad & Wade, 2008)*	119 CABG patients; 30 days (T1) pre-surgery; pre-discharge (T2); 3 months (T3) and 6 months (T4) post-surgery	SS (MOS-SSS)	Lower T3 SS predicted T4 depression symptoms; lower T1 and T2 support predicted T4 anxiety; lower T1, T2 and T3 SS predicted T4 PTSD in univariate analyses; SS not predictor in multivariate analyses.	
(Oxman & Hull, 1997)	147 CABG/valve patients; 1 month (T1) pre-surgery; 1 month (T2) and 6 months (T3) post-surgery	SS (MSPSS)	Perceived adequacy of SS at T2 predicted lower depression symptoms at T3 after controlling for demographics and clinical variables.	Perceived adequacy of SS at T2 predicted less impairment to activities of daily living at T3 after controlling for demographics and clinical variables.
(Panagopoulou, Montgomery, & Benos, 2006)*	157 CABG patients; 1 day pre (T1); 1 month (T2) and 6 months (T3) post-surgery	SS (LSQHP)	No association between social support and quality of life.	

(Pirraglia et al., 1999)*	218 CABG patients; within one week pre-surgery (T1) and 6 months (T2) post-surgery	SS (SSQ)	Low T1 perceived SS predicted T2 depressive symptoms after controlling for demographics and clinical variables but not when controlling for T1 depressive symptoms.	
(Rankin & Monahan, 1991)	117 CABG/cardiac surgery patients; 1 (T1) and 3 months (T2) post-surgery	SS (SSSS)	No effect of SS on mood after controlling for functional status.	No effect of SS on functional status.
(Rantanen, Tarkka, et al., 2009)	163 isolated CABG patients; 1 (T1) and 3 months (T2) post-surgery	SS (SSQ)	SS not related to change in quality of life; aid and affect from social network and affect from nurses related to quality of life.	
(Ruiz et al., 2006)*	111 first-time isolated CABG patients; 1-20 days pre (T1); 6 months (T2) and 18 months (T3) post-surgery	MF (DRS)	T1 marital satisfaction associated with T3 depression symptoms; marital satisfaction moderated relationship between partner neuroticism and T3 depression symptoms.	
(Schröder, Schwarzer, & Konertz, 1998)*	174 CABG patients, pre-surgery (T1) and 1 week (T2) post-surgery	SS (SSS)	T1 social support had an effect on T2 mood via coping.	T1 social support had an effect on T2 activity levels via coping.

(Sorensen & Wang, 2009)	70 first-time 65+ years CABG patients; pre-surgery (T1) and 6 weeks (T2) post-surgery	SS (SSQ)	T1 social support was not related to T2 depression symptoms or quality of life.	T1 social support was not related to post-operative length of stay.
(Thomson, 2008)*	84 CABG patients; 2-3 months (T1) pre-surgery and 4 months (T2) post-surgery	SS (MOS-SSS)	T1 emotional, tangible and affective support and positive social interaction associated with T2 mental health status; tangible support did not predict mental health in multivariate analyses.	T1 tangible support and positive social interaction associated with T2 physical health status.
(Thomson, Molloy, & Chung, 2011)	84 CABG patients; 2-3 months (T1) pre-surgery (CS)	SS (MOS-SSS)	Informational/emotional support predicted mental health study in a model controlling for partner factors.	
(White & Frasure-Smith, 1995)	57 male CABG/angioplasty patients; 1 month (T1) and 3 months (T2) post-surgery	SS (PSSS)	SS was related to less uncertainty and psychological stress; in CABG patients SS did not mediate the relationship between uncertainty and stress.	

List of abbreviations: Abbreviated Dyadic Adjustment Scale (ADAS), cross sectional (CS), Dyadic Relationship Scale (DRS), ENRICHD Social Support Instrument (ESSI), Family Support Measure (FSM), Interpersonal Support Evaluation List (ISEL), Kansas Marital Satisfaction Scale (KMSS), Leiden Screening Questionnaire for Heart Patients (LSQHP), Marital adaptability and Cohesion Evaluation Scale (MACES), marital functioning (MF), Medical Outcomes Study Social Support Scale (MOS-SSS), Multidimensional Scale of Perceived Social Support (MSPSS), Multiprofessional Counselling Scale (MCS), Norbeck Social Support Questionnaire; Perceived Social Support Scale (PSSS), Positive Support and Social Undermining Scale (PSSUS), quality of life (QoL), Social Activities Questionnaire (SAQ), Social Network Scale (SNS), Short Social Support Scale (SSSS), social support (SS), Social Support from Network Scale (SSNetS), Social Support from Nurses Scale (SSNurS), Social Support Scale (SSS), Study specific questionnaire (SSQ), UCLA Loneliness Scale (UCLA)

[*] Studies which found significant associations between pre-surgery support variables and post-surgery outcomes.

In line with the complexities of social support described in this chapter, the table reveals a variable array of findings across studies of the associations between support and outcomes of surgery. The majority used a longitudinal design, though only a proportion of these assessed the relationship between pre-surgical support factors and post-surgery outcomes (marked with an * in the table, and cross-sectional studies marked with 'CS'). More studies used a global assessment of social support than those reporting findings for types of functional support separately, and for those that did report them separately, the heterogeneity of the study designs, conceptualisations of support, measurement tool and outcome variables resulted in varying findings. Partly due to methodological choices, different types of functional support were found to be more or less influential on a range of outcomes, but there is too little comparable data to form any conclusions. Consequently, while functional support is implied to be relevant to some outcomes of surgery, there is limited information that can be drawn from these studies.

The remaining studies adopted less-specific global measures of social support and also saw variation in their findings. General social support was found to predict emotional outcomes across studies including depression symptoms (Burker et al., 1995; Mallik et al., 2005; Okkonen & Vanhanen, 2006; Oxlad & Wade, 2008; Oxman & Hull, 1997; Pirraglia et al., 1999; Sorensen & Wang, 2009), mental health, mood, psychological distress or adjustment (Fontana et al., 1989; Husak et al., 2004; Rankin & Monahan, 1991; Schröder et al., 1998; White & Frasure-Smith, 1995). Social support was also associated with physical health outcomes including cardiac symptoms such as chest pain and breathlessness (Con et al., 1999; Jenkins et al., 1994; Karlsson et al., 1999; Lindsay et al., 2001), and physical functioning (Con et al., 1999; Oxman & Hull, 1997; Schröder et al., 1998) However, some authors found social support was not related to emotional (Elizur & Hirsh, 1999; Panagopoulou et al., 2006; Rankin & Monahan, 1991; Rantanen, Kaunonen, et al., 2009; Sorensen & Wang, 2009) or physical (Lindsay et al., 2001; Okkonen & Vanhanen, 2006; Rankin & Monahan, 1991; Sorensen & Wang, 2009) outcomes. Some of the studies which did find associations, reported the relationship as no longer significant when controlling for covariates (Karlsson et al., 1999; Oxlad & Wade, 2008), or baseline levels of the outcome (Pirraglia et al., 1999; Rantanen, Kaunonen, et al., 2009).

So while the majority of studies in this population do suggest a relationship between social support and emotional and physical outcomes, there are a notable number which do not support a connection, and there does not appear to be a consistent difference in the methodological design or strength of the studies which do and do not. Some well-designed studies show both positive and null findings relating support with outcomes (e.g. Okkonen and Vanhanen (2006)) while in other studies it is only in uncontrolled analyses where positive associations are found, and a more robust analysis removes this effect. Additionally, it is possible these inconsistencies arise from the wide variation in measurement tool, timing of assessment, sample size and make up, as well as choice of outcome variable. Well-designed research would hopefully help to clarify whether social support in general is associated to relevant indicators of recovery and adjustment to CABG surgery in adjusted, longitudinal analyses, and this constitutes the primary aim of my research.

Fewer than half the studies explicitly specified the source of the support, limiting our understanding of which interpersonal relationships were particularly relevant for post-surgery outcomes. For example, Karlsson et al (1999) found 12-month chest pain was related to lower social support from the significant other and friends, but not from the family. Koivula et al (2002b) found support from nurses and other professionals (including a physiotherapist, surgeon and anaesthetist) predicted fear prior to surgery, after controlling for support from a pre-operative support group and next of kin. However, these cross-sectional data were collected only one day prior to surgery and support from the pre-operative group and next of kin was assessed with a single question regarding their availability, while the other measures assessed only one day of social support. So while some evidence is reported in favour of the specificity model in terms of source, this is relatively under-researched, so my study aimed to investigate this further.

Of all the studies in the table, only Elizur and Hirsh (1999) explicitly measured both global social support and specific marital functioning concurrently. Interestingly, they found only marital variables predicted mental health and psychosocial adjustment 8-10 weeks after surgery, where social support was not associated with any outcomes. Specifically, marital satisfaction and marital adaptability (i.e. flexibility) predicted mental health, and together with marital support predicted psychological adjustment. These findings are preliminary evidence suggesting the independence of general social support and specific marital functioning for adjustment. However, the pre-surgery assessments on their relatively small sample (n=84) were conducted whilst patients were hospitalised waiting for surgery, when perceptions of support may be influenced by the anticipation of the imminent surgery. In addition, some of the findings became null in analyses controlling for baseline levels of the outcome variable (even though the variable did not change significantly over time), suggesting negative affectivity may have confounded the results. My research will address these issues to clarify these findings with a better-designed study, replication in a larger sample of patients, with a pre-surgical assessment less proximal to the procedure date, where marital and global social support variables are assessed simultaneously while controlling for other potential predictors, including baseline levels of the outcomes to be clear of the independent contribution of support factors for outcomes.

Only 4 studies examined marital functioning (Elizur & Hirsh, 1999; Kulik & Mahler, 1989; Kulik & Mahler, 2006; Ruiz et al., 2006). Ruiz et al (2006) found marital satisfaction predicted 18-month depression symptoms and moderated the relationship between their partner's neuroticism and their depression symptoms. The two key studies by Kulik and Mahler (1989; 2006) reported useful and unique findings of associations between marital variables and objective proxy measures of physical recovery, including post-operative length of hospital stay, length of stay in ICU and use of pain medication. In their (1989) study, in a sample of male CABG patients, a greater number of visits from the spouse during hospitalisation was associated with less use of pain medication, shorter ICU stay and shorter hospital stay, and better marital quality was associated with shorter ICU stay. Unfortunately, in this relatively small study (n=56), spousal in-hospital support was operationalised as a structural measure of received support, as it was assessed observationally by the researchers during visiting hours, and therefore does not reflect the patient's perception or evaluation of the support. In addition, the marital quality measure was only a one-item non-validated questionnaire in which participants rated on a 5-point scale the quality of their relationship with their spouse, and all analyses were cross-sectional.

In their (2006) study the authors used validated, subjective measures of overall marital adjustment, and specific positive and negative aspects of in-hospital support from the spouse in a larger sample of 296. They found marital adjustment, but not in-hospital support, predicted post-operative length of stay in women only. While this study was an improvement to the (1989) study, the assessments of in-hospital support were made on only one day, only 2-3 days after surgery, providing a very short time scale for evaluation of aspects of the marital relationship, and the authors acknowledge that the measure was perhaps not sensitive enough to identify associations. Unfortunately, the authors standardised the positive and negative scales, subtracting negative from positive scores to give a net score. Consequently, no findings were reported for the separate scales, and no other studies as yet have assessed positive and negative aspects of the marital relationship in this population. Again analyses were cross-sectional, and limited covariates were included in the models. These two studies provide an important stepping stone for this PhD to continue to investigate whether aspects of the marital relationship predict adjustment and objective proxy measures of patients' recovery. This will be investigated in longitudinal, controlled analyses, accounting for positive and negative aspects of the relationship independently and including self-reported physical and psychological outcomes.

So while the current literature begins to address some important points, there are still a number of issues which arise. Though some studies report positive associations, some well-designed studies also report null findings. Therefore, whether social support is an important determinant of CABG surgery outcomes remains inconclusive. This is due to the considerable variety in the support and outcome variables, designs, measures and samples, even in a review which was restricted to studies of perceived functional support in relation to outcomes in this specific population. The relevance of the marital relationship to outcomes is unclear as the assessment of marital functioning is very limited, and as a consequence so is simultaneous analysis of social support and marital functioning and examination of individual aspects of the marital relationship. The key study by Elizur and Hirsh (1999) began to illuminate the implications of differences between the marital relationship and general social support but is in need of updating and improvement. Few studies assessed the influence on objective indices of physical recovery (Kulik & Mahler, 1989; Kulik & Mahler, 2006; Sorensen & Wang, 2009), all of which are restricted by their choice of support measure. Other difficulties exist, such as the timings of the assessments, as while the majority had a longitudinal design, pre-surgery assessments were often very close to the surgery or not reported at all, and some studies provided only pre- or only post-surgery data. Not all authors made it clear whether support predictor scores were derived from pre-surgical assessments, and most cross-sectional studies were based after surgery.

Evidence of pre-surgery support predicting post-surgery outcomes has advantages over post-surgery support predictors as it reduces the risk of cross-sectional confounding. It also reflects a perception of an existing support situation and relationship qualities that will or will not be resilient to the challenges of the recovery period. Knowledge of past supportive interactions are thought to increase feelings of well-being as they help to resolve problems and influence the perception of support (Coyne & DeLongis, 1986). Patients in a marital relationship that they perceive as adaptable, in terms of reorganising priorities and roles have the best chance of emotional recovery (Elizur & Hirsh, 1999). Support assessments made after surgery are likely to reflect an acute, unstable support situation as relationships are likely to be affected through the complex demands of the recovery process. In addition, post-surgery emotional distress may alter patient's perceptions of their available support and quality of their relationships, and thus their associations with outcomes (Elizur & Hirsh, 1999). Finally, research has suggested that assessments of relationships made during an acutely stressful period such as during hospitalisation or immediately after discharge may not be an accurate reflection of marital functioning (Gilliss, Neuhaus, & Hauck, 1990), so it is important to make assessments outside of these time points.

Cross-sectional studies are at risk of confounding, and even the longitudinal studies in the table did not all control for covariates. Post-surgery assessment points ranged from whilst still hospitalised to 9 years after surgery, making generalisations across studies difficult. The table shows there are almost as many support measures used in this literature as there are studies, and some used study-specific questionnaires that were not previously validated. My study will address this by including validated measures in statistical models. Samples are also limited by a small number of women, an almost complete absence of control groups, and some studies do have small sample sizes.

While not drastically so, the literature is to an extent outdated, with only 6 studies conducted in the last 5 years, and it is possible that samples, policies and procedures will have changed over time, requiring updated research. For example, in the last ten years the characteristics of the CABG patient population has changed; mean age has increased from 64.6 to 67.2, a greater proportion are female and have more comorbidities. There has also been a decrease in the number of emergency and isolated CABG procedures, and while a greater proportion of patients are higher risk, mortality has decreased in the UK and Ireland (Hickey et al., 2013), with similar findings in the USA (Epstein, Polsky, Yang, Yang, & Groeneveld, 2011). There have been decreases in post-operative complications such as stroke, reoperation for bleeding and deep sternal wound infections (Aldea et al., 2009; ElBardissi et al., 2012; Matros et al., 2010), and the proportion of redo procedures has dropped (Ghanta, Kaneko, Gammie, Sheng, & Aranki, 2013). Length of post-operative stay decreased between the late 1980s and late 2000s (Maganti et al., 2011; Swaminathan et al., 2009) and there has been an increase in the proportion of off-pump procedures (Edelman et al., 2013). The increase in the use of hypertensive and lipid lowering drugs and PCI procedures (three times more PCIs are conducted than 10 years ago) has delayed the need for CABG surgery, so while the number of procedures has dropped (N. Townsend et al., 2012), it is increasingly being performed on older and more ill patients (Gaughan et al., 2012). Consequently, CABG surgery is in many ways a different experience now from the time when most of these studies were conducted, and my research will provide a necessary update to a number of the existing studies.

2.8 This PhD

In introducing social support as a concept and the literature relating it to health, particularly in terms of CABG outcomes, this chapter raises a number of issues worthy of closer investigation. Much of the social support literature involves replicating established findings, but refining the details of social relationships helps to understand their relevance to health, and would be particularly helpful for designing interventions. This PhD aims to develop the social support literature, particularly in relation to CABG surgery, by attempting to clarify a number of issues, extending and improving the research forming the current knowledge base, and fill a selection of the gaps which have been revealed.

This PhD will investigate the relevance of the various distinctions within social support for CABG surgery patients: functional as opposed to structural support, and perceived opposed to received support, and marital quality as opposed to marital status will be investigated. While a number of these will be measured, primary analyses will be conducted only on perceived, functional indices of social support, and only marital quality, as these are thought to better account for self-reported health outcomes. Finally, aspects of marital relationships will be included in the discussion about support together with an assessment of individual aspects of the relationship to enable an investigation into whether the source and/or type of support are relevant to outcomes. Distinctions between negative vs. positive aspects of relationships, and marital functioning vs. social support will be tested by measuring them simultaneously, with implications for whether they are conceptually and/or practically separate, function via different mechanisms, and should be targeted differentially in interventions.

Regarding the CABG support literature, this PhD aims to enhance the knowledge attainable from the existing studies, particularly those by Elizur and Hirsh (1999) and Kulik and Mahler (1989; 2006) as described in section 2.7.4. It will be the first study to assess positive and negative aspects of relationships separately in relation to CABG outcomes, and only the second to investigate social support and marital functioning simultaneously in this population. It will test whether support variables, measured with validated tools with known norms prior to surgery do predict objective and subjective aspects of physical recovery and relevant indicators of psychological adjustment after surgery. Specifically it will test whether poor quality relationships predict worse physical recovery and/or psychological adjustment to surgery. For the reasons described in section 2.7.4, pre-surgery support scores will be used as predictors, and baseline levels of outcomes will be controlled for, as well as other relevant covariates.

This PhD will hopefully update the existing social support literature (particularly in CABG populations), while addressing many of the limitations highlighted in this chapter. Through testing social support predictors of CABG outcomes, this is an attempt to identify risk factors to show who is at greater risk of poor outcomes from surgery. Finally, because of the focus on perceived support and emphasis on appraisal and the cognitive aspects of support, research has become very individualised, instead of including the family and other interpersonal contexts (Coyne & DeLongis, 1986). Thus, this PhD will address the importance of social relationships for CABG partners in the following chapter (Chapter 3).

Chapter 3 Partner distress

3.1 Introduction

This chapter introduces the caregiving experience of partners of CABG patients. The current literature describing distress and its risk factors is outlined together with its limitations, with indications for how my research will address them. I present a possible conceptual framework with which to investigate specific risk factors for distress related to receiving and the provision of support.

Adjustment and recovery following CABG surgery occurs in the context of the family. Despite the partner's likely role in the patient's recovery and the impact of the partner's adjustment on their ability to provide support, there is too great a research focus on the patient's perspective alone. As part of my PhD I aimed to address this gap in the cardiac literature which most often does not consider the partner's perspective.

3.2 Informal caregiving

Caring for an ill person informally usually occurs in the context of the family (Halm, Treat-Jacobson, Lindquist, & Savik, 2006), and more than 15 million adults in the USA are estimated to be providing care and support to a relative (Schulz & Beach, 1999) and 6.5 million in the UK (Carers UK, 2012a). They are defined as informal caregivers if they are not financially compensated for their services, thus bringing socioeconomic value to society (Vitaliano, Zhang, & Scanlan, 2003). The goal of caregiving has been stated as "promote independence by maintaining the person's most functional state – physically, intellectually, emotionally and spiritually" (Bridges, 1995) (p13). Corbin and Strauss (1988) introduced the concept of 'work' with regards to informal caregiving as being "a set of tasks...to carry out a plan of action designed to manage one or more aspects of the illness and the lives of the ill people" (p9). In essence, it describes the provision of support that exceeds normal care, namely tasks the patient would typically do for themselves or would not be necessary in the absence of the health problem. Informal caregiving is most widely researched within the context of patients with chronic and progressive diseases (Molloy, Johnston, & Witham, 2005), particularly dementia, as it is considered to pose some of the greatest challenges for caregivers (Schulz, O'Brien, Bookwala, & Fleissner, 1995).

In many cases, the spouse or partner is the primary caregiver for adults with a physical, cognitive or emotional limitation. Qualitative studies have revealed that patients primarily attribute their early recovery from illness at home to the support from their spouse (Wilson-Barnett, 1981). This is particularly the case for middle aged and older groups, where the size of the social network will often decrease to just family (Shaw, Krause, Liang, & Bennett, 2007).

3.2.1 Caring for a CABG surgery patient

Following any illness event such as a diagnosis or medical procedure, the patient and their partner will undergo a period of adjustment. However, the partner's experience of giving care will vary on the basis of the patient's illness, and caring for a CABG surgery patient will present its own particular set of challenges. Studies identify the partner as the patient's primary supporter following CABG (Artinian, 1989; Gilliss, 1984; Meleis, 1985; Rantanen, Kaunonen, Åstedt-Kurki, & Tarkka, 2004), and they are in the position to help the patient manage their self-care (Thomson et al., 2011) and improve the likelihood that they will adopt recommended healthy lifestyle changes (Goldsmith, Lindholm, & Bute, 2006).

According to the 'early discharge' protocol (Chapter 4), where possible CABG surgery patients are typically expected to be discharged from hospital 5 days after their surgery. They are encouraged to perform behaviours such as eating a healthy diet and attending cardiac rehabilitation to optimise their recovery and adjustment. For the first week, patients must not be left alone for more than two hours, after which point they must rest regularly, must not drive or carry anything heavier than the weight of a kettle half filled with water, for 6 weeks. This restricts them from most household tasks or any activity which requires them to put their weight through their arms (e.g. getting out the bath or a low chair). After 6 weeks they may begin resuming these tasks, and at approximately 6-8 weeks, patients usually will attend a clinic appointment and be discharged from care. However, higher-risk patients or those with post-operative complications might be expected to have a longer hospitalisation and more prolonged recovery period. The stages of the patient's recovery proposed by Ravven and colleagues (2013) are outlined in Chapter 1 (Table 1-2), and form a useful guideline for understanding their care needs.

During the patient's acute recovery period (the 'early' and 'recovery' periods – up to 2 months after surgery), partners, perhaps for the first time adopt the role of primary caregiver. In this role they are responsible for the patient's physical and emotional well-being and health behaviours, and partners will undergo a period of adjustment to the role as well as to the patient's illness. While patients are most likely to be experiencing symptoms of their CHD prior to surgery, it is expected that only a minority of partners would already be well-established in a caregiving role. Crucially, it is also expected that within a limited period of time, a CABG patient will recover from the physical ordeal of the surgery, and undergo improvements to symptoms evident before surgery. A CABG partner might therefore expect to begin their caregiving role at the point of the surgery and for it to end 2 to 3 months later. This relatively unique caregiving situation creates an important distinction between short-term caregiving for a CABG patient and the long-term role of caring for a patient with a progressive illness, which is the basis of the majority of caregiving research (Gaynor, 1990). This provides an interesting model to investigate the normally chronic experience of caregiving, and the effects of a newly adopted role. In addition, while it is one of the most frequently performed procedures in the world, affecting tens of thousands of families in the UK per year, the literature describing caregiving for this population is relatively small and has certain limitations. Finally, the elective nature of CABG surgery provides "an adequate evaluation period that is both temporally close and antecedent to the event"

(Oxman & Hull, 1997) (p4). This allows for pre- and post-surgical assessments to examine and describe changes that occur over time, and identifying relevant pre-surgery factors that may be targeted for intervention. For these reasons, in this PhD CABG surgery provides a useful model to research caregiving.

An extensive qualitative study by Gillis and Belza (1992) described the types of support required by CABG patients during their recovery. The caregiving activities performed to help manage the patient's illness and their lives are a combination of scheduled and unscheduled, continuous or intermittent, visible or invisible tasks. Partners may use a range of techniques to motivate the patient to comply with recommended behaviour changes such as verbal encouragement, adopting the behaviours along with them and organising opportunities to exercise and cooking healthy food. Partners also support patients by taking on some of their responsibilities thus simplifying the patient's life, and spending an increased amount of time with them, consequently reducing the time available for work or fulfilling other roles.

Gillis and Belza (1992) found that the early days of recovery are characterised by tasks that manage the illness. Two weeks after discharge, managing daily life becomes the priority. Up until week four, the goal is to help the patient reassess their life. Then for the following two weeks, managing daily tasks is the main task, so partners are required to provide various types of support at different stages. This pattern correlates closely with others described in the caregiving literature (Bowers, 1987), and together with multiple other descriptive qualitative studies provides a context in which to understand caring for a CABG surgery patient.

Partners face certain challenges when caring for a CABG patient which shape the recovery experience. While the reduction over recent years in length of post-operative stay is an international cost saving strategy, it means that patients are discharged 'sicker and quicker'. Thus partners take on the role of the caregiver at a much earlier and more acute stage of the patient's recovery (Halm, Treat-Jacobson, Lindquist, & Savik, 2007; Knoll & Johnson, 2000), and have to deal with problems that were previously addressed in hospital (Wu, 1995), which they may have little understanding of or preparation for (K. M. King & Koop, 1999).

Partners may also experience difficulty with receiving information regarding the patient's illness, anticipated recovery and their responsibilities. Seeking information is an important active coping style adopted by partners, particularly in the first week after surgery, and it may be detrimental to their outcome if it is not easy to come by or understand. A number of studies make clear that partners do not receive sufficient information (Carroll, 2011; Davies, 2000), as partners are often not explicitly included within the patient's discharge support (Molloy et al., 2005). It has also been highlighted that information is received during hospitalisation when anxiety levels are high, reducing retention (Buls, 1995). Consequently, some studies report partners as feeling unprepared for discharge (Artinian, 1993; Kneeshaw, Considine, & Jennings, 1999), with 49% of one sample feeling that the patient was discharged too early (Davies, 2000). Evidently, CABG partners play an important role but also face a number of challenges following the patient's surgery.

3.3 Partner distress

The informal caregiving literature consistently reveals that some caregivers experience disruptions to their emotional and physical well-being, and I was interested to identify whether there may also be risks involved with caregiving in the CABG surgery setting. An extensive review demonstrated elevated levels of distress in partners of cardiac patients at varying points surrounding a cardiac event (Randall, Molloy, & Steptoe, 2009). I have updated this review, including studies which assess symptoms of emotional and physical distress in CABG partners in particular.

In accordance with the psychological adjustment outcomes addressed in the CABG patient literature (Chapter 1), Table 3-1 below lists the studies assessing depression symptoms, anxiety or mood disruption in CABG surgery partners or primary caregivers, and also studies reporting physical distress. I conducted a search of the electronic databases PubMed and Medline using multiple search terms including “cardiac surgery”, “coronary artery bypass”, “CABG” which were crossed with search words related to partners, including the terms “partner”, “spouse”, “family”, “caregiver”, linked to words related to distress including “adjustment”, “psychological”, “emotion”, “mood”, “depression”, “anxiety”, “well-being” “distress”, “health”. This was followed by extensive cross-referencing and searching of reference lists of existing studies and reviews, as well as additional searches for papers by authors who had written several papers on the topic.

The table includes cross-sectional and longitudinal studies reporting prevalence, changes or correlates of emotional or physical distress symptoms in CABG partners. In the case of intervention studies, data from only the non-intervention group are reported. Though qualitative studies constitute a large portion of the CABG partner literature, they are by nature unstandardised, so purely qualitative studies were excluded. Due to the scarcity of studies fulfilling the criteria, data from published abstracts, posters and letters were included where sufficient information was available.

Table 3-1 Studies reporting partner emotional/physical distress after CABG

Study	Sample; time-points	Outcomes	Prevalence and change	Associations
(Allen, Becker, & Swank, 1991)	55 first-time isolated CABG spouses; 1 month (T1) post-surgery (CS)	Depression (FSQ); Anxiety (FSQ)	35% depressed or anxious at T1.	
(Artinian, 1991)	67 female first-time CABG spouses; 1-2 days (T1) and 6 weeks (T2) post-surgery	Mood (SSS); Physical (SSS)	Mental stress high at T1 and significantly decreased at T2; physical stress high T1 and significantly decreased T2.	
(Artinian, 1992)	49 female first-time CABG spouses; 1-2 days (T1), 6 weeks (T2) and 1 year (T3) post-surgery	Mood (SSS); Physical (SSS)	Mental and physical stress remain high at T3.	
(Buls, 1995)	30 CABG spouses; 2 days (T1) and 7 days (T2) post-discharge	Anxiety (STAI); Mood (AACL)	Anxiety and mood stable; significantly worse than intervention group.	

(Carroll, 2011)	72 CABG/PCI spouses; 6 weeks (T1) and 12 weeks (T2) post-discharge	Mood (POMS)	Disrupted mood significantly reduced.
(Conway, Skelton, O'Rourke, Cay, & Pentland, 1994)	212 CABG spouses; start of rehab median 16 weeks after surgery (T1), 12 weeks (T2) and 12 months (T3) after rehab	Depression (HADS); Anxiety (HADS)	41% depressed or anxious T1; 29.7% T2; 31.7% T3.
(Davies, 2000)	26 CABG/cardiac surgery carers (80% spouses); 1 week (T1) and 6 weeks (T2) post-surgery	Depression (HADS); Anxiety (HADS)	9% depressed; 24% anxious (time point not stated); depression and anxiety significantly lower at T2.
(de Klerk, du Plessis, & Steyn, 2006)	25 female CABG spouses; 1 day pre (T1); on discharge (T2) and 6 weeks (T3) post-surgery.	Depression (BDI, POMS); Anxiety (POMS)	No improvement to depression or anxiety; depression significantly worse than intervention group at T2 and T3 (BDI) but no differences in POMS depression or anxiety.

(Halm & Bakas, 2007)	166 first-time CABG partners; 3-6 months (T1) post-surgery (CS)	Depression (CES-D); Physical (SF-12)	Low depression; moderate physical health status.	Worse patient health and low personal mastery predict depression; younger age and worse patient health predict physical health, after controlling for demographics and patient factors.
(Hartford, Wong, & Zakaria, 2002)	68 CABG partners; 2 days (T1), 4 weeks (T2) and 8 weeks (T3) post-surgery	Anxiety (BAI)	1/3 minimal mild, 1/3 mild and ¼ moderately anxious at T1; no change in these subscales over time; decreased between T2 and T3; significantly worse than intervention group.	
(Keeping-Burke et al., 2011)	91 CABG caregivers; pre-surgery (T1) and 3 weeks (T2) post-surgery	Depression (CES-D); Anxiety (STAI)	Smaller changes to depression and anxiety compared to intervention group.	
(K. B. King et al., 1993)	103 CABG spouses; pre-surgery (T1); 1 month (T2), 4 months (T3) and 1 year (T4) post-surgery	Mood (POMS-BI); Physical (SCL-90)	Mood significantly improved, biggest improvement at T2 then stable at T3; physical health status stable.	Mood and physical health status associated with social support at all time points.

(Langeluddecke, Tennant, Fulcher, Barid, & Hughes, 1989)	65 CABG spouses; 1 week pre-surgery (T1); 12 months (T2) post-surgery	Depression (CES-D); Anxiety (STAI); Mood (PAIS)	Depression significantly improved; 54% depressed T1; 25% T2; anxiety significantly decreased; 32% anxious T1; 18% T2; psychological distress significantly improved.	T1 depression predicted T2 psychological distress; patient T2 depression predicted spouse T2 anxiety and psychological distress.
(Lenz & Perkins, 2000)	23 CABG family caregivers; 3-4 days post-surgery (T1); 2 weeks (T2), 4 weeks (T3), 6 weeks (T4) and 12 weeks (T5) post-discharge	Depression (CES-D); Physical (COOP)	Depression significantly decreased from T1 to T4 and T5; 44% depressed T1; 19.4% T5; physical health status stable.	
(Mahler & Kulik, 2002)	101 first-time isolated CABG partners; discharge (T1); 1 month (T2), 3 months (T3) and 6 months (T4) post-discharge	Mood (PANAS)	Positive and negative mood high at T1; positive mood significantly decreased at T2 then stable; negative mood significantly decreased over time; emotional difficulties significantly decreased over time.	Worse negative mood and emotional difficulties in women.
(Moser & Dracup, 2004)	417 MI/revascularisation spouses; 2 weeks (T1) post-surgery (CS)	Depression (MAACL); Anxiety (MAACL)	67% depressed above norm; 56% anxious above norm.	Depression and anxiety associated with patient depression and anxiety.

(Nieboer et al., 1998)	110 CABG spouses; 1-20 days pre (T1); 6 months (T2) post-surgery	Depression (HADS); Physical (MOS)	Depression significantly decreased; physical health status stable.	Depression associated with number of caregiving tasks and activity restriction; depression predicted by activity restriction. T1 depression predicted T2 depression, controlling for age, gender and physical health status.
(Rankin & Monahan, 1991)	117 CABG/cardiac surgery spouses; 1 month (T1) and 3 months (T2) post-surgery	Mood (POMS)	Mood disturbance significantly decreased.	Social support buffered the effect of caregiver burden on mood disturbance at high levels of burden.
(Ruiz et al., 2006)	111 female first-time isolated CABG spouses; 1-20 days pre-surgery (T1); 6 months (T2) and 18 months (T3) post-surgery	Depression (CES-D)	Depression significantly reduced from T1 to T3.	T3 depression associated with patient and partner T1 neuroticism, depression, marital satisfaction and partner optimism controlling for T1 depression.
(Stanley & Frantz, 1988)	26 CABG spouses; 4-10 weeks (T1) post-surgery (CS)	Anxiety (WSAS); Mood (WSAS)	35% high anxiety; 27% high fear.	

(Thomson, 2008)	84 CABG partners; 2-3 months pre (T1); 4 months (T2) post-surgery	Physical (SF-12)	Physical health status stable.	T1 physical health status predicted T2 physical health status after controlling for occupation, number of health problems, mental health status and emotional function.

List of abbreviations: Affect Adjective Check List (AACL), Beck Anxiety Instrument (BAI), Beck Depression Inventory (BDI), Centre for Epidemiology Studies Depression Scale (CES-D), Cooperative Information Project charts (COOP), cross sectional (CS), Functional Status Questionnaire (FSQ), Hospital Anxiety and Depression Scale (HADS), Medical Outcomes Scale (MOS), Multiple Affect Adjective Check List (MAACL), Psychosocial Adjustment to Illness Scale (PAIS), physical health (P), Positive and Negative Affect Schedule (PANAS), Profile of Mood States/bipolar (POMS/BI), Short-form 12 health assessment instrument (SF-12), Spouse Stressor Scale (SSS), State Trait Anxiety Inventory, Symptom Checklist (SCL-90), Weissman’s Social Adjustment Scale (WSAS)

The majority of studies reported findings for spouses or partners specifically, and reported that at least a proportion of partners experience symptoms of emotional or physical distress.

3.3.1 Depression symptoms

While elevated levels of depression symptoms were reported in most studies, rates ranged from 9% (Davies, 2000) to 67% (Moser & Dracup, 2004) at different time points in the patient’s recovery, assessed between 2 weeks after surgery (Moser & Dracup, 2004) and 12 months after cardiac rehabilitation (Conway et al., 1994). Variation in the rates of post-surgery depression may be explained by many of the reasons reported in Chapter 1 (section 1.5.2) including the use of different measurement tools, cut-offs, time points, conceptualisations of depression, and samples, making comparisons difficult. For example, Moser and Dracup (2004) reported 67% prevalence 2 weeks after surgery in a large sample but included MI partners, who have been reported as having increasing levels of depression symptoms up to a year after a cardiac event (Leigh, Wikman, Randall, Molloy, & Steptoe, Under review) so may be inflated. In addition, the authors reported prevalence based on scores from an adjective check list that were above published norms, in comparison with Davies (2000) who reported prevalence of only 9% when using a recognised cut-off on a validated measure (the HADS (Zigmond & Snaith, 1983)). Regardless of these restrictions in the literature, it can be seen that depression symptoms are a problem for approximately half of samples of CABG partners at various points after surgery.

Longitudinal studies typically report depression symptoms to reduce from pre-surgery to post-surgery (Langeluddecke et al., 1989; Nieboer et al., 1998; Ruiz et al., 2006) and over time after surgery (Conway et al., 1994; Davies, 2000; Lenz & Perkins, 2000). The exception is De Klerk et al (2006) who reported no improvements from 1 day before surgery to the point of discharge from hospital, but arguably measurements so close to surgery may reflect heightened distress related to the procedure that has not yet had time to remit. In addition, their sample size was only 25 so analyses may have been under powered. The small number of studies examining correlates of post-surgery depression symptoms identified a number of risk factors. These included worse patient health, low personal mastery (Halm & Bakas, 2007), patient depression symptoms (Moser & Dracup, 2004), baseline levels of depression symptoms (Nieboer et al., 1998; Ruiz et al., 2006), optimism, and patient neuroticism (Ruiz et al., 2006). It is worth noting that in some cases these associations were based on analyses that did not control for other risk factors.

In all, limitations to the methodology of studies assessing depression symptoms in CABG partners restrict our knowledge of its prevalence, trajectory, risk factors and outcomes. For the most part, depression symptoms affecting quite a large proportion of partner samples decrease over the course of the patients' recovery. However, in spite of this they remain a problem for a proportion of partners up to a year after surgery (25% - (Langeluddecke et al., 1989); 31% - (Conway et al., 1994)). Nevertheless, without sufficient reference to normal levels it is not clear whether these findings represent relevantly elevated levels of emotional distress.

3.3.2 Anxiety

Elevated anxiety is also identified as a notable problem, and as with depression symptoms there is variability in the rates after surgery. However, the range is narrower, as it is more consistently reported as affecting between a quarter and half of partner samples (41% - (Davies, 2000); 35% - (Stanley & Frantz, 1988)) in the weeks after surgery. However, the figures in the table may be slightly misleading; for example, Allen et al (1991) and Conway et al (1994) reported the prevalence of either anxiety *or* depression symptoms instead of distinguishing them. Again, the timing of the assessments ranged from 2 days (Hartford et al., 2002) to 12 months after rehabilitation (Conway et al., 1994), and assessment tools varied, so our understanding of anxiety symptoms at different times remains vague.

There are few longitudinal studies, which more consistently show that anxiety levels decrease from before to after surgery (Langeluddecke et al., 1989) and after surgery over time (Conway et al., 1994; Hartford et al., 2002) than was the case for depression symptoms. Buls (1995) found levels remained stable within the first 7 days after surgery, though in the absence of an indication of the severity of symptoms, the implications of these changes for clinical levels of distress is not clear, and their sample size was only 30. Only Langeluddecke et al (1989) reported a decline in anxiety from pre- to post-surgery, and with the pre-operative assessment close to the procedure (1 week), levels may have been inflated so this study may not reflect true changes. It is unclear in the studies systematically assessing anxiety in CABG partners whether anxiety levels necessarily improve after surgery, and at what point they reduce. Even in the studies reporting declines, for a proportion of partners, anxiety remained a significant problem up to a year later (e.g. 31% - (Conway et al., 1994); 18% - (Langeluddecke et al., 1989)).

The correlates and predictors of anxiety have been almost entirely unexplored, with only Moser and Dracup (2004) reporting that partner anxiety 2 weeks after surgery was associated with patient anxiety. A greater knowledge of the determinants of anxiety would benefit identifying those at increased risk.

3.3.3 Mood

As with the patient studies, I have included a range of conceptualisations of ‘mood’ in my consideration of the literature, essentially capturing all emotional responses not specifically described as depression symptoms or anxiety. Due to the heterogeneity of the definition of disrupted mood in these studies, the ability to make comparisons is limited. However, in the most general sense, mood disruption is seen to be high before (K. B. King et al., 1993; Langeluddecke et al., 1989) or immediately after surgery (Artinian, 1991; Carroll, 2011; Mahler & Kulik, 2002; Rankin & Monahan, 1991) and then to improve over time. However, the variability in time point, definition and measurement tool are extremely problematic, as the following examples illustrate. Artinian (1991) stated that high psychological distress significantly decreased from 1-2 days to 6 weeks post-surgery, yet at 12 months stated that it ‘remained high’ (Artinian, 1992) in a sample of only 49. King et al

(1993) found improvements from pre-surgery to 1 month after, but then no improvements up to a year later. In all, while disrupted mood does appear to improve after surgery, the studies in the table demonstrate that the patterns over the course of the patient's recovery are unclear when using a broad definition of mood.

Some authors have identified correlates of disrupted mood, such as female gender (Mahler & Kulik, 2002), lower levels of social support (K. B. King et al., 1993), pre-surgery distress and post-surgery patient distress (Langeluddecke et al., 1989), though few studies took other risk factors into account. While the small number of studies examining mood in the literature begin to suggest that partners experience disruptions to their everyday mood state around the time of surgery that for the most part improves, and some partners are at greater risk than others, the knowledge base is too small and flawed.

Summary

In summary, proportions of CABG partners experience symptoms of emotional distress after surgery. For most, initially elevated levels reduce after the weeks immediately following surgery, but for some partners, high levels of distress continue over the course of months, and in some cases, a year. However, variability in the findings, as well as the other highlighted methodological issues, call for further research to understand which partners are most at risk of emotional distress.

3.3.4 Physical distress

Measuring the partner's physical health gives an indication of disruptions that occur to their physical well-being in association with the patient's recovery. The negative physical health outcomes associated with caregiving form an integral part of the caregiving literature, but the physical health of partners is perhaps the most under studied of the outcomes in the table. While emotional distress variables are examined in few quantitative studies, our understanding is supplemented by qualitative reports, but physical distress is equally underreported in the qualitative literature. There is variability in the conceptualisation of physical distress in the CABG partner literature, and it is reported as a combination of symptoms of physical stress, sleep problems and fatigue, health service use, and self-reported physical health status. Authors rarely describe the levels of physical health status; Halm and Bakas (2007) described it as ‘moderate’ 3-6 months after surgery, though this cross-sectional study did not provide comparisons to other points in the patient’s recovery or to levels of healthy norms.

Longitudinal studies for the most part report that physical health remains stable from pre-surgery or immediately after to up to a year after surgery (K. B. King et al., 1993; Lenz & Perkins, 2000; Nieboer et al., 1998; Thomson, 2008), perhaps indicating a low impact of caregiving on partners’ physical health. However, none reported whether the levels represented physical distress or normal levels for adults of a similar age. In all, these studies do not indicate significant changes to partners’ physical health following surgery, in contrast with studies of MI partners who generally report increases in physical distress after the cardiac event (Mayou, Foster, & Williamson, 1978; Skelton & Dominian, 1973; Stern & Pascale, 1979).

Some studies have identified risk factors for worse post-surgery partner health including younger age, worse patient health (Halm & Bakas, 2007), low pre-surgery health status levels (Thomson, 2008) and low levels of social support (K. B. King et al., 1993), which are helpful for identifying individuals at risk of worse physical distress. However, the failure to control for covariates in some of these analyses limits the validity of the findings. In addition, follow-up time points ranged from 12 weeks (Lenz & Perkins, 2000) to 12 months (K. B. King et al., 1993), as well as variety in the time between pre-surgery assessment and the procedure, so the trajectory is unclear. This form of distress is in need of closer investigation, as it may indicate the impact of caring for a cardiac surgery patient on the physical health of partners.

3.3.5 Summary

This review presented a limited literature where some proportion of CABG partners experience elevated emotional and physical distress which may extend beyond the initial recovery period (see section 3.2.1). This persistence of distress after the point where the patient is expected to have recovered has led partners to be described as “hidden patients” following surgery (Ågren, Frisman, Berg, Svedjeholm, & Strömberg, 2009). In my research I aim to investigate the prevalence, trajectory and, importantly, the risk factors for distress while addressing many of the methodological limitations of the current literature. Some emotional distress might be expected following a stressful illness event such as CABG surgery, and may be problematic only if it is above a particular level or is prolonged. Many studies in the table do not adequately describe levels of distress symptoms to enable sufficient comparisons with norms or use accepted cut-offs to indicate significantly elevated levels. Of the 21 studies in the table, only 3 were published in the last 5 years, revealing a relatively old literature. It may not reflect the modern experience of CABG patients and their families including up-to-date treatments, lengths of hospital stay and available sources of information and support (Chapter 2, section 2.7.4)

To address a number of the limitations in this literature, in this PhD I will conceptualise and assess depression symptoms, anxiety and mood as described in the patient sample (Chapter 1), and physical distress will be conceptualised as the impact of the partner’s health on their quality of life. I will use validated standardised measures to compare scores with normal levels and use cut-offs to indicate clinically relevant levels. Assessments will be made prior to surgery following pre-assessment, and again 6 – 8 weeks after surgery to inform of changes that occur from a true baseline before surgery to nearing the end of the patient’s acute recovery period, and to indicate if distress is prolonged to this point of the recovery. The risk factors of distress will be investigated systematically in statistical models that account for a range of potential influences. Finally, my study aims to modernise a relatively outdated literature, updating our knowledge of the experiences of CABG partners.

3.3.6 Implications of distress

The evidence of emotional and physical distress in partners is problematic in its own right, but also has implications for further health problems and their ability to provide care to the patient (McCann, Hebert, Bienias, Morris, & Evans, 2004). There is evidence that caregiver stress and depression are associated with increased risk of patient readmission for heart failure (Schwarz & Dunphy, 2003), and to significantly predict worse physical and psychological recovery in CABG patients (Rankin, 1988).

The key health implications for poor adjustment were outlined in Chapter 1 (section 1.5.3); partners experiencing elevated emotional distress may have increased susceptibility to morbidity and mortality. The physical health of partners is evidently an under studied area of the literature, and with as many as 38% of partners reported as having a serious health problem of their own, and some partners reporting the patient being a full-time carer for the partner themselves (K. M. King & Koop, 1999) there are potentially hazardous implications for the partner's health as a result of their caregiving. Both the emotional distress of caregiving, and the physical burden of household and caregiving tasks may increase partners' risk of physical health problems or exacerbate existing problems.

3.4 Risk factors for distress

With the implications of the caregiving experience for CABG partners' emotional and physical health, I considered it a priority to identify the risk factors for distress that persists beyond the patient's acute period of recovery. There is not a linear relationship between the severity of a patient's illness and their partner's distress, so there is reason to believe that there are other explanations for it. It is important to try and understand why some partners are at an increased risk of heightened and prolonged distress over others.

3.4.1 Caregiving frameworks

Models of partner distress following patient illness are often based on stress theories e.g. the stress process model of caregiving distress (B. Miller et al., 2001). Stress theories based on the Transactional Model of Stress (Lazarus & Folkman, 1984) such as this one assume that partner distress follows an appraisal that the situation exceeds their resources to cope. However, broader frameworks better take into account the variety of ways in which the patient's recovery may impact the partner emotionally or physically, not exclusively through stress processes. Caregiving frameworks describe various contextual influences on a caregiver's experience during the patient's illness or recovery (recovery experience), which may be referred to as 'risk factors', and may then lead to distress. According to Revenson's (2003) framework, the partner's adjustment to the recovery experience occurs within the context of the 'ecological niche' that they occupy involving interrelated systems, including sociocultural, interpersonal, situational and temporal contexts.

These risk factors shape the recovery experience into one which may be stressful, as they affect the patient's health, the amount of support they are required to give the patient, how much support they receive from others, their financial situation, their emotions, their roles in everyday life, their cognitions and so on. Partners may feel stressed as a result of caregiving, from the need to restructure family roles, feelings of helplessness at seeing the patient suffering, societal expectations, and the provision of support may be conceptualised as stressful in its own right. Partners play a dual role; as the primary provider of support and as the closest family member who needs support to cope with the difficulties arising from the patient's recovery experience (Revenson, 2003).

Revenson's framework, combined with others (e.g. (Chappell & Funk, 2011; Lawton, Kleban, Moss, Rovine, & Glicksman, 1989; Pearlin, Mullan, Semple, & Skaff, 1990), forms the basis of my proposed conceptual framework which I present in section 3.9. On the basis of this framework, I have grouped the risk factors for a stressful recovery experience identified from the CABG and caregiving literature into the following four categories: patient factors, partner factors, support factors and caregiving factors.

3.5 Patient factors

Factors associated with the patient's physical state such as the stage of recovery, the prevalence of symptoms and restrictions to their ability to conduct activities of daily living will determine their caregiving needs and the partner's role. As already noted, across the literature the relationship between the two is not clearly linear, signalling the influence of alternative risk factors for partner distress. The dyadic coping literature highlights the importance of the patient's emotional health in influencing partner distress, reflecting a crucial aspect of understanding adjustment to illness in the context of the family. 'Spousal similarity' or 'emotional contagion' is evidenced in levels of psychological distress (Bookwala & Schulz, 1996; Du Fort, Kovess, & Boivin, 1994), as the emotional state of one partner affects that of the other, further justifying the assessment of partner distress. Explanations for these effects include a reaction to their partner's emotions, an increased alertness to or an infection of their emotional state (Randall et al., 2009).

3.6 Partner factors

There are a range of variables related to the partner which may influence their susceptibility to increased distress. Both older and younger age have been identified as risk factors for emotional and physical distress. As almost 80% of CABG patients in the UK are over the age of 60 (NHS, 2012) it is anticipated (and revealed in the literature) that the majority of partners are also in this age group. This may have implications for the length of the patient's recovery and also the difficulty associated with caring for the patient (Halm & Bakas, 2007). However, younger age has also been implicated as a risk factor, on the basis that younger spouses are likely to have competing obligations such as caring for children and elderly parents as well as employment, limiting time availability and increasing strain on partners.

As many as 84% of one sample were reported as being in employment (K. M. King & Koop, 1999), which combined with family responsibilities and caregiving may be considerable stressors for partners. In addition, the partner's socioeconomic status may determine their need to work whilst caring for the patient and their ability to afford additional help from professional sources, influencing the potential stress of the recovery experience.

Gender has been proposed as a risk factor for distress, and mostly it is female caregivers who have been found to have worse emotional well-being, more difficulty with caregiving tasks (Karmilovich, 1994) and more distress in general (Lutzky & Knight, 1994; Yee & Schulz, 2000). However, this is not uncontested and some studies show male partners to be at greater risk of difficulty with caregiving (see section 3.8.1). The vast majority of partner samples consist mostly of women, partly due to the fact that female cardiac patients are typically older (see Chapter 1) and are more likely to be widowed (Dekel et al., 2013), limiting the number of male partners available to participate in research. Consequently the female distress levels reported by women may be inflated, but it is difficult to distinguish female gender and caregiving role in this area of research.

Partners with existing mental or physical health problems may also be more vulnerable to finding the patient's recovery experience stressful and therefore may be at greater risk of poor adjustment (McCann et al., 2004). While a number of these patient and partner factors are crucial risk factors for partner distress, in keeping with the interests and themes of this PhD, I wanted to focus in more detail on the factors related to the receiving and provision of support, and will address these in sections 3.7 and 3.8.

3.7 Support factors

As described in the previous chapter (Chapter 2), there are several ways of conceptualising support from social relationships. CABG surgery is also a useful model for assessing the influence of support factors on the partner's experience of the patient's recovery, as in this situation both the receiving and provision of support are especially important and likely to be different from usual. In a situation in which the partner has an increased responsibility to provide support (which may be perceived as stressful), receiving support is particularly relevant for partners. It is likely to have important implications for the partner's adjustment via the mechanisms described in the previous chapter. Thus, poor quality relationships may be a risk factor for partner distress, and I wanted to investigate this in closer detail.

The caregiving literature reveals some associations between social support and less partner distress, however the findings are inconsistent. There are disputes over which type of support is most effective in reducing distress, which is exacerbated by inconsistencies in the samples and measurement tools used across the literature. Similarly, negative features of the marital relationship have been associated with increased partner distress and worse patient adjustment, including in the cardiac caregiver literature (Arefjord, Hallaråeri, Hawk, & Maeland, 1998; Bennett, 1999; Coyne & Smith, 1991; Stern & Pascale, 1979; Waltz et al., 1988), illustrating that features of the marital relationship may be important for both partners. Poor quality relationships perceived by the partner are likely to have implications for the patient's recovery as well, by disrupting the partner's well-being and reducing their ability to provide support. Some studies have shown the partner's marital satisfaction to be related to the patient's physical recovery (E. K. Beach et al., 1992) and psychological adjustment (Waltz et al., 1988) following a cardiac event.

For the reasons described in Chapter 2 (section 2.7.4), the quality of relationships before surgery may be a particularly important determinant of partners' adjustment following surgery, though the majority of cardiac partner research assesses post-cardiac event levels of support only (Randall et al., 2009). There is evidence that levels of support and the quality of the marital relationship in particular decline following illness due to the shift in roles and reciprocation of support, creating imbalance and marital dissatisfaction. Changes in reciprocity may lead to a lack of equity between partners which has subsequently been linked with worse caregiver outcomes (Thompson, Medvene, & Freedman, 1995; Ybema, Kuijer, Hagedoorn, & Buunk, 2002). A recent review revealed that pre-operative marital functioning is a predictor of post-surgery marital quality, suggesting that those in poorer quality relationships continue to have relationship difficulties, and the process of caring for the patient during their recovery may exacerbate these problems (Randall et al., 2009). Similarly, poor quality relationships with members of the social network may be tested during the patient's recovery so partners will be more vulnerable to distress during this time. Thus, individuals with better quality relationships should be able to achieve more effective adaptation and experience less distress following a cardiac event (Badger, 1990; Elizur & Hirsh, 1999).

With the implications of poor quality relationships for partner distress (and also patient recovery and adjustment), I have chosen to focus on this is a central part of my research. This PhD aims to investigate the role of general social support and the relationship with the patient in particular as a potential influence on partner adjustment. This could be through either benefitting emotional and physical well-being or acting as a source of stress in its own right. I will also investigate the relationship between support and caregiving factors, which will be discussed in greater detail in section 3.9. I have reviewed the studies measuring functional social support and marital functioning together with their correlates in CABG partners below. The findings are summarised in Table 3-2, which uses the same inclusion criteria as Table 3-1 above. My search strategy matched that outlined in section 3.3, but the terms related to cardiac surgery and partners were linked to words related to social support including “social”, “marital”, “relationship”, “support”. A number of the papers identified in the search for studies relating to partner distress were used as a starting point for this search.

Table 3-2 Studies reporting support variables in CABG partners

Study	Sample; time-points	Outcomes	Prevalence and change	Associations
(Artinian, 1991)	67 female first-time CABG spouses; 1-2 days (T1) and 6 weeks (T2) post-surgery	SS (NSSQ); MF (DAS)	Social support high T1, stable T2; marital quality average T1, significantly decreased T2.	
(Artinian, 1992)	49 female first-time CABG spouses; 1-2 days (T1), 6 weeks (T2) and 1 year (T3) post-surgery	SS (NSSQ); MF (DAS)	Social support moderate at T3, significantly lower than at T1 and T2; marital quality average.	
(Halm & Bakas, 2007)	166 first-time CABG partners; 3-12 months (T1) post-surgery (CS)	MF (MS)	High mutuality.	Mutuality predicted caregiving outcomes after controlling for demographics and patient factors.

(Halm et al., 2007)	166 first-time CABG partners; 3-12 months (T1) post-surgery (CS)	SS (ESS); MF (MS, KMSS)	High mutuality, marital satisfaction and social support at all time points; social activities low at 6 months.	Men reported higher marital satisfaction than women.
(Keeping-Burke et al., 2011)	91 CABG caregivers; pre-surgery (T1) and 3 weeks (T2) post-surgery	MF (IPRI)	Marital conflict decreases.	
(K. B. King et al., 1993)*	103 CABG spouses; pre-surgery (T1); 1 month (T2), 4 months (T2) and 1 year (T3) post-surgery	SS (ISEL)	Levels of social support high; significant decrease in emotional closeness over time.	Social support predicted mood and physical health status at all time points; esteem support strongest predictor; closeness also predicted physical health status at T3 after controlling for other types of support.
(Kneeshaw et al., 1999)	33 CABG caregivers (20.4% spouses); discharge (T1); 3 weeks (T2), 6 weeks (T3) and 6 months (T4) post-surgery	MF (MS)	Mutuality high at T1; significantly decreased by T3.	At T3 mutuality predicted patient recovery after controlling for patient age, attitude, T1 recovery scores and partner preparedness for caregiving.

(Langeluddecke et al., 1989)	65 CABG spouses; 1 week pre-surgery (T1); 12 months (T2) post-surgery	MF (PAIS)	Sexual functioning high at T1 and stable at T2.	
(Mahler & Kulik, 2002)	101 first-time isolated CABG partners; discharge (T1); 1 month (T2), 3 months (T3) and 6 months (T4) post-discharge	MF (ADAS)	Men reported higher marital adjustment than women averaged over T1 and T3; no different from intervention group.	
(Marnocha & Marnocha, 2013)	96 female CABG spouses; up to 3 months (T1) post-surgery (CS)	SS (SSI)		Social support associated with life change stress, appraisal of CABG experience, adaptive coping and resilience.
(Monahan, Kohman, & Coleman, 1996)	59 open-heart surgery spouses; pre-surgery (T1) and 6 weeks (T2) post-surgery	MF (SSQ)	Marital satisfaction stable over time; sexual satisfaction lowest score at both times; satisfaction with communication decreased.	

(Rankin & Monahan, 1991)	117 CABG/cardiac surgery spouses; 1 month (T1) and 3 months (T2) post-surgery	SS (SSS)		Social support buffered the effect of caregiver burden on mood disturbance but did not buffer the effect of patient illness severity on mood.
(Rantanen et al., 2004)	39 CABG significant others; during hospitalisation retrospectively at 1 month (T1) post-surgery	SS (SSQ)	Receive high levels of affirmation and low aid from nurses; receive high affect and low affirmation from network.	Older partners receive more aid from nurses.
(Rantanen et al., 2008)	240 CABG significant others; during hospitalisation retrospectively at 1 month (T1) post-surgery (CS)	SS (SSQ)		Affective social support from the social network predicted health related quality of life after controlling for employment, chronic disease and gender.
(Rantanen, Kaunonen, et al., 2009)	367 CABG significant others; 1 month (T1), 6 months (T2) and 12 months (T3) post-surgery	SS (SSQ)	At T2 67% said spouse most important source of support; 78% see main source every day; at T3 78% and 85% respectively; affect support primary type; support scores increased from T2 to T3.	

(Ruiz et al., 2006)	111 female first-time isolated CABG spouses; 1-20 days pre-surgery (T1); 6 months (T2) and 18 months (T3) post-surgery*	MF (DRS)		T1 marital satisfaction associated with T3 depression and caregiver strain after controlling for T1 levels; caregiver burden higher in partners with low T1 marital satisfaction caring for patient with high T1 neuroticism or low marital satisfaction or depression; T3 strain higher in partners with *high* T1 marital satisfaction caring for patient with lower T1 neuroticism; marital satisfaction moderates patient neuroticism on caregiver strain.
(Stanley & Frantz, 1988)	26 CABG spouses; 4-10 weeks (T1) post-surgery	SS (WSAS); MF (WSAS)	77% high social support; 65% no change in support since surgery 42% dissatisfied with social activity, 38% of whom said it was a change since surgery; 77% high satisfaction with ability to discuss feelings/concerns, 73% no change in this since surgery; 77% high satisfaction with marital relationship, 65% no change since surgery; 58% low satisfaction with sexual relationship, 8% of these changed since surgery; 54% low satisfaction with frequency of sexual relationship, 23% changed since surgery.	Those with change to social activity had significantly lower satisfaction with social activity; those married less than 30 years had significantly lower satisfaction with change in social support since surgery.

(Thomson, 2008)	84 CABG partners; 2-3 months pre (T1); 4 months (T2) post-surgery*	SS (MOS)	No change to social support.	Positive social interaction associated with mental health status; emotional and informational, tangible, affective support and positive social interaction associated with physical and social function; affectionate support predicted physical and social function after controlling for mental and physical health status, emotional function, number of health problems and T1 levels.
(Thomson et al., 2011)	84 first-time CABG partners; 2-3 months (T1) pre-surgery (CS)	SS (MOS)		No type of support predicted mental or physical health status after controlling for patient levels.

List of abbreviations: Abbreviated Dyadic Adjustment Scale (ADAS), cross sectional (CS), Dyadic Adjustment Scale (DAS), Dyadic Relationship Scale (DRS), Expressive Support Scale (ESS), Interpersonal Personal Relationships Inventory (IPRI), Interpersonal Support Evaluation List (ISEL), Kansas Marital Satisfaction Scale (KMSS), marital functioning (MF), Medical Outcomes Study Social Support survey (MOS), Mutuality Scale (MS), Norbeck Social Support Questionnaire (NSSQ), Psychosocial Adjustment to Illness Scale (PAIS), social support (SS); Social Support Index (SSI), Short Social Support scale (SSS), Study Specific Questionnaire (SSQ), Weissman's Social Adjustment Scale (WSAS)

[*] Studies which found significant associations between pre-surgery support variables and post-surgery outcomes.

3.7.1 Social support

The majority of studies report findings for global social support, and for the most part levels are high within the first weeks after surgery (Artinian, 1991; Rantanen et al., 2004; Stanley & Frantz, 1988). However, longitudinal studies show variability in the levels over time; some report that levels remain stable from the first assessment to up to 12 months after surgery (Artinian, 1991; Halm et al., 2007; Thomson, 2008), while others report a significant decrease (Artinian, 1992; K. B. King et al., 1993). The study by Rantanen et al (2009) was the only one which reported an increase in social support between 6 and 12 months, however no statistical analyses were conducted so it is unclear whether increases in scores were significant. So overall, though there are inconsistencies, it can be concluded that social support is at best stable over time, but has also been reported to decrease.

Only a very small number of studies tested associations between social support and partner physical and emotional outcomes (K. B. King et al., 1993; Rantanen et al., 2008; Thomson, 2008). King et al (1993) were one of only two authors to use pre-surgery support to predict post-surgery outcomes, and found evidence of links between support and mood and physical health status over different time points over the patient's recovery. However, their models adjusted only for other types of support and did not account for other potential predictors of physical and emotional well-being. Thus the implications of social support for partner adjustment are relatively under studied and in need of further clarification, which I aim to do in my research.

Social support is typically reported as a global score, but many studies used scales which distinguish different types of functional support (Artinian, 1991, 1992; K. B. King et al., 1993; Rantanen et al., 2004; Rantanen et al., 2008; Rantanen, Tarkka, et al., 2009; Thomson, 2008; Thomson et al., 2011). Thomson (2008) reported that positive social interaction was related to better mental health status, but that affectionate support predicted physical and social function. However, this study was restricted by a small sample size (n = 84) and the model did not control for potentially important risk factors such as age and sex.

Further studies used measures which specified the source of the support (Rantanen et al., 2004; Rantanen et al., 2008; Rantanen, Kaunonen, et al., 2009), and Rantanen et al (2009) reported that 67% of their sample identified their spouse (the patient) as their most important source of support. This study is useful in showing that a large proportion of partners perceive the patient as their most important source of support and therefore may be vulnerable in a situation when the patient is less capable of providing the necessary support to the partner.

Summary

In all, these studies show some interesting findings regarding the levels of support received by partners, with some indications of which types and sources are important for outcomes, though the conclusions are not firm. In my partner study, I aim to focus on the areas which may be particularly relevant while addressing some of the methodological limitations in these studies. Support will be measured according to whether it is global social support or marital functioning and both will be examined as predictors of outcomes to elucidate their relative importance.

3.7.2 Marital functioning

Studies which describe initial levels of marital functioning generally report high levels of positive aspects such as mutuality (Halm & Bakas, 2007; Halm et al., 2007; Kneeshaw et al., 1999), marital satisfaction (Halm et al., 2007) and sexual functioning (Langeluddecke et al., 1989). However, Artinian (1991, 1992) reported levels of marital quality as ‘average’, with ‘some dyadic differences, interpersonal tensions and less than maximum dyadic cohesion’.

As with all variables mentioned in this chapter, the timing of the initial and follow-up assessments varies across studies, revealing inconsistencies in the course that marital features take over time. For example, Artinian reported that average levels of marital quality at 1-2 days post-surgery were significantly lower 6 weeks later (Artinian, 1991), but were still average at one year (Artinian, 1992). However, Kneeshaw et al (1999) found high mutuality at discharge was significantly lower by 6 weeks. Consequently, most studies report either stable or declining levels of marital functioning, and choice of measurement tool and design influence the clarity of these distinctions.

Few studies have identified the risk factors or outcomes of poor marital functioning; only two studies revealed gender as a risk factor for worse marital adjustment, in this case female sex (Halm et al., 2007; Mahler & Kulik, 1990). Only three studies assessed the relationship between marital functioning and outcomes (Halm & Bakas, 2007; Kneeshaw et al., 1999; Ruiz et al., 2006), and only two focused on the partner's outcomes. Halm and Bakas (2007) cross-sectionally found mutuality independently predicted caregiving outcomes (aspects of the partner's life affected by caring for the patient) after controlling for demographic and patient-related risk factors. In the only study to examine the impact of pre-surgery marital functioning on post-surgery outcomes, Ruiz et al (2006) showed pre-surgery marital satisfaction was associated with depression symptoms and caregiver strain at 18 months after controlling for baseline levels of these outcomes. Marital satisfaction was found to be a moderator of the relationship between patient personality and caregiver strain. This study begins to elucidate the importance of marital factors for managing the recovery experience, but unfortunately, in isolation it does not provide sufficient information to explain the relationship between these two important factors in CABG partners.

This PhD aims to further investigate the implications of pre-surgical marital factors for the perception of caregiving, but importantly will be the only study using pre-surgery marital functioning to predict distress outcomes (as opposed to caregiver burden). It also aims to address the methodological and theoretical limitations of the current studies as described in section 3.7.1 above. Support will be assessed pre- and post-surgery, so that pre-surgery scores can be examined as a determinant of outcomes (as described in Chapter 2, section 2.7.4). Although support may change over time (as seen in some of the studies in the literature), an assessment of post-surgery support as a correlate of post-surgery outcomes is difficult to interpret because of the cross-sectional nature of the association. My study hopes to address the significant gaps identified in the literature, as although CABG surgery lends itself more easily to pre-surgery assessments than other cardiac events, only two studies utilised these (K. B. King et al., 1993; Ruiz et al., 2006).

Taken together, this PhD aims to assess the influence of support on distress and to specifically identify whether marital functioning differs from general social support, and which aspects of the marital relationship are particular risk factors for distress. It is worth noting that the distinction between positive and negative aspects of social relationships (introduced in Chapter 2) is barely explored in this population (only Keeping-Burke et al (2011) report marital conflict but not its associations with outcomes), so my research will be the first to address this distinction in CABG partners.

3.8 Caregiving factors

Finally, the factors related to the provision of support I have termed ‘caregiving factors’. These refer to the tasks of caring for the patient during their recovery, and include the type and quantity of tasks, the time taken to perform them, the difficulty associated with this, and the restrictions placed on the caregivers’ lives and roles as a result of it. Temporal aspects such as the length of time in the caregiver role and the adoption of new tasks are also relevant here. As the primary caregiver, partners perform a number of caregiving tasks including providing emotional and practical support, as well as taking on new roles and responsibilities they would not otherwise do in the absence of the patient’s health problem. Ultimately, caregiving is the provision of support and hence is relevant to the theme of this thesis, which focuses on the importance of support for adjustment after surgery.

Partners may be at risk of experiencing burden or strain as a result of caregiving. The concept of experiencing strain as a result of caring for a member of the family at home was introduced by Townsend (1957) whose work described the mental and physical demands of caregiving on the family, which has been succeeded by a growing concern for family caregivers. In a crucial population-based study, Schulz and Beach (1999) found that spouses who experienced caregiver strain were at a 63% increased risk of mortality than controls over 4 years. One very large scale study (n = 54 412) found that spouses caring for an ill partner are also more likely to be smokers, have a high BMI and consume more saturated fats, and that caring for more than 9 hours a week increases the risk of CHD for partners almost 2-fold after controlling for other risk factors (S. Lee, Colditz, Berkman, & Kawachi, 2003). Consequently, the health costs ensuing from informal caregiving have been estimated to meet, if not overtake national health care budgets (Arno, Levine, & Memmott, 1999), highlighting the importance of considering the partner's caregiving experience. Some positive appraisals of caregiving have been reported in the literature including personal growth and increased feelings of closeness to the patient as they survive the difficulties of recovery, so caregiving is not perceived as burdensome by all caregivers. However, the burden of caregiving may surpass these positive outcomes, and positive and negative outcomes are not necessarily mutually exclusive.

Caregiving is intrinsic to any close relationship where partners are concerned for the well-being of each other, so it is not a burdensome experience *per se*. Rather it is when caregiving changes from a normal exchange of support between partners in a relationship to an unusual and undistributed burden. Illness or a situation such as recovery from surgery is a setting in which caregiving may be transformed into caregiver burden, as caring for the patient becomes a dominant component in the relationship. As discussed in section 3.2.1, caring for a CABG surgery patient should be a short-term arrangement and less risky for the development of burden than a chronic illness. For this reason, caregiver burden is not expected to be a significant problem in CABG partner samples, and elevated levels should decline after the acute recovery period. However, due to the elective nature of CABG surgery, it is expected that the majority of partners will not to be performing a caregiving role prior to surgery, and instead take it on after surgery for the first time. Adjustment to this new role and shift in the nature of the relationship with the patient may make partners more susceptible to experiencing caregiver burden.

Qualitative CABG partner studies reveal that partners take on new caregiving roles (Lukkarinen & Kyngäs, 2003), that caregiving entails a great deal of work (Ganske, 2006) and consequently partners can feel overwhelmed with the responsibilities in the first weeks after surgery. However, perhaps due to the expectations above, caregiving factors are relatively under studied quantitatively in this field. Aspects of caregiving which may result in burden or strain may be important risk factors for partner distress, but there is little research addressing this in this population. If the risk factors can be identified, support may be targeted towards these particular areas, and greater focus can be placed on caregiver burden in CABG partners; a population that might otherwise not be targeted for additional help. Studies examining caregiving factors in CABG partners are listed in Table 3-3 below and a detailed review follows. Again, my search strategy was the same as described in sections 3.3 and 3.7, but terms were linked to words relating to caregiving including “caregiving”, “burden”, “strain”, “role”. A number of the papers already identified relating to CABG partners formed the basis of this search.

Table 3-3 Studies reporting caregiving factors in CABG partners

Study	Sample; time-points; measure	Prevalence and change	Associations
(Artinian, 1991)	67 female first-time CABG spouses; 1-2 days (T1) and 6 weeks (T2) post-surgery; RSS	Role strain low-moderate at T1; stable at T2.	
(Artinian, 1992)	49 female first-time CABG spouses; 1-2 days (T1), 6 weeks (T2) and 1 year (T3) post-surgery; RSS	Role strain significantly higher at T3 than at T1 and T2.	
(Halm & Bakas, 2007)	166 first-time CABG partners; 3-6 months (T1) post-surgery; OCBS, BCOS	Low difficulty burden; slightly positive caregiver outcomes.	Poor caregiver outcomes predicted by female sex, worse patient health, lower mutuality and depression symptoms after controlling for demographics, personal mastery, difficulty burden, patient age and months since surgery.

(Halm et al., 2006)	166 first-time CABG partners; 3-12 months (T1) post-surgery; OCBS		Worse caregiver burden associated with patient female sex, worse patient health, lower mental health status, increased personal gain and increased caregiver competence after controlling for time since surgery, patient factors, demographics, physical health status, mutuality, depression, neurocognitive symptoms, caregiving outcomes and caregiver satisfaction.
(Halm et al., 2007)	166 first-time CABG partners; 3-12 months (T1) post-surgery; OCBS	Time and difficulty burden low-moderate, stable across 12 months.	Significantly higher total burden in men but no difference for time and difficulty burden scores; men worse for medical treatment, personal care, mobility assistance, arranging care while away and monitoring symptoms.

(Nieboer et al., 1998)	110 CABG spouses; 6 months (T1) and 18 months (T2) post-surgery; IADL, AR	Number of caregiving tasks stable; 26% reported decrease in ≥2 tasks; activity restriction significantly decreases.	Those reporting decrease in ≥2 tasks had significantly lower depression symptoms and bigger decrease in activity restriction; T2 number of caregiving tasks associated with T2 depression symptoms; activity restriction associated with depression symptoms at T1 and T2; activity restriction mediated cross-sectional association between caregiving on depression symptoms; T1 activity restriction predicted T2 depression symptoms after controlling for T1 depression symptoms, physical health status, demographics and number of care tasks.
(Rankin & Monahan, 1991)	117 CABG/cardiac surgery spouses; 1 month (T1) and 3 months (T2) post-surgery; ZCBI		Social support buffered the effect of caregiver burden on mood disturbance at high levels of burden.
(Riegel et al., 1996)	136 CABG/cardiac surgery primary caregivers; 1 month (T1) post-discharge; OCBS		Burden of watching and monitoring higher for patients discharged earlier but otherwise no differences.

(Ruiz et al., 2006)	111 female first-time isolated CABG spouses; 1-20 days pre-surgery (T1); 6 months (T2) and 18 months (T3) post-surgery; ZCBI, CSS	Burden and strain stable	Caregiver burden higher in partners with low T1 marital satisfaction caring for patient with T1 neuroticism or low marital satisfaction or depression; T3 caregiver burden associated with patient T1 depression, optimism and neuroticism but no partner factors; T3 caregiver burden predicted by T1 burden, patient depression and optimism; marital satisfaction moderated relationship; T3 strain associated with partner T1 optimism, marital satisfaction, neuroticism and patient T1 depression, neuroticism and marital satisfaction; T3 strain predicted by T1 strain, partner neuroticism and marital satisfaction and patient T1 depression; T3 strain higher in partners with *high* T1 marital satisfaction caring for patient with lower T1 neuroticism; marital satisfaction moderates patient neuroticism on caregiver strain.

(Stanley & Frantz, 1988)	26 CABG spouses; 4-10 weeks (T1) post-surgery (WSAS)	50% reported increase in household work since surgery; 65% low dependence of patient on partner, 35% of those who rated patient depending on partner said it was a change since surgery; 73% high need to watch over patient; 50% of whom said it was a change since surgery; 12% too tired to perform daily work.	
(Stolarik, Lindsay, Sherrard, & Woodend, 2000)	124 first-time CABG spouses; 1 week (T1) and 6 weeks (T2) post-discharge; OCBS	Burden moderate; providing emotional support, household tasks and monitoring symptoms greatest burden; time burden decreased over time faster in fast-track patients; difficulty burden stable.	Length of stay did not have impact on burden; burden worst in youngest and oldest caregivers; time burden decreased over time faster in partners of fast-track patients.

List of abbreviations: Activity restriction (AR), Bakas Caregiver Outcomes Scale (BCOS), Instrumental Activities of Daily Living scale (IADL), Oberst Caregiver Burden Scale (OCBS), Role Strain Scale (RSS), Weissman's Social Adjustment Scale (WSAS), Zarit Caregiver Burden Inventory (ZCBI)

3.8.1 Caregiving factors

Table 3-3 demonstrates that there are a number of aspects of caregiving assessed in this literature, as determined by the measures adopted by authors. The self-report measures record the nature and extent of caregiving-specific tasks, their influence on their roles, time and well-being, and consequently the likelihood of the patient's recovery experience being perceived as burdensome. In some cases, the burden itself is the caregiving factor that is measured, and often in the literature, caregiving factors are termed caregiver burden as standard. Together these studies cover a range of caregiving factors, but the small number of studies limits the extent of the knowledge they provide.

The studies which describe burden generally report the levels as low (Halm & Bakas, 2007), low-moderate (Artinian, 1991, 1992; Halm et al., 2007) or moderate (Stolarik et al., 2000) around the time of surgery. Evidently, caring for CABG patients does not result in particularly high levels of burden or negative outcomes, which may reflect the differences in this population from caring for patients with more severe disability. These initial descriptive reports are based on assessments ranging from the first few days (Artinian, 1991; Ruiz et al., 2006; Stolarik et al., 2000) to 12 months (Halm & Bakas, 2007; Halm et al., 2007) after surgery, indicating that levels remain relatively stable over the course of the patient's recovery.

Some of the few longitudinal studies confirm this; Artinian (1991) reported that low-moderate role strain remained stable from 1-2 days to 6 weeks, and Ruiz et al (2006) found that burden and strain remained stable from 1-20 days pre-surgery to 18 months post-surgery. Through differentiating the time taken from the difficulty of caregiving, Stolarik et al (2000) was able to identify that while time burden significantly decreased from 1 to 6 weeks, difficulty burden remained stable. However, Artinian (1992) reported that role strain was significantly higher at 12 months than it was at 1-2 days or 6 weeks, and large proportions (50%) of Stanley and Frantz's (1988) sample reported increases in caregiver tasks and burden from before surgery. Evidently, though burden levels are not notably high, the course of different caregiving factors varies within and between studies.

Studies identifying correlates and predictors of caregiving factors give important insight into the implications of caregiving and risk factors for burden. In my research I was concerned with the outcomes associated with caregiving factors, but few studies have assessed this, and have been restricted to depression symptoms and mood disturbance. Nieboer et al (1998) measured the number of caregiving tasks and levels of activity restriction from 6 to 18 months after surgery in 110 CABG partners. The 26% of their sample who performed at least two fewer tasks benefitted from significantly lower depression symptoms and a bigger decrease in activity restriction than those who did not perform fewer tasks. The study gives insight into the links between caregiving and depression symptoms, but its findings must be interpreted with caution. The mediation analysis was based only on a cross-sectional association, and while the authors report that activity restriction predicted depression symptoms, it was only according to a p-value of 0.1. In addition, the regression analyses did not account for any patient factors which may have contributed to the partner's depression symptoms. This study gives indications of the risks of caregiving but is hindered by its statistical methods.

Rankin and Monahan (1991) found that an interaction variable consisting of caregiver burden and social support predicted mood disturbance in 69 cardiac surgery partners. Partners with high social support and high caregiver burden experienced lower mood disturbance than those with high burden and low support. This is one of the only studies to highlight the role of social support for improving (buffering) the negative impact of caregiver burden on psychological well-being. Unfortunately, not only was the sample size small, but the regression model did not control for any other risk factors for disrupted mood, including baseline levels. Also, it is not made clear whether caregiver burden or social support alone predicted mood disruption, or whether these variables were combined at T1 or T2, limiting the information obtainable from this study. While this study suggests an important relationship between caregiver burden and mood and a possible buffering role of social support, it would be premature to draw conclusions from only one study with these limitations. Together these two studies reveal caregiving to be a possible risk factor for poor psychological adjustment for partners following CABG surgery, and make clear the limits of the literature addressing outcomes, indicating areas for this PhD to improve.

A larger number of studies have identified risk factors for greater caregiver burden. The three studies by Halm and colleagues (Halm & Bakas, 2007; Halm et al., 2006; Halm et al., 2007) indicated that male sex (or patient female sex) was associated with worse total caregiver burden. This was specifically for tasks such as personal care, mobility assistance and medical treatment, which may reflect generational role expectations. However, Halm and Bakas (2007) found female sex was an independent predictor of worse caregiver outcomes, highlighting the vulnerability of associations according to the method of conceptualising and measuring caregiving factors. Only Stolarik et al (2000) identified age as a risk factor for caregiver burden; partners aged 31-50 and 71-80 had the highest caregiver burden, revealing both younger and older age to increase risk.

The studies by Halm and colleagues also identified depression symptoms and lower mental health status to be risk factors for worse caregiver burden (Halm & Bakas, 2007; Halm et al., 2006), revealing that psychological distress is problematic in its own right but also increases the risk of burden, which then in turn has been found to predict emotional distress. Therefore caregiver burden is implicated to play an important role in terms of emotional distress following surgery, but needs closer attention. There are some inconsistencies regarding whether the patient’s early discharge from hospital is associated with increases in caregiver strain (Riegel et al., 1996; Stolarik et al., 2000). These studies suggest that the patient’s length of stay may impact individual aspects of burden such as the time burden and burden associated with specific tasks, but perhaps does not influence caregiver burden in general.

Finally, aspects of support have been associated with caregiving variables, such as in the study by Rankin and Monahan (1991). In the study by Ruiz et al (2006) baseline (1-20 days pre-surgery) marital satisfaction predicted 18-month strain after controlling for other risk factors, as described in section 3.7. In all, these studies reveal that low levels of mutuality, social support and marital satisfaction may be risk factors for caregiver burden, connecting the foci of this PhD, and calling for greater clarification through better-designed research.

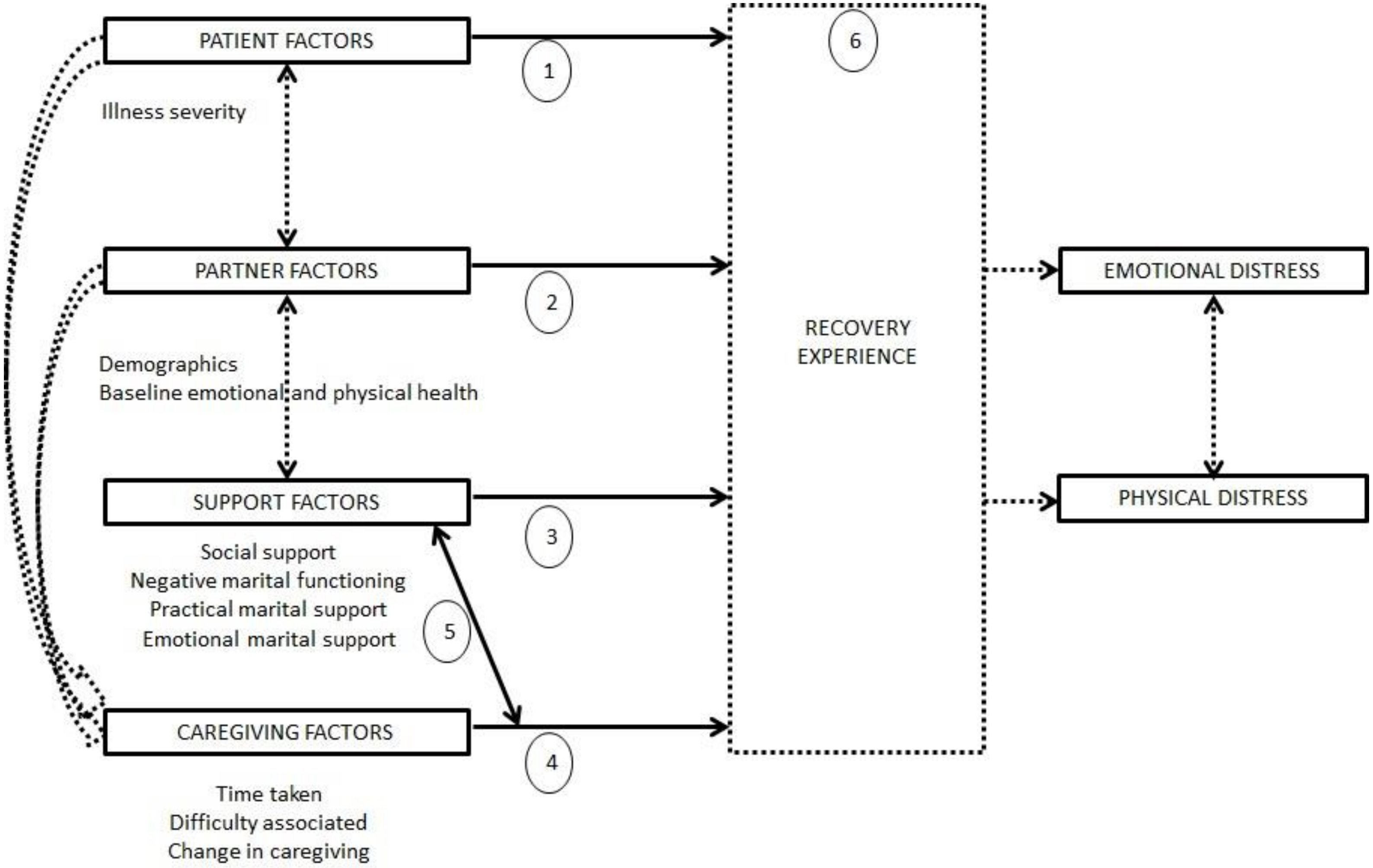
Summary

This PhD aims to address some of the gaps and limitations in the CABG partner literature describing caregiving factors. Both the amount of time and difficulty associated with caregiving tasks will be measured in order to address both more objective and more subjective aspects of caregiving, and allow comparisons with the majority of other CABG partner studies by using the same measure (OCBS). This will also allow identification of the particular aspects of caregiving which are risk factors for distress. Assessments will be made following surgery, but a pre-surgery baseline level will also be obtained. This will allow for examination of the change in caregiving that CABG partners experience when taking on the role of caregiver following surgery. This change in caregiving will be examined as a predictor of post-surgery distress, addressing the significant gap in the literature considering the implications of caregiving for emotional and physical distress. It will also account for temporal factors associated with taking on the role of caregiver for the first time. Finally, the relationship between caregiving and support will be assessed in closer detail in a more methodologically sound way than previously in the literature.

3.9 Conceptual model

In section 3.4.1 I introduced the notion of a conceptual framework devised for this PhD to examine potential risk factors for partner distress following CABG surgery. This model proposes four key influences on the partner’s recovery experience which may result in distress, and is depicted in Figure 3-1 below.

Figure 3-1 Conceptual model of CABG partner distress



Based on the literature described in this chapter and existing caregiving frameworks, I propose a model in which the partner's experience of the patient's recovery is influenced by factors related to the patient, to the partner themselves, to their relationships/support and to features of caregiving. Features of the recovery experience will include the changing status of the patient's health, emotions such as upset, perceptions and cognitions of the situation, the state of their social relationships and interactions, the specific tasks they perform to care for the patient, and economic concerns to name a few. The combination of these features may result in emotional and physical distress in partners. Influences on physical health may result from the activation of biological mechanisms associated with emotional distress if it persists, or more directly by the act of caregiving itself. The bold arrows represent the parts of the model that will be addressed in this PhD, and dotted arrows indicate hypothesised links that will not be examined in this thesis, such as the inevitable associations between risk factors. Circled numbers are used as a reference to the sections which follow:

1. The literature has emphasised that patient factors, introduced in section 3.5 including their physical and emotional well-being will partly construct the context of the recovery experience by influencing the nature and extent of their caregiving needs. In my research, I elected to use a measure of the patient's clinical cardiac severity as a proxy of the quantity of care they will require during recovery, to best represent patient-related risk-factors for distress. This measure (EuroSCORE) also takes into account other patient factors such as age and sex.

2. Factors relating to the partner such as their age, sex and socioeconomic status, their personality and caregiving styles and health history are important determinants of what opportunities, privileges and responsibilities are relevant to them, the stressors they are exposed to and resources available to them to deal with the situation. In my research, I focused on age, socioeconomic status and pre-surgery levels of emotional and physical distress as the key partner-related risk-factors for distress.

3. and 4. The patient and partner factors did not form the key focus of the research but rather were included as important concurrent risk factors that should be taken into consideration. In this PhD I chose to examine support and caregiving factors in closer detail due to my interest in the receiving and providing of support, in terms of their protective or destructive effects on the recovery experience. These two risk factors may also be particularly amenable to intervention. The literature reviews revealed preliminary evidence suggesting that aspects of both are potential risk factors for distress, but the literature was restricted by methodological limitations and a relative scarcity of research assessing the risks they pose for partner distress. Consequently, the particular types of support or caregiving factors that may especially increase the risk of partner distress are unclear but important to identify. The ways in which support and caregiving factors will be investigated in my research are described in sections 3.7 and 3.8 respectively, in each case taking patient and partner factors into account.

5. Finally, the relationship between support and caregiving factors will be assessed; specifically if caregiving factors influence aspects of perceived support and if support influences the impact of caregiving factors on distress. It is possible that support factors may buffer or exacerbate the risks that caregiving factors have for distress. Partners who receive practical help with caregiving or emotional help to encourage and comfort the partner may be at reduced risk of distress than those with poorer quality relationships. The distinctions between marital functioning and global social support may also be relevant here, as the general social network may become the more (or less) important source of support for partners whilst providing support to the patient. In addition, the nature and extent of caregiving tasks may influence the quantity or quality of the support received by the partner; more time-consuming or difficult tasks may result in partners receiving a greater amount of support or indeed limit the support they receive. This will be assessed in my PhD by examining whether caregiving factors influence the support received by partners, and whether the level of support influences the impact of caregiving on distress.

6. The partner's experience of the patient's recovery, influenced by the four types of risk factors, will determine whether or not they will experience distress following

surgery. The mechanisms linking these risk factors to distress extend beyond the limits of this PhD, but hypotheses include the fact that caregiving may result in life disturbances which may lead partners to feeling distressed. Examples include disruptions to the ability to continue employment and financial difficulties, strain on the marital and other personal relationships, over-dependence of the patient and feelings of resentment, anger and fear, as well as those listed at the beginning of this section. The restrictions on activities may also limit the individual’s ability to achieve positive well-being additionally contributing to distress (Nieboer et al., 1998).

In my research I will measure the risk factors prior to surgery, and in the case of caregiving factors, the change after surgery compared to before. Consequently, my research will test this model by identifying whether pre-surgery support factors are important influences on the post-surgery experience, and whether the change from pre-surgery caregiving is a risk factor for distress. I chose to measure post-surgery outcomes at the stage where the patient’s acute recovery is ending, to identify whether partners remain distressed at this point, and identify who is at increased risk of this distress. This is the crucial point to measure distress and identify its risk factors to enable intervention and target partners at increased risk.

3.10 Patients vs. partners

As an additional point, there is useful knowledge to be gained from comparisons between patient and partner levels of distress. In the CABG partner literature, some authors found that partners experienced higher levels of emotional distress than patients (Allen et al., 1991; Carroll, 2011; Lenz & Perkins, 2000; Moore, 1994; Moser & Dracup, 2004; Ruiz et al., 2006), though few report whether the differences were significant. In some cases, no differences were found for depression symptoms (Bergh, Bäckström, Jönsson, Havinder, & Johnsson, 2002; Bruggemans, Van Dijk, & Huysmans, 1995; Conway et al., 1994; Lenz & Perkins, 2000; Ruiz et al., 2006) or indeed for partners to be less anxious than patients (Hartford et al., 2002). Nonetheless, only with significant differences may it be inferred that partners are perhaps in greater need for support than the patient themselves.

These differences have been hypothesised to result from differences in perceived control, as partners perceive themselves as having less control over the patient's illness (Moser & Dracup, 2004). Another possible explanation is gender differences, as partner samples are mostly female and women reporting higher levels of distress is evidenced in the literature. However, caregiving role as opposed to female gender has been posed as an alternative explanation by some researchers (Gilliss, 1984; Rankin & Monahan, 1991). The factors described in the conceptual model may combine to render the recovery experience overall more distressing than for the patient. In particular, differences in patient and partner perceived support could explain differences in distress, as partners are more consistently reported as having lower levels of social support and positive marital functioning than patients (Gortner et al., 1988; Rankin & Monahan, 1991; Rantanen, Tarkka, et al., 2009), though again not all differences were significant.

Evidence of partners suffering greater emotional distress than patients is an important indication of the extent of their distress, and the need for support from the health care system and the social network to give greater attention to partners. Differences in levels of support may reflect the reciprocal relationship between patients and partners being unevenly balanced, with implications for partner distress and again indicating a greater need for partner support following CABG surgery.

3.11 This PhD

In my research, I will test the conceptual model in the ways described in section 3.9, as well as addressing the limitations to the CABG partner literature that have been demonstrated in various subsections of this chapter. I also hope this PhD will enhance the caregiving literature in general by increasing the quantity and quality of studies assessing the specific situation of CABG partners. It has been argued that research should focus on the situation of those caring for people with specific diseases (Biegel & Schulz, 1999), and this population remain relatively under studied. The Randall et al (2009) review identified the relative paucity of studies assessing distress in cardiac partners as well as the outdated state of the literature compared to the advances in cardiac care. I hope to address these issues and methodological limitations in my study.

Chapter 4 Patient methods

4.1 Introduction

This chapter presents the aims and hypotheses of the PhD that are based on the conclusions of Chapter 1 and Chapter 2. The Adjustment and Recovery after Cardiac Surgery (ARCS) study is presented as the model upon which to investigate the hypotheses in CABG surgery patients, and its design, procedure and choice of measures are detailed. The preparation of the data for analyses is described, the findings of which are presented in Chapter 6.

4.2 Aims and hypotheses

Guided by the literature review, the overall aim of this PhD was to better understand the relationship between social relationships and adjustment following cardiac surgery for both patients and their partners. Through examining both spouses in the relationship, this PhD aimed to give a comprehensive picture of the associations between social relationships and recovery from CHD. This overall aim was approached by examining the patients and the partners separately, beginning with the patients. For the patients, adjustment and recovery were defined as the emotional and physical changes that occur after surgery, respectively. This aim for the patients involves three objectives and associated hypotheses:

Objective I: Examine the influence of the quality of various types of social relationships on recovery and adjustment from CABG surgery.

Hypothesis I: Social relationships measured prior to CABG surgery will predict post-surgery emotional and physical health.

In the first instance I wanted to confirm whether the quality of social relationships is an important factor for patients' overall recovery experience from CABG surgery. The quality of patients' social relationships was assessed prior to surgery and examined as a potential predictor of their adjustment and recovery after the procedure. Psychological adjustment was examined with self-report psychological measures of emotional state, and physical recovery was assessed with a combination of self-report health status measures and clinical data from medical records.

Objective II: Investigate the differences between specific features of a social relationship, and their role for adjustment and recovery from CABG surgery.

Hypothesis II: Negative aspects of social relationships are distinct from positive aspects in terms of their role in explaining surgery outcomes.

Secondly, I wanted to clarify whether positive and negative aspects of social relationships are distinct or whether a negative relationship merely indicates the absence of positive features and vice versa. Three separate qualities of the marital relationship were measured individually, two representing ‘positive’ aspects, the other ‘negative’ and their influence on surgery outcomes were examined in conjunction with one another. The independent influence of one type of relationship quality on surgery outcomes in the presence of the other type is an indication of the difference in the role that each plays on health and well-being.

Objective III: Examine the differences between the quality of general social relationships and the quality of the specific marital relationship, in terms of the role in adjustment and recovery from CABG surgery.

Hypothesis III: The marital relationship is distinct from global social support in terms of its role in explaining surgery outcomes.

Finally, I wanted to investigate whether marital relationships provide support in any way that is essentially different from general social support. Are the benefits of marriage for health and well-being a result of receiving support in general, or does the marital relationship have an independent role? The independent influence of one conceptualisation of support on surgery outcomes in the presence of the other is an indication of a difference in the role each type plays on health and well-being.

4.3 The Adjustment and Recovery after Cardiac Surgery (ARCS) study

In order to address the aims and objectives for this part of the PhD, the Adjustment and Recovery after Cardiac Surgery or 'ARCS' study was devised. This extensive, longitudinal study was designed and piloted in 2010. The study has been running since 2011 and is now drawing to a close. Coronary artery bypass graft (CABG) surgery was selected as a model to examine recovery from coronary heart disease, as it is often an elective procedure, enabling assessments both prior to and following a major cardiac event, so post-surgery outcomes can be measured whilst taking into account pre-surgery factors. The aim of the ARCS study was to identify the social, emotional, biological, cognitive and behavioural predictors of adjustment and recovery from CABG surgery. Each aspect was examined with an extensive list of self-report and objective measures spanning the preparation and acute, short-term and long-term recovery periods. My PhD constituted the part of the study examining social predictors, specifically the quality of social relationships, and a selection of the time points and variables from this large scale study were adopted to address the aims and hypotheses of this PhD.

4.4 Participants

Participants were patients undergoing CABG surgery at St George's Hospital, London between February 2011 and October 2012. The target population were patients attending the cardiac outpatients pre-assessment clinic for CABG surgery. Due to the variation in the risks associated with different types of CABG surgery, for homogeneity, only patients selected for elective, first-time full CABG surgery were included in the study. Participants were included if they were patients over the age of 18 who were electively admitted for CABG surgery; this included both on-pump and off-pump CABG and CABG with another cardiac procedure such as valve repair or replacement and with a variety of graft types. Patients were excluded if they were scheduled for minimally invasive direct CABG or isolated valve surgery not including CABG, if they had communication or cognitive impairments, were unable to complete the questionnaires in English, were too unwell, had previously undergone CABG surgery, or if their surgery date was scheduled too close to the recruitment date (and therefore did not have time to complete the pre-surgery assessment). Reasons for exclusions are depicted in Chapter 6, Figure 6-1.

4.4.1 Power calculation

Power calculations were conducted using the software nQuery Advisor v4.0 for the full ARCS study, based on a previous study of psychosocial variables predicting post-CABG recovery. The study by Beresnevaite and colleagues (2010) found that after adjusting for covariates, depression predicted post-operative length of stay. Using the quantity of variance explained by depression as a guide (10.5%), it was calculated that for a power specification of 0.9 and a significance value of $\alpha = 0.01$, a sample size of 103 was needed to find an equivalent effect from a multiple regression with up to 8 predictor variables.

An additional power calculation was conducted on the basis of a study more relevant to the hypotheses of this PhD. In a study linking marital functioning and adjustment after CABG surgery, Elizur and Hirsh (1999) found that after adjusting for covariates, marital adaptability predicted psychosocial adjustment to surgery. Using the quantity of variance explained by marital adaptability (20%), under the same specifications as for the first calculation, it was determined that the necessary sample size was 45. In anticipation of attrition and missing data, and on the basis that a number of sub-analyses would be conducted according to the various hypotheses, I aimed to recruit approximately 200 participants.

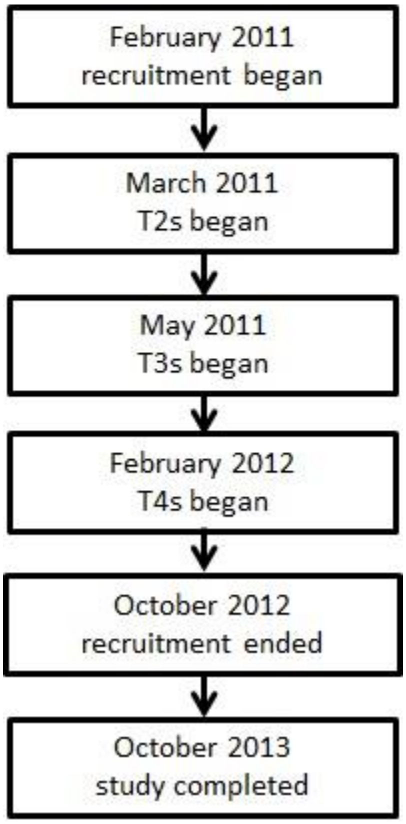
4.5 Design

The full ARCS study was a prospective, longitudinal study that involved a combination of self-completion questionnaires, structured interview, and providing saliva and blood samples over four time points. These assessments were targeted at an average of 3 to 4 weeks before surgery (T1), 2 to 5 days after surgery (T2), 6 to 8 weeks after surgery (T3) and 12 months after surgery (T4). The time between T1 and surgery was determined by the scheduling of the surgery, which the study site aimed to be no more than 18 weeks after pre-assessment. The timing of T2 depended upon the patients' physical state, but was aimed to be conducted as soon as the patient was able after surgery, before discharge. T3 materials were dispatched 6 weeks and T4 12 months after the surgery date, and return dates depended on the patients' willingness to complete the research, as well as the postal system. The procedure for each time point is outlined in Table 4-1 and the study time line is presented in Figure 4-1.

Table 4-1 Patient study design

	When	At hospital	At home
Time 1	3 – 4 weeks before surgery	• Neuro-cognitive test • Health literacy test • Blood sample	• Questionnaire • Saliva samples
Time 2	2 – 5 days after surgery	• Structured interview • 2 blood samples	-
Time 3	6 – 8 weeks after surgery	-	• Questionnaire • Saliva samples
Time 4	12 months after surgery	-	• Questionnaire • Saliva samples

Figure 4-1 Patient study time line



4.6 My contribution

The ARCS study was conducted by a team of researchers (Dr. Lydia Poole, Dr. Tara Kidd, Ms Amy Ronaldson, Professor Andrew Steptoe), together with whom I played a key role in designing and running the study. I was central in organising the practical aspects of the study procedure at the study site, and the selection of questionnaire measures. In particular, I sourced the marital functioning questionnaire, and devised a measure for in-hospital social and marital support for the study. My main involvement surrounded study recruitment and data collection at the first two time points at the hospital, and organising postal data collection at the second two time points. In addition, I had significant involvement in devising the research resources, data entry and processing of saliva samples. I conducted all data analyses myself with the guidance of my supervisors.

4.7 Procedure

4.7.1 Recruitment

Patients who fit the inclusion criteria were identified at the time of the booking of their surgical pre-assessment appointment, and were mailed a letter inviting them to take part in the study and a participant information sheet. Immediately before or after the pre-assessment appointment (conducted by specialist nurses), patients were approached by a researcher who explained the study. Consenting participants signed a consent form, completed the hospital-based section of the first assessment, and were given the materials to complete the home-based section. Typically the procedure of introducing the study and consenting took place in the waiting room prior to the pre-assessment appointment, and the hospital-based assessment was conducted at a suitable time between associated appointments. All documents are presented in Appendix 1.

4.7.2 Time 1

Hospital

Participants completed the Montreal Cognitive Assessment (MoCA) test of memory and concentration, and a health literacy test administered by the researcher in a private research office in the hospital, followed by a detailed explanation of the home-based research procedure. Participants provided a blood sample, taken either by the pre-assessment nurse, or at the outpatients' phlebotomy department.

Home

Participants completed a questionnaire and provided saliva samples at home in the period between their surgical pre-assessment appointment and their surgery, and returned them by post. The self-completed questionnaire included measures of emotional distress, physical health, social support, including marital functioning, health status, illness cognitions, health behaviours, and demographics. Participants were advised that the questionnaire was not timed and that it may take approximately one hour to complete.

Participants gave seven saliva samples over the course of one day for the measurement of cortisol. They were provided with seven salivettes (a dental cotton swab that fits inside a centrifugation tube; Sarstedt Inc., Rommelsdorf, Germany) labelled with the times at which they should give the samples. Providing samples involved gently chewing on the cotton swab until saturated, and returning it to the tube. Participants were advised to avoid food, drink, medications and brushing teeth in the 30-minute period before giving each sample. They also completed a diary, documenting the times of giving the samples, rating their mood and sleep duration and quality.

4.7.3 Time 2

Approximately 2 to 5 days after surgery, participants completed a structured interview on the ward, administered by the researcher, containing questions regarding symptoms of surgery, pain, emotional distress and in-hospital social support. Blood samples were obtained on 2 days following surgery either by phlebotomists or the attending intensive care (ICU) nurse.

4.7.4 Time 3

Participants followed the same home-based procedure as Time 1 approximately 6 to 8 weeks after their surgery, providing saliva samples and completing a questionnaire and returning them by post. The questionnaire was the same as Time 1, with the exception of the exclusion of measures of demographics, optimism, social network, attachment, and life events. Measures of rehabilitation attendance, surgery symptoms and satisfaction, pain, efficacy/confidence and benefit finding were added. There were no differences in the procedure for providing saliva samples. There was no hospital-based assessment at this time point, but clinical information was obtained from hospital records after this point.

4.7.5 Time 4

The procedure at approximately 12 months after the patients' surgery was the same as at Time 3, except the measure of life events was reintroduced into the questionnaire.

4.7.6 Blood samples

Arrangements were made with the phlebotomy and pathology departments for the obtaining, storage and analysis of blood samples. A maximum of 3 samples of 20 ml of blood was drawn from patients into plain serum tubes, stored at -80 degrees Celsius, then later spun and analysed for biomarkers in two batches by Dr David Gaze at St George's (July 2012 and February 2013).

4.7.7 Saliva samples

Salivettes that were returned by post to UCL were stored at -20 degrees Celsius, re-labelled and then shipped to the laboratory of Professor Clemens Kirschbaum in Dresden, Germany for analysis of cortisol in two batches (June 2012 and January 2013).

4.8 Measures

The ARCS study adopted a wide range of measures in order to effectively capture the variety of factors of interest to the study, including a combination of self-report, subjective and objective measures, which are listed in Table 4-2. Where possible, instruments that were validated for longitudinal assessment and that had been used in population studies and cardiac samples were selected, to enable effective comparisons. When available, short forms of instruments were utilised to minimise measurement burden. While any self-report measure, particularly in studies of emotion and health, is subject to response bias, this study aimed to use the most suitable measures possible, and to take potential biases into consideration.

Table 4-2 Patient full study measures

	Measure			Time point			
	Full name	**Abbrv**	**Reference**	**T1**	**T2**	**T3**	**T4**
Emotional variables							
Depression symptoms	Beck Depression Inventory	BDI	(Beck et al., 1988)	✓	-	✓	✓
Anxiety	Hospital Anxiety and Depression Scale	HADS	(Zigmond & Snaith, 1983)	✓	✓	✓	✓
Mood	Positive Emotional Style and Negative Emotional Style questionnaire	PES/NES	(Cohen, Doyle, Turner, Alper, & Skoner, 2003)	✓	✓	✓	✓
Health status/Quality of life							
Health-related quality of life	Short Form – 12 health assessment instrument	SF-12	(Ware, Kosinski, & Keller, 1996)	✓	-	✓	✓
Quality of life	Control, Autonomy, Self-realisation and Pleasure Questionnaire	CASP-19	(Hyde, Wiggins, Higgs, & Blane, 2003)	✓	-	✓	✓
Benefit finding	Benefit Finding Questionnaire	BFQ	(Carver & Antoni, 2004)	-	-	✓	✓
Efficacy/ Confidence	Efficacy Confidence Questionnaire	ECQ	(Rohrbaugh et al., 2004)	-	-	✓	✓
Optimism	Life Orientation Test	LOT	(Scheier & Carver, 1985)	✓	-	-	-

Life events	Multi-Ethnic Study of Atherosclerosis (MESA) Stress Supplemental Questionnaire	MESA-SSQ	(Mezuk, Diez Roux, & Seeman, 2010)	✓	-	-	✓
Physical health variables							
Health service use	Measures designed for this study			✓	-	✓	✓
Sleep problems	Jenkins' Sleep Problems Questionnaire	JSPQ	(Jenkins, Stanton, Niemcryk, & Rose, 1988)	✓	-	✓	✓
Surgery symptoms	Coronary Revascularisation Outcome Questionnaire	CROQ	(Schroter & Lamping, 2004)	-	✓	✓	✓
Angina symptoms	Seattle Angina Questionnaire	SAQ	(Spertus et al., 1995)	✓	-	✓	✓
Pain	McGill Pain Questionnaire – short form	MPQ-SF	(Melzack, 1987)	-	✓	✓	✓
Clinical variables	Extracted from medical notes			-	-	✓	-
Cortisol	Obtained from saliva samples			✓	-	✓	✓
Biomarkers	Obtained from blood samples			✓	✓		
Support variables							
Social network	The Social Network Index	SNI	(Cohen, Doyle, Skoner, Rabin, & Gwaltney, 1997)	✓	-	-	✓

Social support	ENRICHD Social Support Instrument	ESSI	(P. H. Mitchell et al., 2003)	✓	-	✓	✓
Support with recovery behaviours	Adapted from ESSI			✓	-	✓	✓
Marital functioning	The Close Person's Questionnaire	CPQ	(Stansfeld & Marmot, 1992)	✓	-	✓	✓
Loneliness	UCLA Loneliness Scale	UCLA-LS	(Hughes, Waite, Hawkley, & Cacioppo, 2004)	✓	-	✓	✓
In-hospital support	Measures designed for this study			-	✓	-	-
Attachment style	Adult Attachment Scale - Revised	AAS-R	(Collins & Read, 1990)	✓	-	-	-
Cognitive variables							
Illness perceptions	The Brief Illness Perceptions Questionnaire	BIPQ	(Broadbent, Petrie, Main, & Weinman, 2006)	✓	-	✓	✓
Cardiac beliefs	The York Cardiac Beliefs Questionnaire	YCBQ	(Furze et al., 2009)	✓	-	✓	✓
Cognitive screen	Montreal Cognitive Assessment	MoCA	(Nasreddine et al., 2005)	✓	-	-	-
Health literacy	Validated health literacy measure		(Darcovich, 2000)	✓	-	-	-
Health behaviours							

Physical activity	International Physical Activity Questionnaire	IPAQ	(Booth, 2000)	✓	-	✓	✓
Diet	Fat Behaviour Questionnaire/ validated fruit and vegetable scale	FBQ	(Cappuccio et al., 2003; www.healthy-heart.co.uk)	✓	-	✓	✓
Alcohol	Standard survey questions			✓	-	✓	✓
Adherence	Medication Adherence Report Scale	MARS	(Horne & Weinman, 1999)	✓	-	✓	✓
Smoking	Standard survey questions			✓	-	✓	✓
Rehabilitation attendance	Measure designed for this study				-	✓	✓
Demographic variables							
Demographics	Standard survey questions			✓	-	-	-

4.8.1 Full study vs. PhD study

Due to the extensive nature of the full ARCS study and the specificity of the aims and hypotheses of this PhD, only a part of the full procedure comprised the focus of this PhD study. A selection of the questionnaire data from only two time points were used (T1 and T3), and all data from saliva and blood samples were excluded. Time 3 was relabelled Time 2 (T2) and will be referred to as such from this point onwards. The measures used in this PhD are listed in Table 4-3, followed by a description of each measure.

Table 4-3 Patient PhD study measures

Variable	Measure	Time	
		T1	T2
Emotional variables			
Depression symptoms	BDI	✓	✓
Anxiety	HADS	✓	✓
Mood	PES/NES	✓	✓
Physical health variables			
Physical component score	PCS (from SF-12)	✓	✓
Surgery symptoms	CROQ	-	✓
Angina symptoms	SAQ	✓	✓
Comorbidity	Measure designed for study	✓	-
Clinical variables			
EuroSCORE, LVEF, number of grafts, conduit location, valve surgery, cardiopulmonary bypass, ICU stay, length of stay, return to theatre, return to ICU, cardiovascular accident, diabetes	Clinical notes	-	✓
Support variables			
Social support	ESSI	✓	✓
Marital functioning	CPQ	✓	✓
Social network	SNI	✓	-
Demographic variables			
Age, sex, ethnicity, education, employment, income, marital years, household size	General survey questions	✓	-
Occupational classification	The Office of National Statistics Standard Occupation Classification (SOC) 2010 index (The Office for National Statistics, 2010)	✓	-

4.8.2 Emotional variables

Depression symptoms, anxiety and mood were selected as indicators of psychological adjustment, and represent distinct aspects of emotional well-being. Although depression and anxiety commonly occur together, anxiety is characterised by hyperarousal where depression, depending on how it is defined, is a combination of low mood and loss of interest or pleasure (see Chapter 1 for definitions). The self-report measures utilised in this PhD capture feelings of depression symptoms and anxiety over the period of the previous two weeks, and are not diagnostic tools for clinical disorders. However they do represent a combination of symptoms that resemble anxiety and depression as specific types of emotional states, and I argue in Chapter 1 that self-reported symptoms are important in their own right. In order to give a more complete picture of emotional well-being, a measure of general mood (not specific to depression symptoms or anxiety) over the last week was also included. While it is likely there will be an overlap in the constructs being measured by these instruments, a more general indication of the occurrence of everyday moods supplemented the more specific measurement of depression symptoms and anxiety. The measures were selected on the basis of their suitability to the particular population, as well as their methodological capabilities e.g. distinguishing subtypes of depression, allowing the calculation of a net score of everyday mood, and relevant cut-offs.

Depression symptoms

Depression symptoms were measured using the Beck Depression Inventory (BDI) (Beck et al., 1988). This is a 21-item measure with scores ranging from 0 to 63, with higher scores indicating more severe depression symptoms. Respondents can be categorised according to the following recognised cut-off scores (Kendall, Hollon, Beck, Hammen, & Ingram, 1987): 0 to 9 indicates no or low depression symptoms, 10 to 19 indicates mild depression symptoms (scores of 10 to 17 are reflective of dysphoria while above 17 are more indicative of depressive states), 20 to 29 depicts moderate depression symptoms, and 30 and above reflects severe depression symptoms. Depression symptom scores were used as a continuous variable in analyses and the well-used cut-off score of ≥10 was adopted to indicate significantly elevated depression symptoms, which has established sensitivity and specificity for detecting caseness (Beck et al., 1988). Additionally, participants with a total score above 17 who also scored above 0 for the question on suicidal ideation were made known to their GP, and were recommended to seek professional help; otherwise a score of 21 was used as the cut-off for alerting their GP. The BDI is a well-established measure of depression symptoms and has been used extensively in cardiac populations (de Jonge et al., 2006; Freedland, Carney, Lustman, Rich, & Jaffe, 1992), showing good reliability and validity, differentiating subtypes of depression and depression from anxiety (Beck et al., 1988).

Anxiety

Anxiety was assessed with the anxiety subscale of the Hospital Anxiety and Depression Scale (HADS) (Zigmond & Snaith, 1983), a 7-item measure with possible scores ranging from 0 to 21, and higher scores indicating greater anxiety. Anxiety scores were used as a continuous variable, but the recommended cut-off score of ≥8 has established sensitivity and specificity for detecting caseness (Olsson, Mykletun, & Dahl, 2005) and was used descriptively to identify cases of significantly elevated anxiety.

The HADS was developed to assess mutually exclusive levels of anxiety and depression in non-psychiatric hospital outpatients. The full measure has been found to have satisfactory reliability, sensitivity and other psychometric properties (Bjelland, Dahl, Haug, & Neckelmann, 2002; Brennan, Worrall-Davies, McMillan, Gilbody, & House, 2010; Herrmann, 1997), though the two factor structure has been the cause of a great deal of controversy in the literature (Cosco et al., 2012). The measure was specifically designed to assess individuals with somatic illness, and has been used in cardiac samples, including predicting mortality in patients with coronary heart disease (Doyle, Conroy, McGee, & Delaney, 2010).

Mood

Positive and negative mood were measured using a 12-item version of the Positive Emotional Style and Negative Emotional Style questionnaire (PES/NES) (Cohen et al., 2003). The six positive moods fall into three categories: vigour (lively, full of pep), well-being (happy, cheerful) and calm (at ease, calm). The negative moods also fall into three categories: depression (sad, unhappy), anxiety (on edge, tense) and hostility (hostile, angry). Each mood is rated on a 5-point Likert-type scale and the ratings of the positive and negative moods are summed to form positive emotional style and negative emotional style scores. Scores range between 0 and 30 for each subscale, with higher scores representing greater positive or negative emotional style.

The measure was originally designed to test the hypothesis that the extent to which an individual experiences negative emotion contributes to their morbidity (Watson, 1988; Watson & Pennebaker, 1989), and that positive emotion promotes better health through enhancing positive health behaviours and influencing biological stress systems (Cohen et al., 2003). It has been used to show positive mood is related to cardiac reactivity (Bostock, Hamer, Wawrzyniak, Mitchell, & Steptoe, 2011), and shown good internal reliability (Cohen, Alper, Doyle, Treanor, & Turner, 2006).

The risk of using both a negative and a positive mood scale is the possibility that a low score on one is equivalent to a high score on the other, so low negative mood may not be distinguishable from high positive mood. For this reason, for this study, a balanced mood score was created, by subtracting negative mood scores from positive mood scores to give an overall mood score. Scores falling at 0 or below represented a mood level that is predominantly negative and the reverse for scores above 0, and this cut-off was used for descriptive purposes.

4.8.3 Physical health variables

Physical recovery, illness severity, comorbidity and features of the surgery were determined from a combination of self-report measures of physical health, and objective clinical data obtained from hospital records, in order to achieve an understanding of recovery from both the patient's own perspective and objectively.

Self-report data

Self-reported physical health was measured in a general sense as a score of physical health status (over the past four weeks), and more specifically as the severity of symptoms related to CABG surgery in particular (since the surgery), and as the occurrence and treatment of angina symptoms (over the past two weeks). Self-reported comorbidity was also measured as an indicator of the patients' non-cardiac physical health.

Health status

Health-related quality of life or health status, was measured using the SF-12 health assessment instrument (SF-12) (Ware et al., 1996). This shortened version of the Medical Outcome Short Form 36 (Ware & Sherbourne, 1992), which was originally developed to assess general health concepts, not specific to a particular age or illness, reproduces its 8 subscale format, measuring functional health, well-being and an evaluation of overall health. Two scores are derived from two summary components: a Physical Component Score and Mental Component Score which indicate how health affects physical and mental quality of life. These are formed by averaging the scores for the subscales which make up the component scores: physical health status (physical functioning, role limitations resulting from physical problems, pain and general physical health perception) and mental health status (social functioning, role limitations as a result of emotional problems, vitality and general mental health perception). The composite scores can range from 0 to 100, with a normative value of 50, and scores above 50 indicate better physical or mental health-related quality of life (Ware et al., 1996). The physical subscale only was used as a continuous variable, and for descriptive purposes a cut-off of <50 was used to indicate poor physical health.

The measure has been shown to have strong reliability and validity, and to be a viable alternative to the frequently used SF-36, with high reliability between the scores of the two versions (Ware et al., 1996). It has been identified as being more sensitive to improvements to quality of life after CABG surgery than other measures (H. J. Smith, Taylor, & Mitchell, 2000) and to predict 6-month mortality (Rumsfeld et al., 1999). In this shorter form, it is suitable for self-completion and in studies with constraints on questionnaire length. The SF-12 is a well-established measure of health related quality of life and has been used extensively, including in cardiac populations (Melville, Lari, Brown, Young, & Gray, 2003; Müller-Nordhorn, Roll, & Willich, 2004), as well as recently in CABG patients (Sen et al., 2012).

Surgery symptoms

Symptoms after surgery were measured with the Coronary Revascularisation Outcome Questionnaire (CROQ) (Schroter & Lamping, 2004). The full measure contains six subscales assessing symptoms, physical functioning, psychosocial functioning, cognitive functioning, satisfaction with the procedure and adverse effects. In this study, participants completed the 11-item adverse effects subscale, rating on a Likert-type scale the extent to which 11 possible adverse outcomes from the surgery, such as pain or infection in their wounds, have bothered them since their surgery. Possible scores ranged from 0 to 44 with higher scores indicating more adverse effects of surgery, and were used to form a continuous variable.

The CROQ was developed in the absence of a validated instrument designed specifically for measuring health outcomes and quality of life after coronary revascularisation, and is applicable to CABG and PCI. It has been shown to satisfy psychometric criteria of reliability and construct and content validity (Schroter & Lamping, 2004) and is sensitive to change; more so than generic quality of life measures (Schroter, 2006).

Angina symptoms

Angina symptoms were measured using an adapted 3-item version of the angina frequency subscale of the Seattle Angina Questionnaire (SAQ) (Spertus et al., 1995), which assesses the frequency of symptoms and medication use, and is adapted from work by Peduzzi and Hultgren (1979). Possible scores range from 0 to 15 with higher scores representing more severe angina symptoms, and were used to form a continuous variable.

The SAQ was developed to be a disease-specific functional status measure that assesses both the physical and emotional effects of coronary artery disease, and is one of the most commonly used measures for angina patients (Garratt, Hutchinson, & Russell, 2001). It has been validated for use in the UK general patient population (Garratt et al., 2001), and demonstrates satisfactory validity, reliability and responsiveness. Through being specific to coronary artery disease it is suitable for use in patients with more than one illness, compared to a non-disease-specific measure of quality of life.

Chronic conditions

As part of a larger section in the questionnaire regarding health service use, this measure asked the participant to list any longstanding illness, diseases or medical conditions other than their heart problem, for which they had sought treatment in the last 12 months (or new conditions since their surgery). From the list of conditions ranging from 0 to 6 per patient, 8 categories of chronic conditions were selected. Examples are presented in Table 4-4. Combined with information on the presence of diabetes obtained from clinical records, a summed score of the total number of conditions from a total list of 9 conditions was created.

Table 4-4 Patient self-reported chronic conditions

Condition	Includes
Cancer	Prostate, bladder, colon, breast, bowel cell carcinoma
Lung condition	Asthma, chronic obstructive pulmonary disease, bronchiectasis
Inflammatory bowel disease	Ulcerative colitis, Crohn’s disease, coeliac disease, diverticulitis
Thyroid disorder	Hypothyroidism, hyperthyroidism
Neurological disease	Parkinson’s disease, epilepsy
Osteoarthritis	Osteoarthritis
Rheumatoid arthritis	Rheumatoid arthritis
Sleep problem	Sleep apnoea, sleep disorder

Clinical data

Clinical data were obtained from patients’ hospital discharge reports, and whilst a number are encompassed within the EuroSCORE, they were included in the study separately for descriptive purposes.

Illness severity

EuroSCORE

The European System for Cardiac Operative Risk Evaluation (EuroSCORE) (Nashef et al., 1999) is a scoring system for the prediction of early mortality in cardiac surgery patients, based on objective risk factors. The risk factors are grouped into: patient related factors (e.g. over age of 60, previous cardiac surgery, chronic pulmonary disease), cardiac factors (e.g. recent MI, reduced left ventricular ejection fraction [LVEF - see below], unstable angina), and operation related factors (e.g. emergency, other than isolated coronary surgery). It may be scored either using an additive method, which can be administered with simple addition, or a more extensive logistic method requiring a computer, which was used in this study as it was available in hospital records. The resulting score is a risk score so may range from 0

– 100% risk of mortality, and in this study, scores were used as a continuous variable.

EuroSCORE has been found to have better discriminatory power to predict mortality than other widely used risk algorithms (Kurki, Järvinen, Kataja, Laurikka, & Tarkka, 2002; Nilsson, Algotsson, Höglund, Lührs, & Brandt, 2004), and has been used in a number of large scale studies to predict mortality in patients undergoing cardiac surgery (Gogbashian, Sedrakyana, & Treasure, 2004), complications and length of stay (Toumpoulis, Anagnostopoulos, Swistel, & DeRose, 2005), self-reported physical health status (El Baz et al., 2008), and has been validated for use in several countries (Nashef et al., 2002; Roques et al., 2000).

Left Ventricular Ejection Fraction

Left ventricular ejection fraction (LVEF) is the volumetric fraction of blood pumped from the left ventricle of the heart. It is calculated as the percentage of blood that is within the left ventricle before a contraction that is ejected from the left ventricle into systemic circulation via the aortic valve, and is determined from cardiac imaging, typically echocardiography. A healthy LVEF is considered one of 50% and above, and a lower LVEF is considered one of the most important indicators of prognosis after CABG (Kurki & Kataja, 1996). Scores are typically categorised into good (>50%), fair (30 – 50%) and poor (<30%), but in this study cut-off of 50% was used.

Surgical features

Features of the surgery are indicative of both the patient's illness severity and the extensiveness of the procedure, and may have implications for recovery. The number of grafts indicates the extent of the occlusion of the coronary blood vessels, and cardiopulmonary bypass has been inconsistently associated with worse surgery outcomes. The graft type was reported as a combination of six different types which are listed and defined in Table 4-5. Patients receiving grafts from any site other than the left or right internal mammary artery will have obtained a considerable wound in the leg or arm, and while not exceptional, this increases the number of sites at risk of infection and pain. Receiving valve replacement surgery in conjunction with CABG surgery was determined (yes/no), which indicates a greater illness severity, and a more complicated surgical procedure.

Table 4-5 Graft types

Graft type	Abbreviation	Definition
Pedicle left internal mammary artery	Pedicle LIMA	An in-situ stalk of the artery supplying anterior chest wall and breasts
Free left internal mammary artery	Free LIMA	A free section (not in-situ) of the artery supplying anterior chest wall and breasts (left)
Free right internal mammary artery	Free RIMA	A free section (not in-situ) of the artery supplying anterior chest wall and breasts (right)
Long saphenous vein	Long SV	The large vein of the leg and thigh
Short saphenous vein	Short SV	A large vein of the posterior leg
Radial artery	-	The main artery of the lateral aspect of the forearm

Recovery indicators

Length of stay in the intensive care unit (ICU) was one indicator of recovery, and at the study site varied according to the patient's clinical severity. 'Fast-track' patients were those with fewer risk factors who were operated upon in the morning, and transferred from the recovery ward to the surgical ward, bypassing ICU. Patients with a greater number of risk factors typically stayed in ICU for one day before being transferred to the ward. The length of stay in ICU is an indication of the patient's earliest recovery, and is determined by factors such as LVEF, cardiopulmonary bypass time (Michalopoulos et al., 1996), delayed extubation and renal problems (Wong et al., 1999). As a predictor of further recovery, extended length of stay in ICU has been associated with worse outcomes including higher complication rates, need for reoperation and mortality (Rosenfeld, Smith, Woods, & Engel, 2006). However, at the study site, patients often were transferred from ICU to a high dependency unit within the surgical recovery ward. Thus there is not a clear distinction between the care received and illness severity of patients in ICU and on the ward, and consequently length of stay in ICU was not used as the primary indicator of recovery.

Instead, total length of post-operative hospital stay was used as the measure of recovery. In recent decades, and mostly for purposes of reducing costs, the length of post-operative hospital stay, or ‘length of stay’ has reduced significantly. Many institutions apply an ‘early discharge’ protocol whereby the aim is to discharge routine CABG patients in 5 days or fewer (E. D. Peterson et al., 2002), and this is the case for the study site. Surgery on the same day as admittance, prompt transfer from intensive care, use of critical pathways, early extubation and administering of β-blockers are examples of attempts made to increase the chances of early discharge (Lazar et al., 1995; Pearson, Kleefield, Soukop, Cook, & Lee, 2001; E. D. Peterson et al., 2002).

A number of predictors of prolonged length of stay have been identified in large scale studies. These include pre-operative factors such as older age, female sex, comorbidities (Rosen et al., 1999), surgical factors such as repeat CABG, CABG plus valve surgery (Lazar et al., 1995), emergency status, and post-operative complications such as deep sternal wound infection, prolonged ventilation, stroke, renal failure and reoperation (E. D. Peterson et al., 2002). Mental health status has also been identified as a predictor (Halpin & Barnett, 2005), as has EuroSCORE which incorporates a number of these risk factors (Toumpoulis et al., 2005). Patients without pre- or post-operative risk factors have the shortest length of stay, and those with both have the longest. Those with pre-operative risk factors who do not develop post-operative risk factors will still have significantly shorter lengths of stay, and are those best to target for decreased length of stay (Lazar et al., 1995). However, it has been argued that hospital- and surgeon-specific factors and chance events are more significant determinants than pre-operative factors (E. D. Peterson et al., 2002).

Length of stay can be a useful proxy-measure for early recovery, as well as being an important indicator of longer-term recovery, as it has been found to be associated with hospital readmission for complications (Hannan, Racz, Walford, & et al., 2003) and recurrent cardiac events (Connerney et al., 2001). Length of stay complements other outcomes such as complication rates, although cut-off points are arbitrary to an extent (E. D. Peterson et al., 2002), and there may be other causes of length of stay such as bed availability or suitability of the home recovery environment. However, as an indicator of illness severity, surgical features, comorbidity, and complications it serves as a useful measure of early recovery and was used in this study as the primary outcome.

Complications

Post-surgery complications are a measure of earliest recovery, and risk factors for poorer later recovery, and prolonged length of stay. They were determined from the following three pieces of clinical information: a reported new cardiovascular accident, namely a stroke or myocardial infarction occurring whilst hospitalised; the need to return to theatre for re-operation for bleeding or tamponade (fluid accumulating in the pericardium sac containing the heart); and the need to return to ICU, reported as binary yes/no scores.

4.8.4 Support variables

In this PhD, support variables formed the major predictors of interest for outcomes from surgery. It was important that I captured the concept of support from a range of different perspectives that all illustrate the role of personal relationships for emotional and physical health. Perceived functional support was assessed in two ways: a generic social support measure was used to assess perceived support from any source giving a global social support score, while the marital functioning questionnaire aimed to focus on features of the marital relationship. However, the measures used cannot necessarily differentiate global from marital support reliably, since the global measure will have been influenced to an unknown extent by the quality of marital support. Instead, the key contribution of the marital functioning measure may be its inclusion of a scale of negative aspects of relationships. Both measures take into account aspects of emotional and practical support, ensuring that a range of ways of conceptualising social relationships is addressed, however the marital functioning measure purposefully segregates different aspects of marital functioning, allowing for investigations into the role of individual features separately. Social network was examined as an objective indication of potentially available sources of structural support, demonstrating the range of social relationships the individual has, but is not suitable for analyses of the quality of social relationships. These three measures capture conceptually separate aspects of patients' social relationships. Marital functioning was assessed over the past twelve months or since the surgery, social support and social network were not measured over a set time period.

Social support

Social support was measured using the 7-item ENRICHD Social Support Instrument (ESSI) (P. H. Mitchell et al., 2003) which assesses structural, instrumental and emotional support. The perceived availability of 6 types of support is scored on a Likert-type scale, and the final item allocates points according to marital status (4 points if married or living as married, 2 points if single). Scores may range from 8 to 34 with higher scores indicating greater social support, and were used to form a continuous variable. The measure was originally devised in order to standardise the measurement of social support in cardiac patients, but is also designed for use in patients with other chronic illness. It was selected intentionally to examine a number of aspects of perceived social support, including structural (from having a partner), instrumental (tangible help) and emotional (support) in general, but to give a global social support score, not specifically from a partner or spouse. It has been validated for use as a short measure to screen for social support, and is recommended for use in studies where a short instrument is required (P. H. Mitchell et al., 2003). Through being designed for The Enhancing Recovery in Coronary Heart Disease patients (ENRICHD) study, it has been utilised in large-scale studies linking social support to cardiac health, mortality and depression after a cardiac event (Cowan et al., 2008; P. H. Mitchell et al., 2003; Vaglio et al., 2004; Writing

Committee for the ENRICHD Investigators, 2001, 2003), and has been validated for use in patients undergoing cardiac revascularisation (Vaglio et al., 2004).

Marital functioning

Marital functioning was measured using the 15-item Close Persons Questionnaire (CPQ) (Stansfeld & Marmot, 1992) which measures 3 aspects of close relationships with the partner. Seven items are summed to form a confiding/emotional subscale, 3 items comprise the practical support subscale, and 4 items create the subscale of negative aspects of close relationships, which refer to adverse exchanges and conflict within the relationship. Scores may range from 7 to 28 for the confiding/emotional subscale, 3 to 12 for the practical subscale and 4 to 16 for the negative subscale, with higher scores indicating greater amounts of each aspect.

The measure was originally developed for the Whitehall II study, which examined the impact of psychosocial factors on health, in an attempt to establish a social support measure for use in epidemiological studies that took into account the different aspects of structure and quality of support. The original form of the measure adopts a format where the respondent lists up to four significant people from whom they receive support, in order of how close they feel to them, and completes the questionnaire for these four individuals separately. The scores for the four close persons are weighted accordingly, giving a total score for support received from all four (Fuhrer & Stansfeld, 2002). The original instrument also includes elements of measurement of social network size and diversity, making it a comprehensive measure, and has been found to have adequate reliability and validity (Stansfeld & Marmot, 1992).

In this study, participants were restricted to responding about their partner only, and individuals who were not married or cohabiting were not required to complete this measure. Consequently, though the measure was not originally devised as an instrument for marital quality, it is possible to use it to assess the quality of the relationship with one close person, and therefore is suitable as a marital functioning measure. While I am not aware of studies that have used the CPQ as a measure of marital functioning, a number of studies have administered the measure for responses regarding the closest person only (Marmot, Bosma, Hemingway, Brunner, & Stansfeld, 1997; Stansfeld et al., 1998; Stringhini et al., 2012).

The use of this measure in large scale epidemiological studies, such as the Whitehall II study enables comparisons with population norms, and also indicates its suitability for use with individuals with cardiac disease. It has been used to show associations between social support and cardiac health, in particular, negative aspects of relationships increasing the risk of incident cardiac events (De Vogli, Chandola, & Marmot, 2007). This measure was selected on the basis of its assessment of three individual types of relationship quality for use in this patient group. In this study, the three subscales were considered separately as continuous variables. In order to address hypothesis II (section 4.2), the practical support and emotional/confiding support subscales together represented ‘positive support’, while the negative marital functioning subscale represented ‘negative support’.

Social network

Social network was measured using an 11-item version of The Social Network Index (Cohen et al., 1997) which assesses the size and structure of the support network available to the individual, by recording participation in 11 types of social relationships, such as with relatives, colleagues and neighbours. One point is assigned for each relationship for which they speak either in person or on the phone at least once every two weeks, with scores ranging from 0 to 11 and higher scores indicating a larger social network. The item regarding contact with a spouse was removed from the original measure to include unmarried participants. In addition, an extra question recording an individuals’ total number of social contacts was also excluded.

The measure was developed to demonstrate links between social contacts and health, and has shown that the diversity and not just the size of the social network is important for health (Cohen et al., 1997). It differs from the frequently cited Social Network Index from Berkman and Syme (1979) which examines only four types of social relationships, and has been used in cardiac patients to predict rehabilitation attendance and quality of life after acute coronary syndrome (Molloy, Perkins-Porras, Strike, & Steptoe, 2008). However, for the most part the measure has been used in studies assessing the links between social networks and susceptibility to the common cold, as an indication of the association between social ties and the immune system. In this study, scores for this variable were used as a continuous variable.

4.8.5 Demographic variables

Information on age, gender, marital status, ethnicity, education, employment, financial status and number of people in the household were obtained from standard survey questions within the questionnaire. Participants' marital status was categorised as 'married' if they were married, living as married, divorced or widowed with a new partner, and as 'not married' if they were single, separated, divorced or widowed. 'Married' participants were asked how many years they had been with their partner. Participants' ethnicity was categorised as white, mixed, Asian, Black, Chinese or other ethnic group. For the purposes of statistical analyses, participants' ethnicity was categorised as 'white' or 'non-white'. The highest achieved education qualifications were grouped into 'none', 'lower secondary', 'higher secondary' or 'degree'. Employment was classified as 'working' if the participant was employed full- or part-time or self-employed, and as 'not working' if they were retired, disabled, a volunteer or a student.

Participants listed their occupation, their previous occupation and their partner's occupation and from this, the highest level occupation from within a participant's family was selected and classified according to The Office of National Statistics Standard Occupation Classification (SOC) 2010 index (The Office for National Statistics, 2010). This is a classification system for occupational information for the United Kingdom, which categorises occupations according to their associated skill level and skill content. The classification groups range from 1 – managers, directors and senior officials, to 9 – elementary occupations. For the purposes of statistical analyses, these 9 categories were grouped into 3 classes: high (managers, directors and senior officials; professional occupations; associate, professional and technical occupations), intermediate (administrative, secretarial occupations; skilled trade occupations), and low (caring, leisure and other service occupations; sales and customer service occupations; process, plant and machine operatives; elementary occupations).

Financial status was measured with a single-item question of the total income that the participant's household has received in the last 12 months from any source including pension, wages, savings, property and benefits (under £10 000, £10 000 - £20 000, £20 000 - £30 000, £30 000 – 40 000 or over £40 000). The number of people in the household was measured with a question of who the participant lives with, including family, friends, care home residents or alone, and how many people to create a total score including the participant.

Cronbach's alpha scores of reliability for the relevant variables are reported in Table 4-6. The alpha is a coefficient on internal consistency, and scores above .7 are generally considered acceptable. The scores for physical component score and angina symptoms are below this threshold and should be taken into consideration in the interpretation of the results.

Table 4-6 Patient Cronbach's alpha scores

Variable	Cronbach's alpha	
	T1	T2
Emotional variables		
Depression symptoms (BDI)	.82	.81
Anxiety (HADS)	.87	.87
Mood (PES/NES)		
Positive subscale	.86	.87
Negative subscale	.89	.89
Physical health variables		
Physical component score (PCS SF-12)	.68	.54
Surgery symptoms (CROQ)	-	.79
Angina symptoms (SAQ)	.64	.31
Support variables		
Social support (ESSI)	.87	.91
Marital functioning (CPQ)		
Negative marital functioning	.73	.71
Practical marital support	.78	.77
Emotional marital support	.86	.87

4.9 Data storage

The data from this study was stored securely and anonymously. Patients were allocated an identity number, and this was used for all measures. The questionnaires and other material were kept separate from consent forms and personal information forms. All data was stored in locked filing cabinets in offices with restricted access.

4.10 Statistical analyses

All data analyses were conducted using IBM SPSS Statistics 20.00 (SPSS Inc). Summary scores were created for all variables; for depression symptoms, anxiety, surgery symptoms and angina symptoms, scores were totalled. Positive and negative mood scores were summed separately and negative scores were subtracted from positive scores to create a balanced mood score. Social support scores were summed and additional points given for marital status, and marital functioning scores were summed within the individual subscales. Scores for social network were created by summing the number of items for which a score representing contact every two weeks or more frequently was given.

When a participant did not respond to all items from a measure, their scores were scaled-up. For any participants completing half or more of the items on a given measure, their scores were divided by the number of items they had completed, and multiplied by the total number of items in the scale. Any participants with fewer than half the total number of items were not included, as the scaled-up total was used in all analyses. The comorbidity variable was summed from the individual conditions. Categorical demographic data was grouped, and the occupational classification variable was created through cross-referencing the occupations of the patient and their partner from both the patient and partner questionnaires. The occupational classification of the highest ranking occupation between the patient and the partner was selected and categorised. These final variables were used in the analyses reported in Chapter 6.

Chapter 5 Partner methods

5.1 Introduction

This chapter presents the aims and hypotheses of the PhD that are based on the conclusions from Chapter 3. The Partner Adjustment and Recovery after Cardiac Surgery (PARCS) study is presented as the model upon which to investigate the hypotheses in CABG surgery partners, and its design, procedure and choice of measures are detailed. The preparation of the data for analyses is described, the findings of which are presented in Chapter 7.

5.2 Aims and hypotheses

The overall aim of this PhD was to better understand the relationship between social relationships and adjustment following cardiac surgery for both patients and their partners. This part of the PhD focuses on the role *for partners* of the quality of social relationships and providing support to the patient following CABG surgery as two potential risk factors in a proposed conceptual model of partner distress. They were tested for their influence on the partners' adjustment after surgery, defined as their emotional and physical well-being. For the partners, the overall aim involved four objectives and associated hypotheses.

Objective I: Examine the influence of the quality of various types of social relationships on partner adjustment following CABG surgery.

Hypothesis I: Social relationships measured prior to CABG surgery will predict post-surgery partner emotional and physical adjustment.

This objective and hypothesis closely matched the first objective and hypothesis for the patients. Firstly I wanted to examine whether social relationships are an important factor for partner distress during the patient's recovery. The quality of the partners' social relationships was examined prior to the patients' surgery as a potential predictor of their adjustment during the recovery period. Psychological and physical adjustment were assessed with self-report measures of emotional state and health status.

Objective II: Investigate the impact of caring for the patient following CABG surgery on partner adjustment.

Hypothesis II: The burden of caring for the patient will predict post-surgery emotional and physical adjustment.

Secondly, I wanted to evaluate whether *providing* support which in this PhD was operationalised as caregiver burden, is an important influence on partner distress. Specifically, is the change in the quantity and difficulty of caring for the patient following their surgery a risk factor for poorer partner adjustment? The individual measures of time taken and difficulty experienced with caregiving and their combined measure of overall caregiver burden were assessed before and after surgery, and the change over time was examined as a predictor of psychological and physical adjustment.

Objective III: Investigate the relationship between the quality of social relationships and the change in caregiver burden and their influence on partner adjustment.

Hypothesis III: Caregiver burden variables influence support, and support influences the impact of caregiver burden on emotional and physical adjustment following surgery.

Thirdly I wanted to investigate the relationship between the respective receiving and provision of support for partners of CABG surgery patients. This hypothesis was split into two sub-hypotheses:

> IIIa. The change in caregiver burden after surgery will predict post-surgery levels of support.
>
> IIIb. Caregiver burden is related to outcomes differently for partners with high and low social support.

The influence of caregiver burden on the quality of social relationships was tested, followed by the impact of social relationships on the association between caregiver burden and distress. The change in caregiver burden was evaluated as a predictor of changes to the quality of social relationships. Subsequently, the relationship between caregiver burden and emotional distress was examined for partners with low and high levels of support individually.

Objective IV: Compare the quality of social relationships and emotional well-being of patients and partners before and after surgery.

Hypothesis IV: Partners will experience worse levels of emotional and support variables than patients.

Finally, I wanted to investigate differences between patients and partners in terms of their levels of emotional distress after CABG surgery and their perceptions of their social relationships. I hypothesised that spousal emotional differences could coincide with differences in their perceived social relationships, on the basis of the hypothesised influence of social relationships on adjustment. Patients' and partners' emotional and support variables were compared both before and after surgery.

5.3 The Partner Adjustment and Recovery after Cardiac Surgery (PARCS) study

In order to address the aims and objectives for this part of the PhD, the Partner Adjustment and Recovery after Cardiac Surgery or 'PARCS' study was devised. The longitudinal PARCS study was carried out alongside the patient ARCS study (Chapter 4), utilising the patients' CABG surgery as a model to study the role of support and caregiving for partner well-being in the time surrounding a cardiac event. Self-report assessments were made before and at different stages of the patients' recovery after surgery allowing for investigations of change over time, taking pre-surgery levels into account as well as the patients' clinical cardiac severity. The PARCS study assessed a range of predictors and aspects of well-being including emotional, health status, support, caregiving, cognitive and health behaviour variables, and a selection were adopted to address the aims and hypotheses of this PhD.

5.4 Participants

Participants were the partners (spouse or co-habiting partner) of patients undergoing elective first-time CABG surgery at St George's Hospital, London between February 2011 and October 2012. The target population were partners of the patients recruited onto the ARCS study (Chapter 4) and were included if they were over the age of 18 assuming the primary caregiving role, and excluded if they had communication or cognitive impairments, were unable to complete the questionnaires in English, or if their corresponding patient was excluded from the ARCS study. Reasons for exclusions are depicted in Chapter 7, Figure 7-1. As partners were recruited from the corresponding patient sample, the power calculation for the ARCS study (Chapter 4, section 4.4.1) was also relevant here.

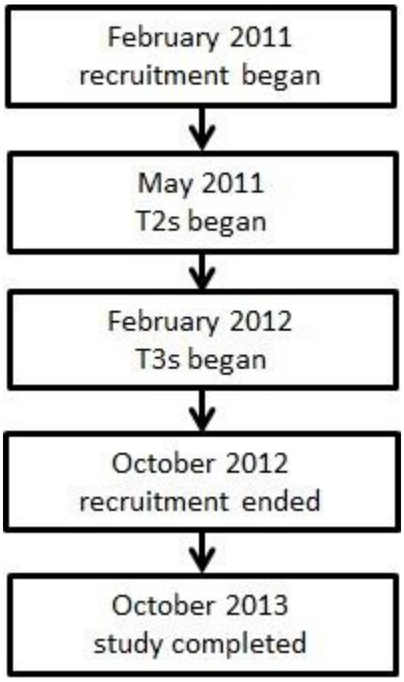
5.5 Design

The full PARCS study was a prospective, longitudinal study involving self-completion of questionnaires, and providing saliva samples at three time points: an average of 3 to 4 weeks before the patient's CABG surgery date (T1), 6 to 8 weeks after surgery (T2) and 12 months after surgery (T3), corresponding to the patient assessments. The procedure for each time point is outlined in Table 5-1 and the study time line is presented in Figure 5-1.

Table 5-1 Partner study design

	When	At home
Time 1	3 – 4 weeks before patient surgery	• Questionnaire • Saliva samples
Time 2	6 – 8 weeks after patient surgery	• Questionnaire • Saliva samples
Time 3	12 months after patient surgery	• Questionnaire • Saliva samples

Figure 5-1 Partner study time line



5.6 My contribution

The PARCS study was devised and carried out for the purposes of my PhD. I arranged for the partner study to be conducted alongside the ARCS study. I conceptualised, designed and coordinated the partner study and had full responsibility for selecting and adapting the measures, in particular the caregiving measures. Together with the other members of the research team (Chapter 4, section 4.6) I was responsible for recruitment, data collection and data entry, organising postal data collection at the second two time points and processing of saliva samples. I conducted all data analyses myself with the guidance of my supervisors.

5.7 Procedure

5.7.1 Recruitment

Participants who fit the inclusion criteria were identified at the time of the recruitment of patients onto the ARCS study. If the partner was present at the patient’s surgical pre-assessment appointment they were approached by a researcher who explained the study and provided a participant information sheet. Typically, partners were approached and informed at the same time as the ARCS patient in the waiting room prior to the patient's pre-assessment appointments, and they consented as a couple. Alternatively, when two researchers were available, the patient and partner were informed and consented separately. Consenting participants signed a consent form and were given the materials for the first assessment.

If the partner was not present at the hospital, and the patient indicated that their partner might participate, the patient was given a pack containing a letter of invitation onto the study, an information sheet, a consent form and the materials for the first assessment to take home for their partner. Patients were requested to give the pack to their partner and within approximately two days, a researcher telephoned the partner to explain the study. Partners who agreed over the telephone signed a consent form at home which was returned by post with the completed questionnaire, saliva samples and diary. All documents are presented in Appendix 2.

5.7.2 Time 1

Participants completed a self-completion questionnaire and provided saliva samples at home in the period between the patient's surgical pre-assessment appointment and surgery, and returned them by post. The questionnaire included measures of emotional distress, physical health, support, caregiving, health status, illness cognitions, health behaviours and demographics. Descriptions of how the measures differed from those in the ARCS questionnaire booklet are detailed below (section 5.8), but the given instructions were the same. Participants used the same procedure for providing saliva samples as in the ARCS study (Chapter 4, section 4.7.7).

5.7.3 Time 2

Participants followed the same procedure as Time 1 approximately 6 to 8 weeks after the patients' surgery, providing saliva samples and completing a questionnaire and returning them by post. The questionnaire was the same as at Time 1 with the exception of the exclusion of measures of demographics, health service use, health behaviours, optimism, attachment, illness beliefs and life events. An additional measure of benefit finding was included, and the procedure for providing saliva samples was the same.

5.7.4 Time 3

The procedure at approximately 12 months after the patients' surgery was the same as at Time 2, however measures of physical health, health behaviours, illness beliefs and life events were reintroduced into the questionnaire.

5.7.5 Saliva samples

The procedure for the storage, processing and analysis of the saliva samples matches that for the ARCS study (Chapter 4, section 4.7.7). No blood samples were taken from partners.

5.8 Measures

The full PARCS study utilised a large number of measures to identify a range of factors relevant to partner distress following CABG surgery, and are listed in Table 5-2. Again, a range of variables was selected for each category of outcomes, including a combination of objective and subjective measures, and validated and short form instruments were chosen where possible.

Table 5-2 Partner full study measures

	Measure			Time point		
	Full name	**Abbrv**	**Reference**	**T1**	**T2**	**T3**
Emotional variables						
Depression symptoms	Beck Depression Inventory	BDI	(Beck et al., 1988)	✓	✓	✓
Anxiety	Hospital Anxiety and Depression Scale	HADS	(Zigmond & Snaith, 1983)	✓	✓	✓
Mood	Positive Emotional Style and Negative Emotional Style questionnaire	PES/NES	(Cohen et al., 2003)	✓	✓	✓
Health status/Quality of life						
Health-related quality of life	Short Form – 12 health assessment instrument	SF-12	(Ware et al., 1996)	✓	✓	✓
Quality of life	Control, Autonomy, Self-realisation and Pleasure Questionnaire	CASP-19	(Hyde et al., 2003)	✓	✓	✓
Benefit finding	Benefit Finding Questionnaire	BFQ	(Carver & Antoni, 2004)	-	✓	✓
Optimism	Life Orientation Test	LOT	(Scheier & Carver, 1985)	✓	-	-
Life events	Multi-Ethnic Study of Atherosclerosis (MESA) Stress Supplemental Questionnaire	MESA-SSQ	(Mezuk et al., 2010)	✓	-	-
Physical health variables						

Health service use	Measures designed for this study			✓	-	✓
Sleep problems	Jenkins’ Sleep Problems Questionnaire	JSPQ	(Jenkins et al., 1988)	✓	✓	✓
Cortisol	Obtained from saliva samples			✓	✓	✓
Support variables						
Social network	The Social Network Index	SNI	(Cohen et al., 1997)	✓	✓	✓
Social support	ENRICHD Social Support Instrument	ESSI	(P. H. Mitchell et al., 2003)	✓	✓	✓
Support with recovery behaviours	Adapted from ESSI			✓	✓	✓
Marital functioning	The Close Person’s Questionnaire	CPQ	(Stansfeld & Marmot, 1992)	✓	✓	✓
Loneliness	UCLA Loneliness Scale	UCLA-LS	(Hughes et al., 2004)	✓	✓	✓
Attachment style	Adult Attachment Scale - Revised	AAS-R	(Collins & Read, 1990)	✓	-	-
Caregiver variables						
Caregiver burden	Oberst Caregiver Burden Scale	OCBS	(Oberst, Thomas, Gass, & Ward, 1989)	✓	✓	✓
Caregiving quantity	Validated caregiving scale			✓	✓	✓
Cognitive variables						
Partner illness perceptions	The Brief Illness Perceptions Questionnaire - Adapted	BIPQ	(Broadbent, Ellis, Thomas, Gamble, & Petrie, 2009)	✓	-	✓

Cardiac beliefs	The York Cardiac Beliefs Questionnaire	YCBQ	(Furze et al., 2009)	✓	-	✓
Health behaviours						
Physical activity	International Physical Activity Questionnaire	IPAQ	(Booth, 2000)	✓	-	✓
Diet	Fat Behaviour Questionnaire/validated fruit and vegetable scale	FBQ	(Cappuccio et al., 2003; www.healthy-heart.co.uk)	✓	-	✓
Alcohol	Standard survey questions			✓	-	✓
Adherence	Medication Adherence Report Scale	MARS	(Horne & Weinman, 1999)	✓	-	✓
Smoking	Standard survey questions			✓	-	✓
Demographic variables						
Demographics	Standard survey questions			✓	-	-

5.8.1 Full study vs. PhD study

Due to the extensiveness of the full PARCS study and the specificity of the aims and hypotheses of this PhD, only a part of the full procedure comprised the focus of this PhD study. Only a selection of the questionnaire data from only two time points were used (T1 and T2), and all data from saliva samples were excluded. The measures used in this PhD are listed in Table 5-3, followed by a description of the measures not previously described in Chapter 4.

Table 5-3 PhD partner study measures

Variable	Measure	Time	
		T1	T2
Emotional variables			
Depression symptoms	BDI	✓	✓
Anxiety	HADS	✓	✓
Mood	PES/NES	✓	✓
Physical health variables			
Physical component score	PCS (from SF-12)	✓	✓
Health service use	Measure designed for study	✓	-
Support variables			
Social support	ESSI	✓	✓
Marital functioning	CPQ	✓	✓
Social network	SNI	✓	✓
Caregiver variables			
Caregiver burden	OCBS	✓	✓
Caregiving quantity	Validated caregiving quantity scale	✓	✓
Patient clinical variables			
EuroSCORE, LVEF, number of grafts, conduit location, valve surgery, cardiopulmonary bypass, ICU stay, length of stay, return to theatre, return to ICU, cardiovascular accident	Clinical notes	-	✓
Demographic variables			
Age, sex, ethnicity, education, employment, income, marital years, household size	General survey questions	✓	-
Occupational classification	The Office of National Statistics Standard Occupation Classification (SOC) 2010 index (The Office for National Statistics, 2010)	✓	-

5.8.2 Emotional variables

The emotional variables depression symptoms, anxiety and mood were assessed using the same measures as in the ARCS study (Chapter 4, section 4.8.2). The same established cut-offs for depression symptoms and anxiety were used, and the net mood variable was created in the same way. These three constructs were selected in order to capture a range of distinct aspects of emotional distress that could be relevant for CABG partners. The measures of depression symptoms and anxiety have been used in studies of caregivers of patients from a variety of patient groups, including those undergoing cardiac surgery, revealing worse emotional distress in partners than patients (Young et al., 2005) and linking distress to caregiving (Pinquart & Sorensen, 2003) and marital functioning (Morris, Morris, & Britton, 1988).

5.8.3 Physical health variables

The physical health of the partners was determined through self-report measures of health status (from the physical component score of the SF-12 (Chapter 4, section 4.8.3) and health service use. Health service use, including chronic conditions, measured at baseline only was used to describe the presence of illness in the partners. Physical component score was measured both before and after surgery to indicate changes to self-reported physical health status over time. Once again, the potential for overlap between the mental component score and the other emotional variables led to the exclusion of this subscale from analyses. Again, for descriptive purposes a cut-off of <50 was used to indicate poor physical health. The SF-12, and specifically the physical component score has been used in studies of caregivers, including of heart failure patients (Mårtensson, Dracup, Canary, & Fridlund, 2003) and CABG patients (Halm et al., 2007).

Health service use was measured separately as the number of GP visits and hospital visits in the past 12 months. The number of visits was categorised into: 1 to 5, 6 to 10, 11 to 15 and more than 15 times, and for descriptive purposes the last two categories were collapsed into one of 11 or more visits. Chronic conditions were measured, categorised and summed in the same way as for the patients, though the categories varied and are listed in Table 5-4.

Table 5-4 Partner self-reported chronic conditions

Condition	Includes
Cancer	Chronic myeloid leukaemia, skin cancer
Lung condition	Asthma, chronic obstructive pulmonary disease
Thyroid disorder	Hypothyroidism, hyperparathyroidism
Neurological disease	Parkinson's disease
Osteoarthritis	Osteoarthritis
Cardiac condition	Hypertrophic cardiomyopathy, heart condition, arrhythmia
Multiple sclerosis	Multiple sclerosis

5.8.4 Support variables

In fitting with the overall aim of this PhD, support variables were one of the key factors of interest for predicting partner distress following the patient's surgery. The same measures were adopted as in the ARCS study (Chapter 4, section 4.8.4) including general social support, specific marital functioning and structural social network accounting for conceptually separate aspects of partners' social relationships. Social support and the marital functioning subscales were examined for their predictive role for emotional and physical outcomes following surgery, however social network was used primarily for descriptive purposes as it did not capture the quality of social relationships. The social support measure has been used previously in studies of caregivers (Choi-Kwon et al., 2009) and in cardiac partners in particular (Aggarwal, Liao, Christian, & Mosca, 2009). The marital functioning and social network scales have been used in non-clinical adult samples and therefore are suitable for use in this study.

5.8.5 Caregiver variables

Caregiver variables were the second set of key variables of interest, and were used to identify the extent to which partners of CABG patients spend time and experience difficulty with caring for the patient, and whether this is important for adjustment. The change in the amount of caregiving time and difficulty was examined as a predictor of the partner's emotional and physical outcomes after surgery. These caregiving factors were termed 'caregiver burden' within this PhD. As well as a potential risk factor for distress, measuring caregiver burden linked the partners' distress to the fact that their spouse was undergoing CABG surgery. Measures of caregiver burden were used to indicate whether they were playing a caregiving role to the patient specifically as a result of this event. I wanted to investigate whether caregiver burden was a relevant feature for partners of patients during recovery from CABG surgery which is typically short-term, as opposed to partners providing long-term care for patients with chronic illness. Caregiver burden was measured formally with an instrument considering the time and difficulty associated with caregiving tasks, and also descriptively with a record of hours providing care to particular individuals, to obtain both subjective and objective indicators of caregiving. Before surgery no time scales were specified, but after surgery measures referred to the time since the surgery.

Caregiver burden

Caregiver burden was measured with the 15-item Oberst Caregiver Burden Scale (OCBS) (Oberst et al., 1989). It was designed to measure the physical demand and emotional difficulty involved with informally caring for an ill person living at home. The 15 items load onto three factors: direct caregiving tasks, instrumental care tasks, and interpersonal caregiving tasks (Harkness & Tranmer, 2007). Participants rated on Likert-type scales the amount of time they generally spend performing each task, and the emotional difficulty associated with doing each task. These formed 'time' and 'difficulty' burden subscales, which could also be considered as separate objective and subjective measures of burden. The scores for each subscale ranged from 15 to 75, with higher scores depicting greater time or difficulty burden. A total burden score was obtained by calculating the square root of the product of the two subscales, which also could range from 15 to 75. The recommended cut-off of a mean rating of ≥3 on either subscale was used to indicate moderate time or difficulty burden.

The measure was formed on the basis of theoretical concepts of stress and coping (D. W. Scott, Oberst, & Dropkin, 1980), whereby partners' cognitive and emotional appraisals of giving care, whether positive or negative, may impact their quality of life (Halm et al., 2006). It was adapted from the earlier Caregiving Load Scale which was found to link caregiver load to negative appraisals of the illness-caregiving situation (Oberst et al., 1989).

The measure has been validated for use in cardiac surgery partners, showing good psychometric properties (Stolarik et al., 2000). It has been used almost exclusively in partners of patients undergoing CABG surgery (Halm & Bakas, 2007; Halm et al., 2006; Halm et al., 2007; Riegel et al., 1996), showing that caregiver burden is related to health related quality of life and the health status of the patient (Halm et al., 2006). It has also been used in heart failure (Chung et al., 2010; Pressler et al., 2009) and stroke (Bakas, Austin, Jessup, Williams, & Oberst, 2004) partners. It is suitable for use in partners of cardiac patients as it assesses the burden related to everyday instrumental and personal activities, which are necessary for the self-management of cardiac illness, covering a wide range of practical and personal tasks. It also makes the important distinction that appraising a task as time-consuming does not necessarily signify that it is considered difficult.

Caregiving quantity

Participants were asked how many hours in an average week they give care to their partner, whether they give care to children, grandchildren, parents, relatives or friends, and for how many hours a week. This provided three scores: number of hours of partner support and total hours of support, and a score for whether they give care to anyone aside from their partner to indicate their status as an informal caregiver in general. The variables for partner and total support were categorised into groups by number of hours.

5.8.6 Patient clinical variables

Clinical data obtained from hospital notes were used as an indication of the patients' clinical severity and features of their recovery. A combination of clinical cardiac illness severity, surgery features, post-operative complications and recovery indicators were described to implicate the extent to which the patients were in need of care, and described in detail in Chapter 4 (section 4.8.3). Clinical cardiac severity was determined from EuroSCORE and left ventricular ejection fraction which are predictors of prognosis following cardiac surgery. Features of the surgery included the number of grafts, graft types and whether or not the patient underwent cardiopulmonary bypass and valve surgery. These are indicators of the extent of the procedure, the number of wounds the patient will have received, and have implications for recovery. Post-operative complications included return to theatre, return to the intensive care unit (ICU) and a reported new cardiovascular accident. They are indicators of poor early recovery and have implications for worse later recovery. Recovery indicators were length of stay in ICU and length of post-operative hospital stay, and are predictors of later recovery. EuroSCORE combines a number of factors of clinical severity and therefore was selected as the primary measure of the patient's illness severity.

5.8.7 Demographic variables

Demographic information was obtained in order to describe the study sample and to enable the identification and inclusion of covariates for analyses. Information on age, gender, marital status, ethnicity, education, employment and number of people in the household were obtained and recorded in the same way as in the ARCS study. All participants were categorised as 'married' by the nature of their inclusion in the study, and household income was obtained from the corresponding patient's questionnaire. Occupational classification was derived the same way for partners as it was for the patients.

Cronbach's alpha scores of reliability for the relevant variables are reported in Table 5-5. The alpha is a coefficient of internal consistency, and scores above .7 are generally considered acceptable. The scores for negative marital functioning at T1 and practical marital support at T3 were below this threshold and should be taken into consideration in the interpretation of the results.

Table 5-5 Partner Cronbach's alpha scores

Variable	Cronbach's alpha	
	T1	T2
Emotional variables		
Depression symptoms (BDI)	.83	.82
Anxiety (HADS)	.87	.77
Mood (PES/NES)		
Positive subscale	.89	.86
Negative subscale	.85	.92
Physical health variables		
Physical component score (PCS SF-12)	.70	.73
Support variables		
Social support (ESSI)	.85	.88
Marital functioning (CPQ)		
Negative marital functioning	.65	.72
Practical marital support	.70	.62
Emotional marital support	.88	.83
Caregiving variables		
Caregiver burden		
Time burden	.89	.91
Difficulty burden	.91	.94

5.9 Data storage

The data from this study were stored securely and anonymously. Partners were allocated an identity number that corresponded to the patient, and this was used for all measures. The questionnaires and other material were kept separate from consent forms and personal information forms. All data were stored in locked filing cabinets in offices with restricted access.

5.10 Statistical analyses

All data analyses were conducted using IBM SPSS Statistics 20.00 (SPSS Inc). Summary scores were created for all variables in the same way as in the ARCS study, and caregiver burden scores were created using the method outlined in section 5.8.5. Scores were scaled up using the same method as for the patients. These final variables were used in the analyses reported in Chapter 7.

Chapter 6 Patient results

6.1 Introduction

In this chapter, I report the findings from the analyses of the patient data. In order to complete the overall aim of better understanding the relationship between social relationships and adjustment following cardiac surgery, support variables were considered predictors, and emotional and physical variables were considered outcomes. The hypotheses being examined in the patient sample were the following:

I. Social relationships measured prior to CABG surgery will predict post-surgery emotional and physical health.

Support variables included general social support and specific marital functioning in terms of negative marital functioning, practical marital support and emotional marital support. The post-surgery outcomes included both emotional and physical outcomes. The emotional outcomes of interest were depression symptoms, anxiety and mood, and the physical outcomes were physical health status and length of post-operative hospital stay. This hypothesis was tested through multivariate analyses predicting the emotional and physical outcomes individually. The support variables were entered into multiple regression models predicting emotional and physical outcomes. Covariates were selected on the basis of previous literature and included the demographic variables age, sex, ethnicity and a sociodemographic variable of occupational classification, as these have been identified as relevant to the study variables, as well as a risk score for early mortality (EuroSCORE) to account for clinical severity. Pre-surgery baseline levels of the outcome variable were also included in all models (with the exception of length of stay as this variable does not have more than one data point) in order that models both controlled for pre-surgery levels of the outcome, but also predicted the change in this variable over time from before to after surgery. Consequently, models explained the changes that occurred in emotional and physical health following CABG surgery. This hypothesis will be confirmed if social support or marital functioning subscales are significant independent predictors of emotional or physical outcomes after controlling for covariates.

II. Negative aspects of social relationships are distinct from positive aspects in terms of their role in explaining surgery outcomes

The distinction between negative and positive aspects of the marital relationship was based on the three subscales of the marital functioning measure. Scores from the negative marital functioning subscale represented the negative aspects, and the practical and emotional support scales comprised positive support. This hypothesis was tested with multiple regression models in which scores from all three marital functioning subscales were entered simultaneously, in order to examine the impact of each subscale whilst taking into account the others. This hypothesis will be fulfilled if any of the marital functioning subscales is identified as being a significant predictor of emotional or physical outcomes while the other subscales are present in the model. If negative marital functioning is significant even with positive subscales present in the model then it demonstrates that negative aspects of relationship are important for outcomes regardless of positive aspects; and vice versa if positive aspects are significant predictors.

III. The marital relationship is distinct from global social support in terms of its role in explaining surgery outcomes.

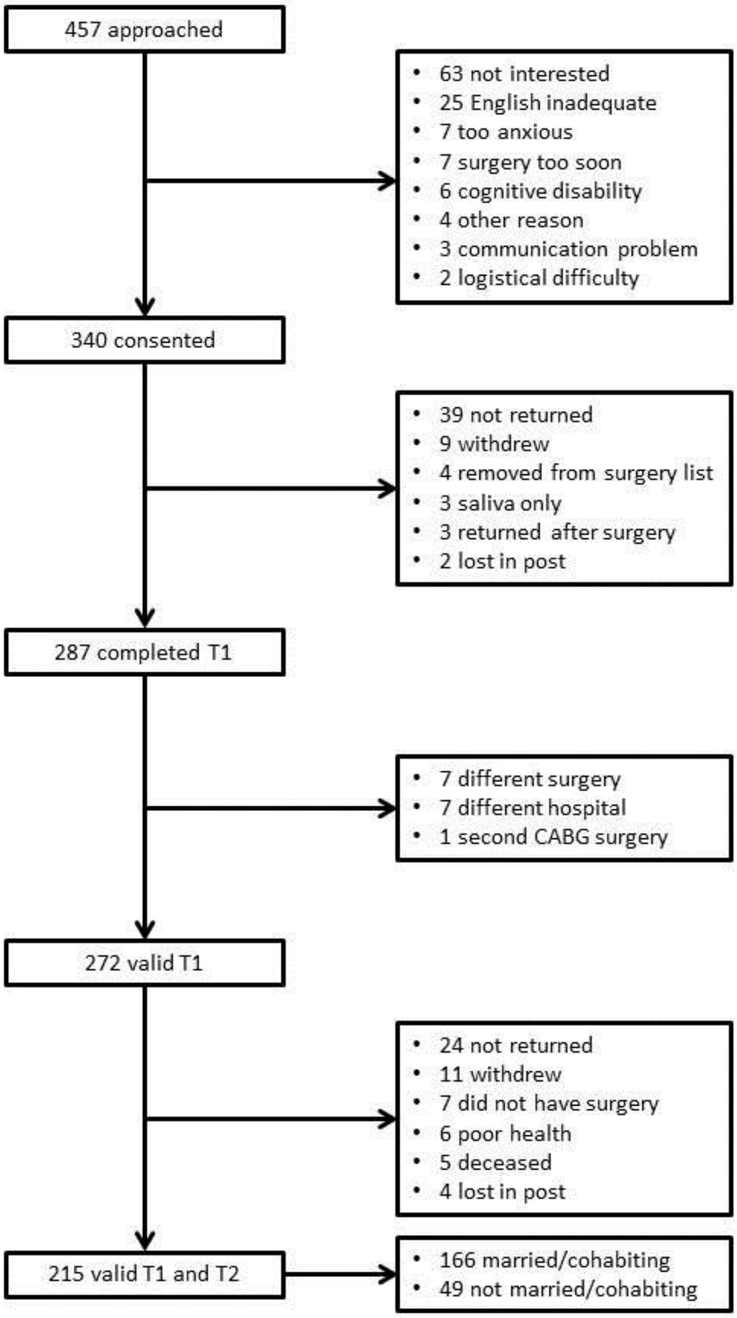
This hypothesis was examined using multiple regression models in which both marital functioning and general social support scales were entered. For any variables that marital functioning was identified as being a significant predictor, social support was entered as an additional variable. This hypothesis will be confirmed if marital functioning remains a significant predictor with the introduction of social support into the model, and signifies that marital functioning is a predictor of outcomes even when taking levels of general social support into account.

The chapter begins with a description of the sample of patients who provided data before surgery (T1) and approximately 8 weeks after surgery (T2). Data for married and unmarried participants were compared, and the finding that levels of general social support were significantly higher in married than unmarried participants led to the decision to perform multivariate analyses on only married participants. From this point only the married sample was used. Scores at both time points were compared and support variables were used as independent variables in multiple regression models predicting emotional and physical outcomes of surgery. Findings are followed by a results summary and discussion in relation to the existing literature and hypotheses.

6.2 Recruitment and response rate

457 patients were approached in the outpatients department, and 340 (74.4%) were recruited onto the study. Of these, 287 (84.4%) completed baseline data and returned their T1 questionnaire, and a further 15 participants were excluded on the basis of exclusion criteria. This left 272 (94.7%) eligible participants with valid baseline data, and of these, 215 (79%) also provided data at T2 and were included in the main prospective analysis. The following flow-diagram depicts the recruitment and retention in the study, and includes all reasons for exclusions and drop-outs (Figure 6-1).

Figure 6-1 Patient recruitment and retention



6.3 Descriptive statistics

Data for all married and unmarried participants who completed baseline and T2 assessments were compared using t-tests for continuous variables and chi-squared tests for categorical variables. Demographic characteristics are presented in Table 6-1. The mean age of the whole sample was 68.46 years (standard deviation [SD] 8.72) and ranged from 44 to 90 years. The large majority of the sample were men (86.5%) and married participants were more likely to be men than unmarried participants (p <.001). Across the whole sample, the large majority of participants were white, and approximately 70% were educated to secondary level or higher. Around two thirds were not in employment, and were classified as within a family of a high occupational classification. Married participants were significantly more likely to have an annual household income of over £20 000 (p <.001), and two thirds had been in a relationship with their partner for over 42 years. Almost three-quarters of the unmarried participants lived alone; the remainder living with children (8), other relatives (4), friends (1), other carehome residents (1) or other members of their religious community (1). The number in the household ranged from 1 to 5 in unmarried and from 2 to 7 in the married participants. The large majority of married participants lived in a household of two, and married participants were more likely to live in a significantly larger household than unmarried participants (p <.001).

Table 6-1 Demographic characteristics for whole patient sample

		Married N = 166			Unmarried N = 49		
		Mean (SD)	**N (%)**	**Range**	**Mean (SD)**	**N (%)**	**Range**
Demographic variables							
Age*		68.25 (8.38)		44 – 90	69.14 (9.83)		48 - 88
Sex*	Men		152 (91.6)			34 (69.4)	
	Women		14 (8.4)			15 (30.6)	
Ethnicity	White		143 (86.1)			46 (93.9)	
	Not white		23 (13.9)			3 (6.1)	
Education	None		47 (30.7)			15 (31.3)	
	Secondary		66 (43.1)			21 (43.8)	
	Higher		23 (15)			8 (16.7)	
	Degree		17 (11.1)			4 (8.3)	
Employment	Employed		55 (33.3)			11 (22.9)	
	Not employed		110 (66.7)			37 (77.1)	
Occupation classification	High		107 (65.6)			22 (53.7)	
	Intermediate		33 (20.2)			9 (22)	
	Low		23 (14.1)			10 (24.4)	
Income*	Up to £20 000		50 (35.2)			34 (81)	
	Over £20 000		92 (64.8)			8 (19)	
Marital years	Up to 41 years		71 (34.4)			-	
	42 years +		141 (65.6)			-	
Total number* in household	1		0 (0)			33 (70.2)	
	2		135 (82.8)			10 (21.3)	
	≥3		28 (17.2)			4 (8.5)	

* Significantly different at the <0.05 level

Clinical characteristics are presented in Table 6-2. Mean EuroSCORE was low and negatively skewed, and unmarried participants had a significantly higher risk of early mortality than married participants (p = .001). The number of coronary bypass grafts ranged from 1 to 6, and the majority had a graft type of a combination of a pedicle left internal mammary artery (LIMA) and long saphenous vein (SV). Only 11 participants received pedicle LIMA alone, so the majority obtained a leg or arm wound in addition to their chest wound. Approximately a quarter of the sample did not undergo cardiopulmonary bypass (i.e. off-pump) and also underwent valve surgery. The length of time in ICU ranged from 0 to 11 days, and length of post-operative hospital stay ranged from 4 to 66 days, with married participants experiencing a non-significantly shorter mean length of stay than unmarried (p = .055). The majority of participants had a good left ventricular ejection fraction (LVEF) (>50%).

The occurrence of complications (Table 6-3) was relatively low, with a total of only 5 of the whole sample returning to theatre for re-operation for bleeding or tamponade, only 3 returning to ICU after discharge to the ward, and no reported new cardiovascular accidents. Consequently, length of stay was a more suitable choice of outcome variable than complications. The incidence of comorbidity was low, with two thirds suffering from no additional chronic conditions, with the exception of diabetes which was present in a quarter of the whole sample.

Table 6-2 Clinical characteristics of whole patient sample

		Married N = 166			Unmarried N = 49		
		Mean (SD)	**N (%)**	**Range**	**Mean (SD)**	**N (%)**	**Range**
Clinical characteristics							
EuroSCORE*		4.10 (2.60)		1.51 – 14.61	5.70 (3.91)		1.51 – 14.24
Number of grafts	1		20 (12)			6 (12.2)	
	2		33 (19.9)			14 (28.6)	
	3		54 (32.5)			21 (42.9)	
	4		45 (27.1)			8 (16.3)	
	5		13 (7.8)			0 (0)	
	6		1 (.6)			0 (0)	
Graft type	Pedicle LIMA		10 (6)			1 (2.1)	
	Pedicle LIMA + long SV		103 (62)			35 (72.9)	
	Pedicle LIMA, long SV + radial artery		17 (10.2)			2 (4.2)	
	Long SV		16 (9.6)			9 (18.8)	
	Pedicle LIMA + radial artery		10 (6)			1 (2.1)	
	Other		10 (6)			0 (0)	
Cardiopulmonary bypass	Yes		123 (74.1)			48 (98)	
	No		43 (25.9)			1 (2)	
Valve surgery	Yes		33 (19.9)			16 (32.7)	
	No		133 (80.1)			33 (67.3)	
ICU stay		1.23 (1.52)		0 – 11	1.16 (1.23)		0 – 6
Length of stay		6.84 (3.75)		4 – 34	8.51 (8.81)		4 – 66
LVEF	Good (≥50%)		143 (86.1)			46 (93.9)	
	Poor - fair (<50%)		23 (13.9)			3 (6.1)	

* Significantly different at the <0.05 level

List of abbreviations: intensive care unit (ICU), left internal mammary artery (LIMA), left ventricular ejection fraction (LVEF), right internal mammary artery (RIMA), saphenous vein (SV)

Table 6-3 Complications and comorbidity for whole patient sample

		Married N = 166	Unmarried N = 49
Complications			
Return to theatre	Re-operation for bleeding or tamponade	4 (2.4)	1 (2)
	No	162 (97.6)	48 (98)
Return to ICU	Yes	3 (1.8)	0 (0)
	No	163 (98.2)	49 (100)
Cardiovascular accident	None	166 (100)	49 (100)
Comorbidity			
Self-reported	Cancer	6 (3.6)	3 (6.1)
	Lung condition	4 (2.4)	3 (6.1)
	Thyroid condition	5 (3)	3 (4.1)
	IBD	3 (1.8)	1 (2)
	Neurological disease	1 (.6)	0 (0)
	OA	9 (5.4)	5 (10.2)
	RA	1 (.6)	1 (2)
	Sleep problem	2 (1.2)	0 (0)
Hospital notes	Diabetes	36 (21.7)	13 (26.5)
Number of chronic conditions	0	110 (66.3)	28 (57.1)
	1	48 (28.9)	15 (30.6)
	2	7 (4.2)	5 (10.2)
	3	1 (.6)	0 (0)
	4	0 (0)	1 (2)

* Significantly different at the <0.05 level

List of abbreviations: inflammatory bowel disease (IBD), osteoarthritis (OA), rheumatoid arthritis (RA)

6.4 Baseline measures in married vs. unmarried

Baseline scores for emotional, physical and support variables for married and unmarried participants are presented in Table 6-4. Pre-surgery levels of depression symptoms and anxiety were moderately elevated and negatively skewed, with approximately one quarter of the whole sample crossing the thresholds for moderate depression symptoms (26.3%) and anxiety (23.9%), and mood scores were high, with 80.2% positive scores. Married participants had more favourable baseline levels of all emotional variables than unmarried, but not significantly so ($p > .05$). Physical component scores were low, with 79% below the threshold of good physical health status and levels of angina symptoms were moderate. For all physical variables, married participants once again presented more favourable levels than unmarried, though only EuroSCORE differed significantly ($p = .001$). The size of the participants' social networks were relatively small, with a mean of only 4 types of personal relationships with contact every two weeks or more across the whole sample, and 66.5% of the sample with fewer than 5 contacts. Married participants experienced relatively low levels of negative marital support, and high levels of practical and emotional support. Negative marital functioning was negatively skewed and emotional marital functioning and social support were positively skewed. Married participants had a marginally larger social network, but not significantly ($p = .169$). However, levels of social support were significantly higher in the married participants ($p < .001$).[3]

These comparisons between married and unmarried patients were included to investigate any meaningful differences that occur on the basis of marital status. However, the quality and not the presence of relationships (e.g. marriage) was the primary focus for this PhD. In order to remove the possible effects of marital status, and to test the conceptual distinctions between global and marital support in a

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[3] ESSI scores were recalculated for this analysis to exclude the item awarding points for marital status. All further analyses used the full score to allow comparisons with other studies.

sample in which both occur, unmarried participants were excluded from further analyses.

Table 6-4 Baseline variables for whole patient sample

	Married			Unmarried			P-value
	Mean (SD)	**Range**	**N**	**Mean (SD)**	**Range**	**N**	
Emotional variables							
Depression	7.80 (5.72)	0 – 30	164	9.37 (6.14)	0 – 33	49	.098
Anxiety	5.63 (4.08)	0 – 18	164	6.07 (4.33)	0 – 16	49	.514
Mood	9.76 (10.19)	-23 – 30	164	6.82 (10.38)	-21 – 30	48	.081
Physical variables							
Physical component score	39.90 (10.94)	14.66 – 58.67	166	38.02 (10.47)	21.73 – 59.10	49	.285
Angina symptoms	4.22 (3.11)	0 – 11	131	5.10 (3.25)	1 – 12	36	.140
EuroSCORE	4.10 (2.60)	1.51 – 14.61	166	5.70 (3.91)	1.51 – 14.24	49	**.001**
Support variables							
Social support	26.65 (3.94)	13 – 30	164	20.44 (5.87)	8 – 30	48	**<.001**
Marital functioning							
Negative support	6.29 (2.24)	4 – 14	165	-	-	-	-
Practical support	8.51 (2.43)	3 – 12	165	-	-	-	-
Emotional support	22.76 (3.99)	9 – 28	164	-	-	-	-
Social network	4.10 (1.49)	1 – 8.8	164	3.77 (1.41)	1 – 7	48	.169

6.5 Attrition analyses

Of the 206 married participants who completed the baseline questionnaire, 166 (83%) provided data at T2. The reasons for drop outs are listed in Table 6-5. Participants who completed both time points were compared to those who did not complete the T2 assessment for all baseline variables, using t-tests for continuous variables and chi squared tests for categorical variables. There were no differences for the demographic variables age, sex, education, ethnicity, employment or occupational classification (p >.05). There were no significant differences for baseline emotional variables, depression symptoms, anxiety or mood, for physical variables, physical component score or angina symptoms, or for the support variables, social support, marital functioning and social network (p >.05). For clinical variables, there were no differences for EuroSCORE or LVEF (p >.05).

Table 6-5 Reasons for patient drop outs

Reasons for drop outs (N = 40)	Pre-surgery	Post-surgery	%
Deceased	3	1	10
Removed from surgery list	3	-	7.5
Withdrawn	2	11	32.5
Lost questionnaire	-	5	12.5
Health problems	-	7	17.5
Questionnaire not completed	-	8	20

6.6 Descriptive statistics and changes over time

T1 occurred a mean 28 days before surgery and T2 was a mean 2 months (62 days) after surgery. Baseline and follow-up scores for the emotional, physical and support variables are presented in Table 6-6. Where relevant, baseline and follow-up scores were compared using paired t-tests, and p-values are presented in the table. T-tests revealed that pre-surgery elevated levels of anxiety and depression symptoms significantly reduced at T2 and mood significantly improved. Physical component scores significantly worsened, reflecting poorer function during the period of convalescence following surgery. Angina symptoms significantly decreased, however pre-surgery angina symptoms were reported by only a proportion of participants (79%), and by only 78 participants (47%) after surgery. Though reflective of the success of the surgery for reducing angina symptoms, this relatively small subsample of participants providing angina symptom data would reduce the number of cases included in the final regression model and could lead to failure to detect significant relationships. For these reasons together with the very low reliability of this scale (Table 4-6), angina symptoms will not be included in further analyses. A low to moderate level of surgery symptoms, such as pain, bruising and infection in surgical wounds were reported. However, as this measure is relevant only to post-surgery outcomes and was introduced at T2 only, it is difficult to know whether responses were influenced by a response bias which could otherwise be controlled for with a baseline measure. Consequently, this variable will also be excluded from further analyses.

Mean levels of social support were high in this married sample, with 25% of the sample giving the highest score (i.e. 34). Scores significantly increased following surgery, indicating an increase in the support perceived by patients to be provided to them during their recovery. Relatively low levels of negative marital functioning decreased after surgery, and high levels of practical support increased, indicating improvements to the marital relationship following surgery. The high levels of emotional support remained stable over time, however the support measures all showed marked variability, with some patients reporting very low levels. Social network scores indicated a mean of only 4 relationships with regular contact. As it was measured only at baseline, and is reflective of the diversity of social relationships rather than perceived social support, it will not be used in further analyses.

Table 6-6 Changes to patient emotional/physical/support variables over time

	Time 1			Time 2			P-value
	Mean (SD)	**Range**	**N**	**Mean (SD)**	**Range**	**N**	
Emotional variables							
Depression	7.80 (5.72)	0 – 30	164	6.51 (5.49)	0 – 31.50	165	**<.001**
Anxiety	5.63 (4.08)	0 – 18	164	3.71 (3.56)	0 – 16	166	**<.001**
Mood	9.76 (10.19)	-23 – 30	164	13.73 (9.84)	-18 – 30	164	**<.001**
Physical variables							
Physical component score	39.90 (10.94)	14.66 – 58.67	166	35.84 (8.68)	18.77 – 55.92	166	**.029**
Angina symptoms	4.29 (3.17)		131	1.26		78	**<.001**
Surgery symptoms	-	-	-	15.21 (8.02)	0 – 35	162	-
EuroSCORE	4.10 (2.60)	1.51 – 12.61	166	-	-	-	-
Support variables							
Social support	30.65 (3.94)	17 – 34	164	31.34 (3.76)	14 – 34	161	**.011**
Marital functioning							
Negative support	6.29 (2.24)	4 – 14	165	5.88 (2.23)	4 – 13	164	**.007**
Practical support	8.51 (2.43)	3 – 12	165	9.32 (2.24)	3 – 12	163	**<.001**
Emotional support	22.76 (3.99)	9 – 28	164	22.88 (4.33)	8 – 28	164	.765
Social network	4.10 (1.49)	1 – 8.80	164	-	-	-	-

The final predictor, outcome and covariate variables selected to be used in multivariate analyses for this study are presented in Table 6-7, and are termed ‘study variables’. Support variables represented both general and marriage-specific support, a range of emotional variables were selected, and physical variables included both self-report and objective indicators of recovery. Length of stay was selected in place of length of ICU stay for reasons listed in Chapter 4, and complications were not used as a measure of recovery due to their low incidence. Covariates were selected on the basis that age, sex, ethnicity and socioeconomic status are all implicated for surgery outcomes as well as social relationships. EuroSCORE takes into account a range of factors that may influence recovery and therefore is an indicator of the clinical severity of the patient.

Table 6-7 Patient study variables

Predictor variables	**Outcome variables**		**Covariates**	
Support variables	**Emotional variables**	**Physical variables**	**Demographic variables**	**Emotional and physical variables**
Social support	Depression	Physical component score	Age	EuroSCORE
Negative marital functioning	Anxiety	Length of stay	Sex	Baseline levels of outcome variable
Practical marital support	Mood		Ethnicity	
Emotional marital support			Occupational classification	

6.7 Correlations

Associations between the baseline levels of the outcome variables and covariates that were selected for analyses, and other demographic variables were assessed using Pearson's product-moment correlation coefficients and all results are reported as Pearson's r and p-values.

Of the covariates that were selected for analyses, pre-surgery levels of anxiety were lower in older patients (r = -.181, p = .020) and higher in female patients (r = .169, p = .030). Of the other demographic variables, being employed was associated with a higher level of baseline depression symptoms (r = .184, p = .019) and anxiety (r = .199, p = .011), and a greater number of people in the household was associated with higher baseline depression symptoms (r = .216, p = .006) and anxiety (r = .166, p = .035). (Table 6-8 6-8).

All pre-surgery support variables were significantly inter-correlated (highest Pearson's r = -.481 between social support and negative marital functioning), with the exception of practical marital support and negative marital functioning, indicating a relatively strong independence between the predictor variables. (Table 6-9). Screening for multicollinearity between variables revealed that no correlations were greater than the threshold of .80 (Katz, 2006), so were not considered problematic.

Regarding covariates, length of stay was longer in older patients (r = .245, p = .001) and those with a higher EuroSCORE (r = .284, p <.001). Post-surgery depression symptoms were higher (r = .195, p = .012) and physical health status was lower (r = -.196, p = .011) in female patients. A higher EuroSCORE was also associated with worse post-surgery depression symptoms (r = .173, p = .026) and mood (r = -.172, p = .027). Lower occupation classification was associated with worse post-surgery anxiety (r = .177, p = .024). (Table 6-10).

For support variables, low social support was associated with worse post-surgery depression symptoms (r = -.211, p = .007), mood (r = .219, p = .005) and a longer length of stay (r = -.194, p = .013). Similarly, a high level of negative marital functioning was associated with less favourable post-surgery depression symptoms (r = .280, p = <.001), anxiety (r = .212, p = .006), mood (r = -.248, p = .001) and length of stay (r = .176, p = .023). Worse baseline levels of depression symptoms, anxiety, mood and physical component score were associated with worse post-surgery depression symptoms, anxiety and mood, a longer length of stay and a lower physical component score. (Table 6-11).

Post-surgery depression symptoms were significantly intercorrelated with all other outcome variables, particularly with anxiety (r = .710, p = <.001), and mood (r = -.706, p = <.001), and anxiety was also associated with mood (r = -.705, p = <.001). These Pearson correlations are indicative of a relatively high level of similarity between the emotional outcome variables, suggesting a low level of independence from each other. However, importantly, the emotional and physical variables were not highly correlated, and so can be considered conceptually different aspects of recovery. (Table 6-12).

Table 6-8 Correlations between covariates and T1 scores

		Outcome variables T1			
		Depression	**Anxiety**	**Mood**	**PCS**
Covariates					
Age	r	-.129	-.181	.065	-.123
	p	.100	**.020**	.405	.116
Sex	r	.074	.169	-.078	-.145
	p	.344	**.030**	.319	.063
Ethnicity	r	.107	.137	-.135	-.016
	p	.174	.080	.084	.838
Occupation classification	r	.145	.035	.033	-.140
	p	.067	.656	.680	.075
EuroSCORE	r	-.005	-.035	-.054	-.111
	p	.945	.660	.495	.154
Demographics					
Education	r	.081	.086	-.157	.114
	p	.321	.296	.055	.160
Employment	r	.184	.199	-.108	.028
	p	**.019**	**.011**	.171	.718
Income	r	-.021	-.011	-.020	.130
	p	.797	.894	.803	.104
Marital years	r	.013	-.094	.050	-.210
	p	.873	.231	.527	**.007**
Number in household	r	.216	.166	-.122	.022
	p	**.006**	**.035**	.123	.777

List of abbreviations: physical component score (PCS)

Table 6-9 Intercorrelations between support variables

Support variables T1		Social support	Negative marital support	Practical marital support	Emotional marital support
Social support	r	1	-.481	.204	.448
	p	-	**<.001**	**.009**	**<.001**
Negative marital support	r	-.481	1	-.087	-.399
	p	**<.001**	-	.264	**<.001**
Practical marital support	r	.204	-.087	1	.480
	p	**.009**	.264	-	**<.001**
Emotional marital support	r	.448	-.399	.480	1
	p	**<.001**	**<.001**	**<.001**	-

Table 6-10 Correlations between covariates and outcomes

		Outcome variables T2				
		Depression	**Anxiety**	**Mood**	**Length of stay**	**PCS**
Covariates						
Age	r	.079	.101	-.096	.245	.008
	p	.314	.897	.221	**.001**	.919
Sex	r	.195	.117	-.140	.135	-.196
	p	**.012**	.133	.073	.083	**.011**
Ethnicity	r	.027	-.021	-.040	.050	.087
	p	.735	.791	.612	.522	.318
Occupation classification	r	.100	.177	-.096	.032	.052
	p	.205	**.024**	.225	.688	.509
EuroSCORE	r	.173	.091	-.172	.284	.056
	p	**.026**	.245	**.027**	**<.001**	.437

Table 6-11 Correlations between baseline variables and outcomes

		Outcome variables T2				
		Depression	**Anxiety**	**Mood**	**Length of stay**	**PCS**
Support variables T1						
Social support	r	-.211	-.137	.219	-.194	-.025
	p	**.007**	.081	**.005**	**.013**	.751
Negative marital support	r	.280	.212	-.248	.176	-.024
	p	**<.001**	**.006**	**.001**	**.023**	.763
Practical marital support	r	.122	.119	-.102	-.076	-.025
	p	.119	.127	.194	.332	.749
Emotional marital support	r	-.105	-.053	.071	-.110	.146
	p	.181	.500	.369	.160	.063
Outcome variables T1						
Depression	r	.470	.422	-.442	.250	-.273
	p	**<.001**	**<.001**	**<.001**	**.001**	**<.001**
Anxiety	r	.303	.499	-.410	.143	-.226
	p	**<.001**	**<.001**	**<.001**	.068	**.004**
Mood	r	-.323	-.452	.565	-.141	.227
	p	**<.001**	**<.001**	**<.001**	.072	**.003**
PCS	r	-.282	-.092	.199	-.146	.169
	p	**<.001**	.237	**.010**	.061	**.029**

Table 6-12 Intercorrelations between outcomes

Outcome variables T2		**Depression**	**Anxiety**	**Mood**	**Length of stay**	**PCS**
Depression	r	1	.710	-.706	.241	-.327
	p	-	**<.001**	**<.001**	**.002**	**<.001**
Anxiety	r	.710	1	-.705	.123	-.334
	p	**<.001**	-	**<.001**	.115	**<.001**
Mood	r	-.706	-.705	1	-.244	.256
	p	**<.001**	**<.001**	-	**.002**	**.001**
Length of stay	r	.241	.123	-.244	1	-.009
	p	**.002**	.115	**.002**	-	.912
PCS	r	-.327	-.334	.256	-.009	1
	p	**<.001**	**<.001**	**.001**	.912	-

6.8 Predictors of surgery outcomes

Examination of the plausibility of the three hypotheses was conducted with multiple regression analyses on emotional and physical outcomes. All results are presented as standardised regression coefficients (β), standard errors (SE) and p-values (p).

6.8.1 Social support as a predictor

First, non-marital social support was examined as a predictor of all emotional post-surgery outcomes. In these models related to social support, support and covariates were entered in one step, and together accounted for 28.6% of the variance for T2 depression symptoms, 29.5% for anxiety and 36.7% for mood (Table 6-13). In all three models, baseline levels of the outcome variable were independent predictors, and in addition, sex was a predictor of depression symptoms, and occupational classification was a predictor of anxiety. Social support was not a significant predictor of any emotional outcomes.

Table 6-13 Social support predicting T2 emotional outcomes

	Depression			Anxiety			Mood		
	β	SE	P	β	SE	P	β	SE	P
Step 1									
Age	.048	.075	.667	.054	.048	.625	-.073	.126	.484
Sex	.162	1.496	.025	.049	.937	.495	-.087	2.437	.200
Ethnicity	-.047	1.181	.518	-.064	.745	.376	-.002	1.992	.977
Baseline	.449	.073	<.001	.494	.064	<.001	.549	.067	<.001
EuroSCORE	.145	.246	.191	.069	.158	.529	-.097	.417	.354
Occupational classification	.048	.539	.502	.165	.341	.019	-.129	.892	.052
Social support	-.031	.110	.690	-.034	.066	.644	.037	.178	.603
R^2	.286			.295			.367		

In the models predicting physical outcomes, again social support and covariates were entered together, and accounted for 11.2% of the variance in physical component score (Table 6-14) and 12.4% for length of stay (Table 6-15). Sex and baseline levels of the outcome variables were significant predictors of physical component score, but social support was not. However, social support was the only significant predictor of length of stay (β = -.168, p = .036) (Model 1, Table 6-15). Higher levels of social support predicted a shorter length of stay, in support of hypothesis I. Following this, a second model (Model 2, Table 6-15) included all covariates and social support in step one, and three markers of complications as well as comorbidity (return to theatre, return to ICU, cardiovascular accident and number of chronic conditions) that might otherwise predict length of stay in step two (values in model 2 represent step 2 values). No patients included in this model experienced a new cardiovascular accident so this variable was excluded from the model. Return to theatre, return to ICU and number of chronic conditions were all significant predictors of length of stay, and this second step accounted for a further 10.3% of the variance. However, social support remained a significant predictor (β = -.208, p = .007), so social support was an independent predictor of length of stay, even when controlling for additional risk factors.

Table 6-14 Social support predicting T2 physical component score

	PCS		
	β	**SE**	**P**
Step 1			
Age	-.053	.128	.664
Sex	-.246	2.506	.002
Ethnicity	.117	1.988	.145
Baseline	.180	.062	.025
EuroSCORE	.107	.421	.383
Occupational classification	.086	.924	.280
Social support	-.070	.176	.390
R^2	.112		

Table 6-15 Social support predicting length of stay

	Model 1			Model 2		
	β	**SE**	**P**	**β**	**SE**	**P**
Step 1						
Age	.173	.055	.154	.187	.052	.105
Sex	.121	1.075	.125	.147	1.024	.050
Ethnicity	.042	.862	.596	.017	.847	.827
EuroSCORE	.105	.182	.383	.104	.175	.371
Occupational classification	.085	.394	.270	.054	.375	.466
Social support	-.168	.076	**.036**	-.208	.072	**.007**
R^2	.124					
Step 2	-	-	-			
Return to theatre	-	-	-	.154	1.737	.034
Return to ICU	-	-	-	.197	2.071	.009
Comorbidities	-	-	-	-.231	.468	.003
R^2	-	-	-	.227		
R^2 change	-	-	-	.103		

6.8.2 Marital functioning as a predictor

The second stage of multivariate analyses examined the predictive value of the three sub-types of marital functioning for both emotional and physical outcomes. Initially, in the models predicting emotional outcomes, all three types of marital functioning and all covariates were entered together. Together these accounted for 31.8% of the variance in depression symptoms, 33.2% for anxiety and 38.2% for mood (Table 6-16). Again, baseline scores of the outcome variable were significant predictors of outcomes, and in addition, ethnicity and occupational classification predicted anxiety. Of the marital functioning variables, negative marital functioning was an independent predictor of depression symptoms (β = .201, p = .019) and anxiety (β = .232, p = .006). A higher level of negative marital functioning predicted higher depression symptoms and anxiety. Practical and emotional support were not significant predictors of emotional outcomes, and no marital functioning variables predicted mood, though the predictive level of negative marital functioning neared significance (p = .054). These models show that negative marital functioning is a predictor of both depression symptoms and anxiety, in support of hypothesis I. They also show that negative aspects predict depression symptoms and anxiety independently of positive aspects of the marital relationship and covariates, in support of hypothesis II.

Following this, a second model included all marital functioning variables and covariates in step one, and social support in step two (Table 6-17). Social support was not a significant predictor of any emotional outcomes. Negative marital functioning remained a significant predictor of depression symptoms (β = .211, p = .019) and anxiety (β = .248, p = .005), demonstrating its ability to predict emotional outcomes when controlling for social support. These findings indicate that marital functioning is distinct from general social support, in support of hypothesis III.

Table 6-16 Marital functioning predicting T2 emotional outcomes – Model 1

	Depression			**Anxiety**			**Mood**		
	β	**SE**	**P**	**β**	**SE**	**P**	**β**	**SE**	**P**
Step 1									
Age	.084	.079	.474	.072	.050	.533	-.076	.131	.486
Sex	.137	1.518	.062	.018	.950	.809	-.063	2.523	.368
Ethnicity	-.108	1.263	.158	-.158	.806	.039	.053	2.168	.476
Baseline	.421	.072	<.001	.464	.064	<.001	.519	.068	<.001
EuroSCORE	.114	.254	.321	.046	.162	.680	-.091	.430	.398
Occupational classification	.058	.534	.418	.170	.337	.015	-.128	.898	.056
Negative MF	.201	.214	**.019**	.232	.134	**.006**	-.160	.372	.054
Practical MF	.057	.194	.487	.068	.124	.399	-.043	.328	.587
Emotional MF	.030	.126	.744	.041	.080	.645	-.023	.213	.789
R^2	.318			.332				.382	

Table 6-17 Marital functioning predicting T2 emotional outcomes - Model 2

	Depression			**Anxiety**			**Mood**		
	β	**SE**	**P**	**B**	**SE**	**P**	**β**	**SE**	**P**
Step 2									
Age	.076	.080	.523	057	.051	.631	-.074	.135	.510
Sex	.138	1.526	.061	017	.952	.810	-.064	2.532	.369
Ethnicity	-.107	1.268	.164	-.157	.808	.041	.053	2.176	.470
Baseline	.429	.075	<.001	.468	.065	<.001	.520	.069	<.001
EuroSCORE	.123	.261	.297	.063	.167	.589	-.093	.444	.403
Occupational classification	.055	.537	.438	.168	.338	.016	-.128	.901	.057
Negative MF	.211	.225	**.019**	.248	.141	**.005**	-.162	.386	.060
Practical MF	.055	.195	.501	.067	.124	.412	-.042	.330	.592
Emotional MF	.021	.131	.825	.024	.084	.793	-.021	.226	.819
Social support	.032	.129	.723	.049	.079	.569	-.007	.215	.936
R^2	.318			.333			.382		
R^2 change	.000			.001			.000		

In the models predicting physical outcomes, all three types of marital functioning and covariates were entered together and combined explained 12.4% and 13.9% of the variance in physical component score and length of stay, respectively. Sex and baseline scores were significant predictors of physical component scores, but none of the variables independently predicted length of stay. Marital functioning did not significantly predict either outcome.

Table 6-18 Marital functioning predicting T2 physical outcomes

	PCS			**Length of stay**		
	β	**SE**	**P**	**β**	**SE**	**P**
Step 1						
Age	-.079	.132	.542	.091	.057	.472
Sex	-.223	2.615	.008	.115	1.118	.157
Ethnicity	.120	2.208	.164	.040	.954	.636
Baseline	.168	.062	.035	-	-	-
EuroSCORE	.165	.419	.194	.215	.181	.089
Occupational classification	.064	.932	.417	.082	.397	.286
Negative MF	.040	.366	.671	.143	.158	.127
Practical MF	-.065	.331	.471	-.114	.143	.203
Emotional MF	.137	.214	.170	.013	.093	.895
R^2	.124			.139		

6.9 Additional analyses

A number of additional analyses were conducted to address some of the factors highlighted as important for this area of research in Chapter 1 and Chapter 2. Results are reported in full in Appendix 3. Firstly, in light of the negative skew in the length of stay data, the models reported in Table 6-15 ‘Social support predicting length of stay’ were repeated with length of stay modelled as a binary variable, splitting length of stay at the point of ≥5< days. Social support remained a significant independent predictor. Secondly, to account for the possible overlap between the somatic symptoms of depression and physical illness (Chapter 1, section 1.5.2), a new depression symptoms variable was created with the somatic items of the BDI removed. The model predicting depression symptoms in Table 6-17 ‘Marital functioning predicting emotional outcomes’ was repeated using the affective-only BDI score, and negative marital functioning remained a significant predictor. Thirdly, to account for the possible confounding effects of pre-operative depression treatment (Chapter 1, section 1.5.2), the models in Table 6-17 for depression symptoms and anxiety were repeated including a variable of anti-depressant medication taken within the two weeks before T1, and negative marital functioning remained a significant predictor. Finally, I included the number of marital years as a covariate in the models in Table 6-17 (marital functioning predicting depression symptoms and anxiety), and the findings did not change.

6.10 Summary of results

In summary, in a sample of predominantly middle aged, white, educated, male CABG surgery patients, about three-quarters were married or cohabiting, the majority in a long-term relationship, living with just their partner. The married patients had a higher income, lower risk of early mortality (EuroSCORE), and a higher level of social support. The results of the analyses in this chapter are summarised in Table 6-19.

Table 6-19 Summary of patient results

	Finding
Changes over time	Depression symptoms, anxiety and mood levels improved after surgery. Physical component scores worsened and angina levels improved after surgery. Social support, negative and practical marital functioning improved after surgery.
Correlations	Worse baseline levels of depression symptoms and anxiety were associated with female gender, younger age, being employed and a larger household. Worse physical and emotional outcomes were associated with female gender, lower occupation classification, higher EuroSCORE, lower social support and more negative marital functioning.
Regressions	Social support predicted length of stay controlling for covariates and clinical variables. Negative marital functioning predicted depression symptoms and anxiety, controlling for positive aspects of the marital relationship and for general social support.
Additional analyses	Social support predicted length of stay as a binary variable. Marital functioning predicted depression symptoms and anxiety when controlling for anti-depressant medication, number of marital years, and when using an affective-only measure of depression symptoms.

Table 6-20 summarises the results in relation to the hypotheses.

Table 6-20 Patient results in relation to hypotheses

Finding	In relation to hypothesis
Social support was a significant predictor of length of stay. Social support was not a significant predictor of physical health status or emotional outcomes.	Hypothesis I – support variables are predictors of outcomes of surgery.
Negative marital functioning was a significant predictor of post-operative depression symptoms and anxiety. No marital functioning variables predicted post-operative mood, physical health status or length of stay. Practical and emotional marital functioning did not predict depression symptoms or anxiety.	Hypothesis I – support variables are predictors of outcomes of surgery.
Negative marital functioning was a significant predictor of depression symptoms and anxiety in a model including positive marital functioning.	Hypothesis II – negative marital functioning is distinct from positive aspects of marital functioning.
Negative marital functioning was a significant predictor of depression symptoms and anxiety when controlling for social support.	Hypothesis III – marital functioning is distinct from social support.

6.11 Discussion

This study investigated the role of support variables for physical recovery and psychological adjustment of patients following CABG surgery. It aimed to explore whether aspects of interpersonal relationships are important for surgery outcomes, and to examine theoretical distinctions between social support vs. marital functioning, and positive vs. negative aspects of relationships.

6.11.1 Discussion of the data

This study deliberately did not focus on the implications of marital status for physical and psychological health, but comparisons between married and unmarried patients revealed differences in the level of social support prior to surgery. As only levels of support, but not of well-being varied on the basis of marital status, all further analyses focused on married patients only.

Response rates were high and attrition rates were low, providing a sample size of married participants larger than many other CABG studies measuring support variables (Table 2-2). The mean age of 68 years and prevalence of men over women were typical of the general CABG surgery patient population treated at the hospital. However the majority were white, were educated to secondary level or higher and in the highest occupational classification category, which is not necessarily an accurate reflection of residents of the London Borough of Wandsworth. In particular, participants from ethnic minorities were under-represented (London Councils, 2011). The large proportion with a high number of years married and prevalence of only two people in the household is indicative of a sample for whom the marital relationship is a focal and long-term social relationship. The mean EuroSCORE (4.1) was typical for cardiac patients in the UK (mean 4.1 – (Roques et al., 2000)) and the proportion with good LVEF levels (86.1% ≥50%) was relatively high (single centre 77.2% LVEF ≥50 - (Kurki et al., 2002), 76% LVEF ≥50 – (Kurki & Kataja, 1996)) so the sample was not particularly high risk. However, the rates of cardiopulmonary bypass, concurrent valve surgery, a wide range of number of grafts and numerous graft types allowed for potential variation in how patients might have recovered. In terms of indicators of early recovery, the occurrence of complications was very low, and the mean length of stay (7.22 days for the full sample) was shorter than the average for 19 522 CABG patients in the UK ((mean 12.48 days, though this includes emergency CABG patients and patients transferred from another hospital) (Gaughan et al., 2012)). However, the wide range of days in ICU and post-operative hospitalisation indicate variation in physical recovery, with implications for longer-term recovery.

Pre-surgery measures were taken an average 28 days prior to the procedure, reducing the risk of anticipatory distress inflating baseline scores. In terms of emotional well-being, compared to other studies, pre-operative surgery levels of depression symptoms and anxiety were low. Depression symptoms scores (mean 7.80) were notably lower than baseline scores in other CABG samples using the BDI (BDI 12.49 - (Khoueiry et al., 2011), BDI 11.5 - (Kustrzycki et al., 2012), BDI 12.2 (women only) - (R. H. B. Mitchell et al., 2005)), and anxiety (mean 5.63) was slightly lower than other studies using the HADS (HADS 6.54 - (Gallagher & McKinley, 2007), HADS 6.68 - (Murphy, Elliott, Higgins, et al., 2008)). However, almost a quarter crossed the threshold (≥10) for depression symptoms (24.4%) and over a fifth for anxiety (≥8) (21.3%). The prevalence of depression symptoms (≥10) is slightly lower than that in other studies using the BDI (28.1% - (Burg et al., 2003), 32% - (Rymaszewska et al., 2003)), and anxiety prevalence was also lower than studies using the HADS (40% - (Gallagher & McKinley, 2007), 38.7% - (Gallagher & McKinley, 2009)) with the same cut-offs. Since many of these previous studies assessed pre-surgery levels within days of surgery, this study indicates rates might be slightly lower when measured on average a month before surgery, giving a more reliable baseline score. However, a proportion of CABG patients are distressed prior to surgery.

The large proportion of patients reporting positive moods (>0; 84.4%) indicates that scores were high, though unfortunately no other studies using this measure report scores to enable comparisons. However, the high proportions of positive mood suggest there is value in measuring moods not confined to depression symptoms and anxiety, as they may co-exist. At baseline, physical health status was notably low, with 78.3% below the threshold (<50) for poor physical health. The mean (39.90) was markedly lower than UK population norms for healthy adults (53.64 men aged 18-64 with no longstanding illness (Jenkinson, Stewart-Brown, Petersen, & Paice, 1999); 41.3 healthy men aged 65+ (Pettit et al., 2001); 44.8 healthy adults aged 65+ (Gandek et al., 1998)). However, scores were comparable to other CABG and PCI patients prior to surgery (PCS 39.28 (PCI patients), PCS 39.60 (CABG patients) - (Höfer et al., 2006), PCS 40.6 (patients with angina only) - (Pirraglia et al., 2003)) and cardiac patients admitted with MI (PCS 41.9 - (Thombs et al., 2008)).

Levels of social support were high (30.65), notably higher than scores reported in the study by Mallik et al (2005) (ESSI 17.9 – 20.5), likely due to their sample including unmarried patients and those living alone. Unfortunately, the majority of studies using this scale in cardiac patients do not report mean scores for the whole sample or use adapted versions of the scale, making comparisons difficult. However, scores were comparable to cardiac patients following MI (ESSI 29.9 - (P. H. Mitchell et al., 2003). Scores for marital functioning were positive, with low scores on the negative subscale (6.29) and high scores on the positive subscales (practical – 8.51, emotional - 22.76), which were comparable to healthy adults.[4] The support data was positively skewed, and there was notable variation in support levels at baseline, particularly in the marital functioning scores, with almost the full range of scores reported across the sample. In addition, social network sizes ranged from only 1 member to almost 9 outside the marriage, so some patients had much larger sources of potential support than others.

Post-surgery assessments were returned an average of 2 months following surgery, reflecting the later end of the acute recovery period, at which point recovery to full functioning is expected in most patients (Ravven et al., 2013). Physical health status scores significantly worsened, in contrast with other studies which typically show improvements (at 3 months - (Höfer et al., 2006), at 4 months - (Thomson, 2008)). This may be a reflection of the assessment in my study being closer to surgery than in other work, since physical component scores decline in the acute recovery period in some studies (10 days - (Krannich, Lueger, et al., 2007)). All three emotional distress variables showed significant improvements, corresponding with the

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[4] Data from Whitehall II phase 2, approximately 10 308 civil servants. This measure has been used mostly in the Whitehall II study, but authors do not report mean scores for each subscale. The first author of one paper (Stringhini et al., 2012) provided me with mean scores for each subscale for the unimputed sample. The measures were scored from 0 – 3 where in this PhD the recommended 1 – 4 scoring was used. Converting the 2012 study scores to the 1 – 4 scale resulted in means of: 6.78 for negative marital functioning, 8.67 for practical support and 22.46 for emotional support.

majority of previous studies (Chapter 1). By this ‘mid-recovery’ stage, the mean emotional distress levels (depression symptoms 6.51, anxiety 3.71) were again lower than those of other CABG samples using the same measure (BDI 14.16 (1 month) - (Khoueiry et al., 2011), BDI 8.0I (3 months) – (Kustrzycki et al., 2012), BDI 7.9 (women only; 6-12 weeks) - (R. H. B. Mitchell et al., 2005); HADS 4.89 - (Murphy, Elliott, Higgins, et al., 2008)), and of healthy adults of a similar age (BDI 7.58 - (Rabbitt, Donlan, Watson, McInnes, & Bent, 1995), implying that as a whole this sample did not experience notably elevated depression levels after surgery.

However, there is marked variation in the post-operative scores, and a proportion of patients experienced increased depression symptoms and anxiety scores, and decreased mood scores. This reflects the lack of improvement to emotional distress seen in some other CABG studies (Andrew et al., 2000; Grossi et al., 1998; Jensen et al., 2006; Penckofer et al., 2005; Szalma et al., 2006), and suggests some possible cases of new-onset distress, perhaps for reasons suggested by Dickens et al (2008) and others in Chapter 1. 42.2% did not see improvements to depression symptoms scores, and 30.6% showed increases; with 37.2% (no improvement) and 20.6% (worsened) for anxiety, and 34.1% (no improvement) and 27.4% (worsened) for mood. While only 7.8% crossed the threshold for anxiety, as many as 19.4% demonstrated elevated depression symptoms after surgery. These rates are slightly lower than those of other samples tested 2 months after surgery (16.4% - (R. H. B. Mitchell et al., 2005), 25% - (Khatri et al., 1999), 27% - (Hallas et al., 2003)), though this may be explained by the fact that the baseline rates for these studies were also higher than the current study. So while overall scores improved and emotional distress levels were relatively low, there was variation after surgery. Significant proportions remained distressed or experienced increased distress, which provides an interesting sample with which to test the hypotheses of this PhD.

6.11.2 Discussion by hypothesis

I. Social relationships measured prior to CABG surgery will predict post-surgery emotional and physical health.

The regression analyses revealed that general social support was not a significant predictor of any of the emotional outcome variables, in contrast with some previous studies (K. B. King et al., 1993; Kulik & Mahler, 1993; White & Frasure-Smith, 1995). However, of the studies assessing emotional outcomes at a similar time point after surgery, several did not show social variables to be related to emotional variables (Elizur & Hirsh, 1999; Hämäläinen et al., 2000; Rankin & Monahan, 1991; Rantanen, Tarkka, et al., 2009; Sorensen & Wang, 2009). The findings from this study support the possibility that pre-surgery global social support is not related to emotional outcomes at this point in the recovery. While the regression models accounted for between 28% and 36% of variance in the three outcomes, it was baseline levels of emotional distress which explained the largest amount of variance in each case. Some demographic variables were also predictors, and were more relevant for outcomes than social support. Social support was also not a significant predictor in models predicting self-reported physical health status. Other studies using physical subscales of quality of life measures also found no association with support variables (Barry et al., 2006; Rankin & Monahan, 1991), with the exception of Thomson (2008) who found only one specific type of support (tangible) to predict physical health status. The findings from my study suggest that pre-surgery global social support does not influence the extent to which participants feel their physical health affects their quality of life as much as other variables do.

The majority of studies which relate support variables to physical recovery have used more specific outcomes, consequently there are a greater number of studies linking social support to outcomes such as cardiac symptoms, length of stay, medication use and health behaviours related to recovery. Complementing the previous research, in this study I found lower levels of baseline social support significantly predicted a longer length of stay. This finding was confirmed in logistic regression models predicting length of stay as a binary variable using a cut-off of 5 days (Appendix 3.1), (both the median, and the target length of stay according to the early discharge protocol [see Chapter 4]), and in a second linear model which controlled for three additional indicators of length of stay, as well as in several additional models. Consequently overall, social support is a reliable predictor of length of stay, and these findings may have important implications. These findings supplement those of Kulik and Mahler (1989; 2006) whose studies were the only others in which support variables predicted length of stay. However, they assessed only marital variables in a cross-sectional design. The only other study to assess global social support in relation to length of stay found social support did *not* predict length of stay (Sorensen & Wang, 2009). This may be because of their use of a one-item measure of support and a sample size smaller than half of this study (n=63 post-operatively). In addition, their sample was exclusively aged 65 and over, limiting generalisability. My study brings new information regarding social support predicting length of stay, as the first study using global social support with a validated measure showing support to longitudinally predict length of stay.

This hypothesis was further supported by findings that pre-surgery marital functioning predicted emotional outcomes. Specifically, negative marital functioning predicted post-operative changes to depression symptoms and anxiety. Only three previous studies tested the association between marital functioning and emotional outcomes. My findings supplement those of Elizur and Hirsh (1999) who found marital satisfaction, support and adaptability predicted a range of emotional outcomes following surgery, and Ruiz et al (2006) who found marital satisfaction predicted depression symptoms 18-months after surgery. Kulik and Mahler (1989) did *not* find significant results for marital support predicting anxiety, possibly because of the observational measure of marital support, and because anxiety was assessed the evening before surgery, prior to the assessment of marital support. Thus, my findings suggest that the quality of the marital relationship prior to surgery influences the change in depression symptoms and anxiety 2 months after surgery. This was the case even when controlling for demographics, baseline levels of distress and illness severity, and marital quality made larger contributions to the variance than all other variables excluding baseline distress. Unlike my null findings for global social support, the aspects of the marital relationship partly determined patients' psychological adjustment after surgery. However, marital functioning did not significantly predict changes to mood, despite the variables in the mood model explaining 38.2% of the variance. Thus, my findings support the first hypothesis to some extent. The difference in findings for social support and marital functioning lend support to hypothesis III, and evidently different support variables are relevant to different recovery and adjustment variables. However, to a certain extent features of relationships are relevant for CABG patients' recovery and adjustment.

II. Negative aspects of social relationships are distinct from positive aspects in terms of their role in explaining surgery outcomes

This hypothesis was tested by including both positive (emotional and practical support) variables and negative aspects of the marital relationship as potential predictors in all models of marital functioning. The findings indicated that the pre-surgery marital relationship was relevant for explaining significant variance in post-operative depression symptoms and anxiety, and in both cases, negative marital functioning was the only significant predictor. As positive aspects were present in the model, there was evidence that negative marital functioning predicted emotional outcomes even after controlling for positive marital functioning. So despite the supportive elements of the marital relationship, patients with higher pre-surgery levels of negative elements had increased risk of worsening depression symptoms and anxiety 2 months after surgery, suggesting the two components of the marital relationship work independently, perhaps via separate mechanisms, and that negative relationships are not necessarily characterised by low levels of support.[5]

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[5] Patients with high or low negative marital functioning did not significantly differ in their baseline practical support scores (means high negative group 8.18 SD 2.30 vs. low negative group 8.71 SD 2.50, p = .175).

From the 4 items which constituted this subscale, it can be speculated that the feelings that their partner gave them worries, made things worse or that they would have preferred to have been able to rely on their partner more for emotional and practical support prior to surgery, predicted smaller improvements, or greater increases to emotional distress after surgery. These findings supplement others showing negative aspects of the closest relationship to predict cardiac disease risk and risk factors (De Vogli et al., 2007; Kouvonen et al., 2011). They also supplement studies showing independent influences of positive and negative aspects of relationships on health outcomes (Ruehlman & Wolchik, 1988), for negative to be stronger predictors than positive aspects (Rook, 1990; Schuster et al., 1990), and even that negative aspects outweigh the benefits of supportive aspects (Coyne & Bolger, 1990; Schuster et al., 1990); in all models which also included positive marital or general social support, negative marital functioning was the only significant predictor of outcomes. However, these are the first findings of their kind in the CABG literature, as only one other study included a measure of both positive and negative marital functioning, but did not report the findings for each subscale separately (Kulik & Mahler, 2006). The positive aspects of the marital relationship were not found to predict any outcomes, so while positive and negative aspects did not predict different outcomes, the negative aspects were seen to be particularly important for emotional adjustment after surgery, providing some support for this hypothesis.

III. The marital relationship is distinct from general social support in terms of its role in explaining surgery outcomes.

Various findings from this study contribute to the discussion of this hypothesis. Firstly, married participants were found to have significantly higher levels of social support than unmarried, suggesting a synonymy between marriage and social support (discussed in Chapter 2), and indicating that while there may be distinctions, support is an integral aspect of the marital relationship. Consequently, for the subsample of married participants used to test this hypothesis, perceived general social support levels were high. However, initial evidence that general social support and aspects of the marital relationship predicted different outcomes suggests a distinction relevant to this hypothesis. Specifically, social support predicted length of stay, and negative marital functioning predicted depression symptoms and anxiety. Like Elizur and Hirsh (1999) I found marital variables predicted emotional outcomes while social support did not. My findings confirm theirs with a larger sample size, in a better designed study with a pre-surgery assessment less proximal to the procedure, and after controlling for covariates and baseline levels of the outcome variables.

The hypothesis was further supported in additional models in which social support was included as a covariate and marital functioning continued to predict emotional outcomes. Consequently, even when controlling for levels of general social support, negative aspects of marital functioning significantly predicted depression symptoms and anxiety. The fact that social support predicted physical outcomes and marital functioning predicted emotional outcomes suggests that they may be relevant for physical and emotional outcomes separately, and that they may work through different mechanisms. Consequently, though being married is integral to perceptions of social support, there is evidence that among married patients, social support and aspects of the marital relationship have distinctive influences on surgery outcomes.

Chapter 7 Partner results

7.1 Introduction

In this chapter, I report the findings from the analyses of the partner data. The hypotheses being examined in the partner sample were the following:

I. Social relationships measured prior to CABG surgery will predict post-surgery partner emotional and physical adjustment.

This hypothesis matched the first hypothesis for the patient sample. Again, support variables included general social support and specific marital functioning (negative marital functioning, practical marital support and emotional marital support). Post-surgery emotional adjustment was assessed with the same variables as for the patients (depression symptoms, anxiety and mood) to ensure consistency. A measure of self-reported physical health was also included as an indicator of the impact on partners' physical adjustment, and once again the physical component score was used. The hypothesis was again tested through multiple regression models with support variables predicting emotional and physical outcomes. This hypothesis will be confirmed if social support or marital functioning subscales are significant independent predictors of emotional or physical outcomes after controlling for covariates.

II. The burden of caring for the patient will predict post-surgery emotional and physical adjustment.

This hypothesis focuses on the potential influence of caregiver burden on the partners' well-being following surgery. Caregiver burden was modelled on the perceived burden of both the time taken and difficulty involved with caring for the patient. Scores from the time burden and difficulty subscales of the caregiver burden measure were examined separately, and in a combined form as a measure of total caregiver burden. The change in the amount of time, difficulty and overall burden from before to after surgery were used in multiple regression models predicting emotional and physical adjustment. This hypothesis will be fulfilled if any caregiver burden variables are identified as a significant predictor of emotional or physical outcomes.

III. Caregiver burden variables influence support, and support influences the impact of caregiver burden on emotional and physical adjustment following surgery.

This hypothesis considered the relationship between support and caregiver burden on adjustment to surgery, whereby one might impact the other and its influence on emotional and physical outcomes. I was particularly interested in whether the change in caregiver burden over time had an adverse impact on the support that partners received after surgery, and whether the level of pre-surgery support influenced the impact of caregiver burden on outcomes. This hypothesis was examined with further multiple regression models. Two sub-hypotheses were formed:

IIIa. The change in caregiver burden after surgery will predict post-surgery levels of support.

For this hypothesis, multivariate regression models examined whether the change in caregiver burden predicted post-surgery levels of the support variables that were seen to change after surgery. This hypothesis will be confirmed if the change in burden independently predicts change in support, indicating that caregiver burden influences the level of support perceived by partners after surgery.

IIIb. Caregiver burden is related to outcomes differently for partners with high and low social support.

This hypothesis involved categorising partners according to their level of pre-surgery support and testing the influence of caregiver burden change on post-surgery outcomes for these separate groups. This hypothesis will be fulfilled if the change in caregiver burden significantly predicts outcomes for only one or other of the support level groups. Support will be demonstrated to have a particular benefit for partners experiencing large increases to their caregiver burden if outcomes are more favourable in partners with high support and a large increase in their burden than those with high support and a small increase in burden.

IV. Partners will experience worse levels of emotional and support variables than patients.

This hypothesis was examined on the subsample of patients who corresponded to the sample of partners who participated in the study. Comparisons were made between patient and partner levels of all emotional and support variables both before and after surgery. This hypothesis will be met if partners have significantly worse levels of depression symptoms, anxiety or mood, general or marital support than patients.

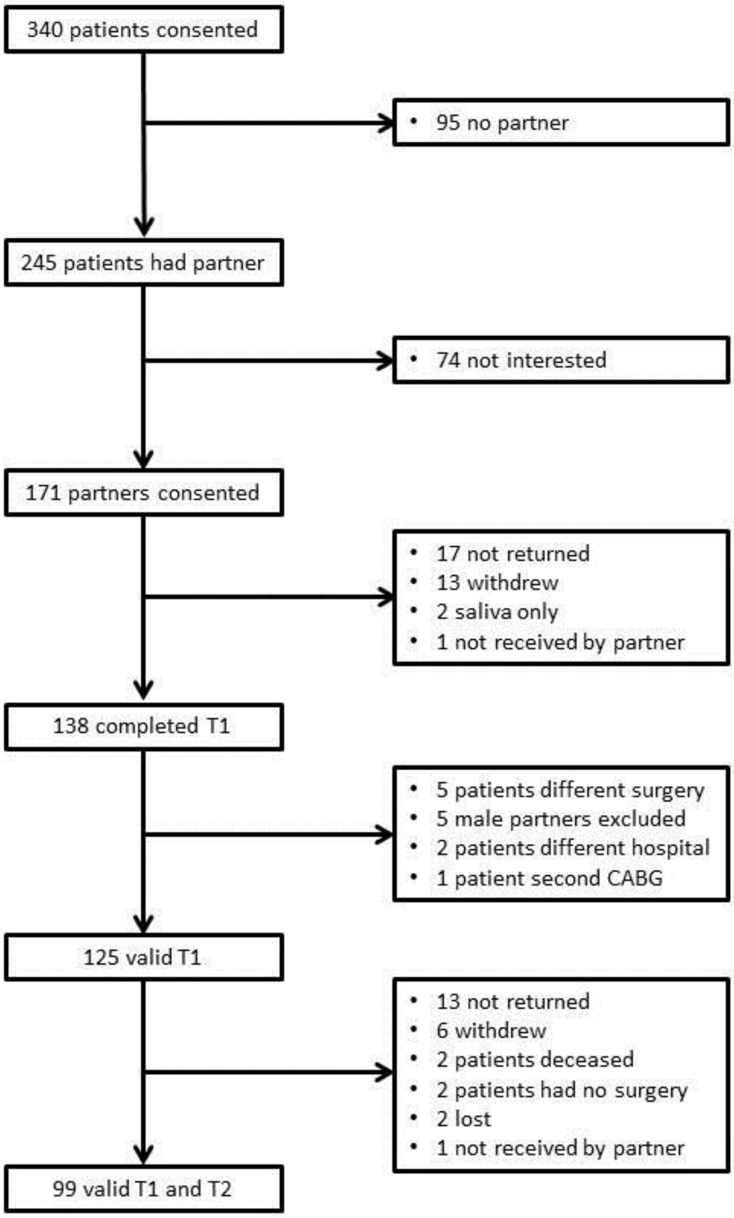
The chapter begins with a description of the sample which provided data before surgery (T1) and approximately 8 weeks after surgery (T2). Scores for emotional, physical, support and caregiver burden variables were compared over time. Support and burden variables were used as independent variables in multiple regression models predicting emotional and physical adjustment following surgery. Further analyses investigated the relationship between support and burden variables for outcomes. Comparisons are then made between partners and their corresponding patients on emotional and support variables. Findings are followed by a results summary and discussion in relation to the hypotheses.

7.2 Recruitment and response rate

Partner participants were recruited alongside patients (Chapter 5) and consequently were excluded if their corresponding patients were excluded. Of the 340 patients who consented onto the study, 245 (72%) reported having a partner, and of these 171 (69.8%) partners agreed to participate. 138 partners (80.7%) provided data for the first assessment, but 8 were excluded due to the corresponding patient undergoing a procedure other than first time CABG surgery at St George’s Hospital. This left 130 partners, the vast majority of whom were women, as just five women with male partners were recruited. As the male sample was so small I decided to exclude them from the analysis sample in order to increase homogeneity.

Consequently, this left 125 (90.6%) participants with valid baseline data, and of these, 99 (79.2%) also provided data at T2. The following flow-diagram depicts the recruitment and retention in the study, and includes all reasons for exclusions and drop-outs (Figure 7-1).

Figure 7-1 Partner recruitment and retention



7.3 Attrition analyses

The 99 participants who completed both time points were compared to the 26 who did not complete the T2 assessment for all baseline variables using t-tests for continuous variables and chi squared tests for categorical variables. There were no differences for the demographic variables age, education, ethnicity, employment or occupational classification, but those who dropped out were more likely to have a yearly income of less than £20 000 (p =.001). There were no significant differences for baseline emotional variables, depression symptoms, anxiety or mood, for physical component score, for the support variables, social support, marital functioning and social network, or for patient clinical cardiac severity (EuroSCORE) (p >.05).

In addition, the 125 married patients who provided baseline data whose partners participated were compared to those 81 with partners who did not participate. There were no differences for the demographic variables age, education, employment or occupational classification, but those with partners who did not participate were more likely to be not white (p <.001). There were no significant differences for baseline depression symptoms, anxiety or mood, physical component score, angina symptoms or EuroSCORE (p >.05). Regarding baseline support variables, those patients with partners who participated had significantly higher negative marital functioning scores (p <.001) and lower levels of social support (p <.001), though there were no differences for practical and emotional marital support or size of the social network.

7.4 Descriptive statistics and changes over time

Demographic characteristics for all participants who completed T1 and T2 are presented in Table 7-1. The mean age of the sample was 65.64 years (SD 8.30) and ranged from 39 to 88 years. All participants were female and the large majority were white. Around two thirds were educated to secondary level or higher, were not in employment, were classified as within a family of a high occupational classification, and had an annual household income of over £20 000. Approximately

50% of the sample had been in a relationship with their partner for over 43 years, and while the number in the household ranged from two to six, the large majority lived in a household of two.

Table 7-1 Demographic characteristics of partner sample

		Mean (SD)	N (%)	Range
Demographic variables				
Age		65.64 (8.30)		39 – 88
Sex	Women		99 (100)	
Ethnicity	White		95 (96)	
	Not white		4 (4)	
Education	None		33 (34)	
	Secondary		37 (38.1)	
	Higher		9 (9.3)	
	Degree		18 (18.2)	
Employment	Employed		31 (31.3)	
	Not employed		68 (68.7)	
Occupation classification	High		63 (63.3)	
	Intermediate		22 (22.2)	
	Low		14 (14.1)	
Income	Up to £20 000		50 (35.2)	
	Over £20 000		92 (64.8)	
Marital years	Up to 42 years		54 (54.5)	
	43 years +		45 (45.4)	
Total number in household	2		85 (87.6)	
	≥3		12 (12.4)	

Regarding participants' self-reported physical health (Table 7-2), most had consulted their GP in the previous 12 months, and 20% of these had visited more than five times. Approximately half the sample had attended hospital, and again, 20% more than five times. Over 80% were taking prescribed medication, but only a third suffered from one or more chronic conditions.

Table 7-2 Partner physical health

		N (%)
Physical health		
Consulted GP	Yes	84 (84.8)
	No	15 (15.2)
Number of GP visits	1 – 5	67 (79.8)
	6 – 10	12 (14.3)
	≥11	5 (6)
Visited hospital	Yes	55 (55.6)
	No	44 (44.4)
Number of hospital visits	1 – 5	44 (80)
	6 – 10	10 (18.2)
	≥11	1 (1.8)
Taking prescribed medications	Yes	81 (81.8)
	No	18 (18.2)
Chronic conditions	Cancer	2 (2)
	Lung condition	9 (9.1)
	Thyroid disorder	13 (13.1)
	Cardiac condition	3 (3)
	OA	13 (13.1)
	Diabetes	3 (3)
	MS	1 (1)
Number of chronic conditions	0	63 (63.6)
	1	27 (27.3)
	2	9 (9.1)

List of abbreviations: general practitioner (GP); multiple sclerosis (MS); osteoarthritis (OA)

The clinical characteristics of the partner sample's corresponding patient sample are reported in Table 7-3. The mean EuroSCORE was low, ranging from 1.51 to 14.57. The number of coronary bypass grafts ranged from 1 to 6, and the majority had a graft type of a combination of a pedicle left internal mammary artery (LIMA) and long saphenous vein (SV). Only 7 (7.1%) participants received pedicle LIMA alone, so the majority obtained a leg or arm wound in addition to their chest wound. Approximately a quarter of the sample did not undergo cardiopulmonary bypass (i.e. off-pump) and a similar proportion underwent concurrent valve surgery.

The length of time in ICU ranged from 0 to 11 days, and length of post-operative hospital stay ranged from 4 to 22 days. The large majority of participants had a good left ventricular ejection fraction (LVEF) (>50%), and the incidence of post-operative complications was very low, with only 4 patients returning to theatre or to ICU.

Table 7-3 Clinical characteristics of corresponding patients

		Mean (SD)	N (%)	Range
Patient clinical characteristics				
EuroSCORE		3.99		1.51 – 14.57
Number of grafts	1		15 (15.2)	
	2		17 (17.2)	
	3		32 (32.3)	
	4		25 (25.3)	
	5		9 (9.1)	
	6		1 (1)	
Graft type	Pedicle LIMA		7 (7.1)	
	Pedicle LIMA + long SV		59 (59.6)	
	Pedicle LIMA, long SV + radial artery		10 (10.1)	
	Long SV		13 (13.1)	
	Pedicle LIMA + radial artery		6 (6.1)	
	Other		4 (4)	
Cardiopulmonary bypass	Yes		73 (73.7)	
Valve surgery	Yes		24 (24.2)	
ICU stay		1.03 (1.34)		0 – 11
Length of stay		6.47 (2.89)		4 – 22
LVEF	Good (≥50%)		86 (86.9)	
	Poor - fair (<50%)		13 (13.1)	
Complications				
Return to theatre	Reoperation for bleeding or tamponade		3 (3)	
Return to ICU	Yes		1 (1)	
Cardiovascular accident	Yes		0 (0)	

List of abbreviations: intensive care unit (ICU); left internal mammary artery (LIMA); left ventricular ejection fraction (LVEF); saphenous vein (SV)

T1 occurred a mean 28.86 days before surgery and T2 was a mean 2 months (60.94 days) after surgery. Baseline and follow-up scores for the emotional, physical and support variables were compared using t-tests and p-values are presented in Table 7-4. Pre-surgery levels of depression symptoms and anxiety were moderately elevated, with approximately one fifth crossing the threshold for moderate depression symptoms (20.2%), and a quarter for elevated anxiety (25.3%). Mood scores were high, with 80% reporting positive scores. T-tests revealed that anxiety levels improved significantly after surgery, while depression symptoms and mood remained stable. Baseline physical component scores were low, with 32.7% of scores below the threshold of good health status, and worsened at the borderline of significance (p = .05) with 42.4% reporting low health status at T2.

T1 mean levels of social support were high, with 14.3% of the sample giving the highest score (i.e. 34). However, levels significantly worsened at T2, with only 5.1% giving the highest score. Baseline scores of the marital functioning measures were moderate, and while levels of negative marital functioning remained stable over time, levels of practical and emotional marital support significantly worsened to notably low levels. The participants' social networks were relatively small, with a mean of between 4 and 5 types of relationships with contact every two weeks or more, and with 77.8% of the sample having fewer than 6 contacts. The size of the social network remained stable after surgery, however as it is reflective of the diversity of social relationships rather than perceived social support, it will not be used in further analyses.

Table 7-4 Partner emotional, physical and support variables

	Time 1			Time 2			P-value
	Mean (SD)	**Range**	**N**	**Mean (SD)**	**Range**	**N**	
Emotional variables							
Depression	7.35 (6.05)	0 – 26	99	6.99 (6.00)	0 – 25.2	99	.330
Anxiety	6.24 (3.98)	0 – 20	99	5.44 (3.15)	0 – 15	99	**.021**
Mood	8.89 (9.75)	-15 – 30	97	10.64 (10.02)	-14 – 30	99	.097
Physical variables							
Physical component score	49.84 (9.71)	23.37 – 65.93	98	48.09 (10.81)	13.48 – 64.76	99	**.050**
Support variables							
Social support	28.40 (4.51)	14 – 34	98	25.73 (5.05)	11 – 34	99	**<.001**
Marital functioning							
Negative support	7.20 (2.29)	4 – 16	98	7.36 (2.32)	4 – 16	99	.461
Practical support	8.04 (2.12)	3 – 12	99	5.63 (1.84)	3 – 12	99	**<.001**
Emotional support	21.67 (4.34)	11 – 28	98	16.85 (4.27)	7 – 27	99	**<.001**
Social network	4.53 (1.42)	1 – 9	99	4.73 (1.47)	2 – 9.17	99	.094

Baseline and follow-up caregiving variables are reported in Table 7-5 and were compared using t-tests. Baseline levels of burden (time, difficulty and total scores) were low, with few participants crossing the threshold for moderate burden, and time burden scores were higher than difficulty burden scores. All three measures of burden significantly increased after surgery. The number of hours giving care to any relatives or friends per week revealed that 57.4% of the sample were not caregiving, and 10.6% were caring for over 20 hours a week before surgery. The total number of hours giving care increased significantly after surgery with only 19.8% not reporting any care hours, and a third of the sample giving more than 20 hours of care per week. The number of hours giving care specifically to the patient showed a similar pattern. Before surgery 35.7% of the sample was providing care to individuals aside from the patient, and after surgery this number rose to 40.8%.

Table 7-5 Caregiving variables

		Time 1			Time 2		
		Mean (SD)	**Range**	**N (%)**	**Mean (SD)**	**Range**	**N (%)**
Time burden*		27.54 (9.27)	15 – 62		34.77 (10.26)	16 – 71	
	Above cut-off			6 (6.1)			17 (17.2)
Difficulty burden*		17.66 (5.39)	15 – 42		21.27 (8.77)	15 – 62	
	Above cut-off			0 (0)			4 (4)
Total burden*		21.89 (6.42)	15 – 47.62		26. 98 (8.79)	15.49 – 63.62	
Total hours giving care*		7.33 (16.26)	0 – 90		32.12 (50.02)	0 – 218	
	None			54 (57.4)			17 (19.8)
	≤5			13 (13.1)			14 (16.3)
	6 – 10			10 (10.1)			15 (17.4)
	11 – 20			7 (7.1)			7 (7.1)
	>20			10 (10.6)			33 (33.3)
Hours caring for patient*		5.57 (14.30)	0 – 84		30.20 (46.20)	0 - 168	
	None			52 (66.7)			14 (17.7)
	≤10			16 (20.5)			29 (36.7)
	11 – 20			2 (2.6)			6 (7.6)
	21 – 60			7 (9)			18 (22.8)
	>60			1 (1.3)			12 (15.2)
Give care to others	Yes			35 (35.7)			40 (40.8)
	No			63 (64.3)			58 (59.2)

* Significantly different between time 1 and time 2 at the <0.05 level

Table 7-6 presents the scores for the individual caregiving tasks directed towards the patient regarding time and difficulty burden at T1 and T2, and their ranking order. T1 and T2 scores were compared with t-tests and p-values are reported in the table. With the exception of managing finances and assisting with communication, both the time and difficulty burden of all activities significantly increased after surgery. Providing emotional support, providing transport or company on journeys and monitoring symptoms were the most time-consuming tasks both before and after surgery. Managing behaviour problems such as moodiness was the most difficult task both before and after surgery, and together with providing emotional support, housework was one of the most difficult tasks after surgery. The least time-consuming and difficult tasks were giving assistance with mobility before surgery, and with assisting communication after surgery.

Table 7-6 Caregiving tasks

	Mean (rank)				**P-value**	
	Time 1		**Time 2**			
	Time	**Difficulty**	**Time**	**Difficulty**	**Time**	**Difficulty**
Task						
Medical care	1.21 (12)	1.09 (10)	1.95 (10)	1.23 (13)	**<.001**	**.022**
Personal care	1.10 (14)	1.05 (12)	1.84 (11)	1.26 (12)	**<.001**	**<.001**
Assist walking	1.06 (15)	1.03 (13)	1.73 (13)	1.22 (14)	**<.001**	**<.001**
Emotional support	3.34 (1)	1.32 (2)	3.71 (1)	1.63 (2)	**.004**	**.001**
Monitor symptoms	2.50 (3)	1.23 (4)	3.15 (3)	1.59 (4)	**<.001**	**<.001**
Provide transport	2.68 (2)	1.24 (3)	3.37 (2)	1.58 (5)	**<.001**	**.002**
Manage finances	1.97 (6)	1.23 (4)	2.10 (9)	1.34 (9)	.243	.131
Housework	2.16 (4)	1.23 (4)	2.75 (4)	1.63 (3)	**<.001**	**<.001**
Errands	2.05 (5)	1.18 (5)	2.51 (6)	1.43 (6)	**.001**	**<.001**
Planning activities	1.96 (7)	1.13 (7)	2.54 (5)	1.41 (7)	**<.001**	**<.001**
Managing mood	1.81 (9)	1.46 (1)	2.35 (7)	1.86 (1)	**<.001**	**.001**
Care when absent	1.14 (13)	1.12 (8)	1.46 (14)	1.27 (11)	**<.001**	**.025**
Communications	1.29 (11)	1.08 (11)	1.36 (15)	1.12 (15)	.310	.250
Arranging services	1.39 (10)	1.15 (6)	1.76 (12)	1.28 (10)	**.001**	**.027**
Seeking info	1.82 (8)	1.10 (9)	2.18 (8)	1.40 (8)	**<.001**	**<.001**

To illustrate the impact of the significant increase of caregiver burden on post-surgery outcomes, a change score was created for the three variables by subtracting T1 scores from T2 scores, so positive scores indicated an increase in caregiver burden over time. These change scores were used in multivariate analyses and are reported in Table 7-7.

Table 7-7 Caregiver burden change scores

	Mean (SD)	Range	N
Change scores			
Time burden	7.19 (9.27)	-25 – 28	98
Difficulty burden	3.65 (6.71)	-11 – 30	98
Total burden	5.10 (6.76)	-13.74 – 27.37	98

The predictor, outcome and covariate variables selected to be used in multivariate analyses for this study are presented in Table 7-8, and are termed ‘study variables’. Support variables represented both general and marriage specific support, a range of emotional variables were selected, and self-reported physical health status represented partner health. The choice of covariates was based on the conceptual model (Chapter 3, section 3.9): age, ethnicity and occupational classification were the ‘partner factors’, and the patient’s clinical cardiac severity (EuroSCORE) represented the ‘patient factors’. These were controlled for in analyses in which support and caregiving factors were examined as predictors of outcomes. Sex was not included as a covariate as the whole sample was female.

Table 7-8 Partner study variables

Predictor variables		Outcome variables		Covariates	
Support variables	**Caregiver burden variables**	**Emotional variables**	**Physical variables**	**Demographic variables**	**Emotional and physical variables**
Social support	Time burden change	Depression	Physical component score	Age	Patient EuroSCORE
Negative marital functioning	Difficulty burden change	Anxiety		Ethnicity	Baseline levels of outcome variable
Practical marital support	Total burden change	Mood		Occupational classification	
Emotional marital support					

7.5 Correlations

Associations between the baseline levels of the outcome variables and covariates and other demographic variables were assessed using Pearson's product-moment correlation coefficients and are presented in Table 7-9. Intercorrelations between the support and caregiver burden predictor variables are in Table 7-10. Correlations between covariates and outcome variables at T2 are presented in Table 7-11. Associations between support and caregiver burden predictor variables and outcome variables at T2, and baseline levels of outcome variables and T2 levels are in Table 7-12. Finally, intercorrelations between outcome variables at T2 are presented in Table 7-13. All results are reported as Pearson's r and p-values.

Of the covariates, pre-surgery physical health status levels were poorer in older partners (r = -.294, p = .003) and depression symptoms were higher in those of lower occupational classification (r = .028, p = .039). Of the other demographic variables examined in this study, a worse pre-surgery physical component score was associated with being unemployed (r = .237, p = .019) and a greater number of marital years (r = -.365, p <.001) (Table 7-9).

Table 7-9 Correlations between covariates and T1 scores

		Outcome variables T1			
		Depression	**Anxiety**	**Mood**	**PCS**
Covariates					
Age	r	.104	.039	-.002	-.294
	p	.307	.698	.982	**.003**
Ethnicity	r	.022	-.038	.002	.060
	p	.828	.706	.981	.558
Occupation classification	r	.208	.108	-.106	-.018
	p	**.039**	.288	.303	.864
EuroSCORE	r	.056	.091	-.074	-.198
	p	.587	.373	.475	.051
Demographics					
Education	r	-.071	-.103	-.008	.007
	p	.492	.313	.935	.949
Employment	r	.011	.003	-.052	.237
	p	.911	.979	.613	**.019**
Income	r	-.054	-.084	.072	.187
	p	.604	.417	.493	.069
Marital years	r	.121	.113	-.062	-.365
	p	.234	.265	.544	**<.001**
Number in household	r	-.035	-.146	.032	-.556
	p	.915	.651	.921	.060

List of abbreviations: physical component score (PCS)

All pre-surgery support variables were significantly inter-correlated (highest Pearson's r = .642 between social support and emotional marital support), with the exception of practical marital support and negative marital functioning. The three caregiver burden scores were highly intercorrelated (highest Pearson's r = .897 between difficulty burden and total burden change scores), however the total burden score is a composite of the time and difficult subscales so would be expected to be highly correlated. With this exception, screening for multicollinearity between variables revealed that no correlations were greater than the threshold of .80 (Katz, 2006), so were not considered problematic. Support and caregiver burden scores were not significantly associated, with the exception of negative marital functioning and time burden change scores (r = -.203) indicating a relatively strong independence between the predictor variables (Table 7-10).

Table 7-10 Intercorrelations between predictor variables

		T1				**Change**		
		Social support	**Negative marital support**	**Practical marital support**	**Emotional marital support**	**Time burden change**	**Difficulty burden change**	**Total burden change**
Support variables T1								
Social support	r	1	-.413	.311	.642	.032	-.102	-.036
	p	-	**<.001**	**.002**	**<.001**	.758	.320	.726
Negative marital support	r	-.413	1	-.159	-.414	-.203	.036	-.089
	p	**<.001**	-	.119	**<.001**	**.046**	.729	.384
Practical marital support	r	.311	-.159	1	.476	.072	-.002	.048
	p	**.002**	.119	-	**<.001**	.480	.984	.642
Emotional marital support	r	.462	-.414	.476	1	.042	.009	.036
	p	**<.001**	**<.001**	**<.001**	-	.686	.993	.727
Caregiver variables								
Time burden change	r	.032	-.203	.072	.042	1	.514	.836
	p	.758	**.046**	.480	.686	-	**<.001**	**<.001**
Difficulty burden change	r	-.102	.036	-.002	.009	.514	1	.897
	p	.320	.729	.984	.933	**<.001**	-	**<.001**
Total burden change	r	-.036	-.089	.048	.036	.836	.897	1
	p	.726	.384	.642	.727	**<.001**	**<.001**	-

Regarding the covariates and outcomes at T2, only age was significantly correlated with physical component score (r = -.363, p <.001) with higher scores reported by younger participants (Table 7-11).

Table 7-11 Correlations between covariates and outcomes

		Outcome variables T2			
		Depression	Anxiety	Mood	PCS
Covariates					
Age	r	.119	-.053	-.045	-.363
	p	.242	.602	.656	**<.001**
Ethnicity	r	-.026	.135	.013	.094
	p	.800	.184	.901	.357
Occupation classification	r	.149	.106	-.041	-.091
	p	.140	.298	.684	.369
EuroSCORE	r	.033	-.003	-.023	-.192
	p	.750	.980	.823	.058

For pre-surgery support variables, low social support was associated with worse post-surgery depression symptoms (r = -.332, p = .001) and mood (r = .295, p = .003), and a high level of negative marital functioning was associated with less favourable scores for all outcome variables. A greater increase in difficulty and total burden scores was significantly associated with worse depression symptoms, anxiety and mood. Baseline emotional variables were significantly correlated with all T2 emotional outcomes. In addition, worse T1 depression symptoms were associated with a worse T2 physical component score (r = -.241, p = .016), and a higher T1 physical component score was associated with worse depression symptoms (r = -.394, p <.001), anxiety (r = -.249, p = .013) and physical component score (.720, p <.001) at follow-up (Table 7-12).

Table 7-12 Correlations between baseline/predictor variables and outcomes

		Outcome variables T2			
		Depression	**Anxiety**	**Mood**	**PCS**
Support variables T1					
Social support	r	-.332	-.160	.295	.130
	p	**.001**	.116	**.003**	.203
Negative marital support	r	.358	.293	-.303	-.237
	p	**<.001**	**.003**	**.002**	**.019**
Practical marital support	r	.115	.078	-.037	-.147
	p	.256	.444	.714	.145
Emotional marital support	r	-.143	.021	.066	-.008
	p	.159	.838	.516	.940
Caregiver variables					
Time burden change	r	.057	.066	-.044	.047
	p	.579	.518	.670	.645
Difficulty burden change	r	.316	.295	-.324	-.047
	p	**.002**	**.003**	**.001**	.649
Total burden change	r	.222	.211	-.225	-.002
	p	**.028**	**.037**	**.026**	.988
Outcome variables T1					
Depression	r	.825	.601	-.568	-.241
	p	**<.001**	**<.001**	**<.001**	**.016**
Anxiety	r	.420	.565	-.413	-.112
	p	**<.001**	**<.001**	**<.001**	.268
Mood	r	-.439	-.446	.489	.185
	p	**<.001**	**<.001**	**<.001**	.069
PCS	r	-.394	-.249	.166	.720
	p	**<.001**	**.013**	.101	**<.001**

All post-surgery outcome variables were significantly intercorrelated, with the exception of anxiety and physical component score. However, physical and emotional variables were not highly correlated (highest Pearson's r -.391 between depression symptoms and physical component score), so can be considered conceptually separate aspects of the partners' adjustment following surgery (Table 7-13).

Table 7-13 Intercorrelations between outcomes

Outcome variables T2		Depression	Anxiety	Mood	PCS
Depression	r	1	.679	-.683	-.391
	p	-	**<.001**	**<.001**	**<.001**
Anxiety	r	.679	1	-.618	-.140
	p	**<.001**	-	**<.001**	.166
Mood	r	-.683	-.619	1	.205
	p	**<.001**	**<.001**	-	**.042**
PCS	r	-.391	-.140	.205	1
	p	**<.001**	.166	**.042**	-

7.6 Predictors of post-surgery outcomes

Testing of the hypotheses was conducted with multiple regression analyses. Initially, support variables (both general and marital) were used as independent variables, and then variables of caregiver burden were used in models predicting emotional (depression symptoms, anxiety and mood) and physical outcomes (physical component score). All results are presented as standardised regression coefficients (β), standard errors (SE) and p-values (p).

7.6.1 Social support as a predictor

First, non-marital social support was examined as a predictor of all emotional post-surgery outcomes. In these models related to social support, support variables and covariates were entered in one step, and together accounted for 68.3% of the variance for T2 depression symptoms, 36% for anxiety and 28.2% for mood (Table 7-14). In all three models, baseline levels of the outcome variable were independent predictors, and in addition, ethnicity was a predictor of anxiety. Social support was not an independent predictor of depression symptoms or anxiety but did significantly predict post-surgery mood (β = .194, p = .040). Higher levels of social support predicted larger improvements to mood following surgery, in support of hypothesis I.

Table 7-14 Social support predicting T2 emotional outcomes

	Depression			**Anxiety**			**Mood**		
	β	**SE**	**P**	**β**	**SE**	**P**	**β**	**SE**	**P**
Step 1									
Age	.051	.057	.501	-.068	.042	.531	-.063	.145	.583
Ethnicity	-.027	2.080	.658	.183	1.546	.034	.023	5.267	.800
Baseline	.821	.065	<.001	.552	.069	<.001	.451	.097	<.001
EuroSCORE	-.043	.171	.569	-.006	.128	.957	.036	.437	.755
Occupational classification	-.026	.509	.672	.080	.375	.355	.006	1.276	.950
Social support	-.019	.087	.775	-.075	.061	.393	.194	.209	**.040**
R^2	.683			.360			.282		

In the model predicting physical outcomes, social support and covariates accounted for 52.5% of the variance in physical component score (Table 7-15). However, only the baseline level of the outcome variable was a significant predictor of physical component score, and social support was not.

Table 7-15 Social support predicting T2 physical outcomes

	PCS		
	β	**SE**	**P**
Step 1			
Age	-.144	.122	.119
Ethnicity	.040	4.352	.574
Baseline	.683	.081	<.001
EuroSCORE	.026	.359	.776
Occupational classification	-.025	1.047	.721
Social support	.127	.169	.079
R^2	.525		

7.6.2 Marital functioning as a predictor

The second stage of multivariate analyses examined the predictive value of the three sub-types of marital functioning for both emotional and physical outcomes. In the models predicting emotional outcomes, all three types of marital functioning and all covariates were entered together. Together these accounted for 69.5% of the variance in depression symptoms, 38.3% for anxiety and 27.3% for mood (Table 7-16). Again, baseline scores of the outcome variable were significant predictors of outcomes, and again ethnicity predicted anxiety. However, no marital functioning subscales independently predicted any of the emotional outcomes.

Table 7-16 Marital functioning predicting T2 emotional outcomes

	Depression			**Anxiety**			**Mood**		
	β	**SE**	**P**	**β**	**SE**	**P**	**β**	**SE**	**P**
Step 1									
Age	.049	.055	.513	-.068	.041	.518	-.090	.146	.434
Ethnicity	-.022	2.081	.714	.180	1.554	.037	.030	5.389	.748
Baseline	.793	.065	<.001	.520	.072	<.001	.443	.102	<.001
EuroSCORE	-.046	.168	.535	-.011	.126	.914	.068	.440	.554
Occupational classification	-.028	.500	.649	.066	.367	.441	.011	1.307	.904
Negative MF	.080	.181	.248	.162	.136	.102	-.163	.475	.133
Practical MF	.087	.193	.204	.061	.143	.526	-.029	.507	.782
Emotional MF	-.010	.102	.887	.026	.077	.803	.019	.268	.868
R^2	.695			.383			.273		

In the model predicting physical outcomes, marital functioning and covariates explained 57.1% of the variance in physical component score. However, again only baseline scores significantly predicted post-surgery physical component scores (Table 7-17).

Table 7-17 Marital functioning predicting T2 physical outcomes

	PCS		
	β	**SE**	**P**
Step 1			
Age	-.172	.121	.061
Ethnicity	.049	4.368	.491
Baseline	.678	.088	<.001
EuroSCORE	.041	.355	.643
Occupational classification	-.014	1.056	.849
Negative MF	-.156	.375	.056
Practical MF	.113	.433	.190
Emotional MF	-.097	.217	.274
R^2	.571		

7.6.3 Caregiver burden change as a predictor

The second set of predictor variables were the caregiver burden change scores. In the models predicting emotional outcomes, initially the total burden change score was entered with covariates in one step and together accounted for 69.8% of the variance in depression symptoms, 40.3% for anxiety and 30.2% for mood (Table 7-18). Together with baseline scores, the change in the amount of total caregiver burden significantly predicted worse levels of all three types of emotional outcomes after surgery, in support of hypothesis II. In order to delineate this relationship, post-hoc tests using individual models were created for time burden and difficulty burden change. In the time burden models, covariates and time burden change scores accounted for 69% of the variance in depression symptoms, 33% for anxiety and 25.2% for mood (Table 7-19 7-19). Only baseline levels were significant predictors and time burden change did not predict post-surgery emotional variables.

Table 7-18 Total burden predicting T2 emotional outcomes

	Depression			Anxiety			Mood		
	β	**SE**	**P**	**β**	**SE**	**P**	**β**	**SE**	**P**
Step 1									
Age	.059	.054	.420	-.052	.040	.612	-.118	.142	.292
Ethnicity	-.044	2.057	.458	.151	1.521	.073	.059	5.280	.517
Baseline	.711	.060	<.001	.576	.065	<.001	.490	.093	<.001
EuroSCORE	-.036	.166	.619	-.003	.123	.976	.062	.428	.581
Occupational classification	-.021	.501	.725	.076	.363	.360	-.005	1.297	.957
Total burden change	.120	.053	**.047**	.207	.039	**.014**	-.239	.135	**.010**
R^2	.698			.403			.302		

Table 7-19 Time burden predicting T2 emotional outcomes

	Depression			Anxiety			Mood		
	β	**SE**	**P**	**β**	**SE**	**P**	**β**	**SE**	**P**
Step 1									
Age	.046	.055	.530	-.069	.041	.512	-.102	.146	.377
Ethnicity	-.043	2.101	.478	.159	1.568	.067	.039	5.498	.681
Baseline	.830	.060	<.001	.583	.067	<.001	.495	.096	<.001
EuroSCORE	-.037	.167	.617	-.006	.125	.957	.069	.441	.553
Occupational classification	-.023	.497	.702	.082	.365	.335	-.007	1.314	.943
Time burden change	.075	.587	.217	.112	.441	.198	-.074	1.548	.438
R^2	.690			.330			.252		

The difficulty burden models accounted for 70.1% of the variance in depression symptoms, 38.5% for anxiety and 34.8% for mood (Table 7-12). Together with baseline scores, difficulty burden change independently predicted depression symptoms (β = .136, p = .026), anxiety (β = .255, p = .002) and mood (β = -.323, p

<.001). A larger increase in difficulty burden predicted a smaller improvement to emotional outcomes after surgery, again in support of hypothesis II.

Table 7-20 Difficulty burden predicting T2 emotional outcomes

	Depression			**Anxiety**			**Mood**		
	β	**SE**	**P**	**β**	**SE**	**P**	**β**	**SE**	**P**
Step 1									
Age	.067	.054	.357	-.038	.039	.708	-.138	.137	.204
Ethnicity	-.037	2.021	.522	.159	.75	.051	.051	5.035	.555
Baseline	.797	.060	<.001	.563	.064	<.001	.484	.090	<.001
EuroSCORE	-.043	.164	.552	-.012	.120	.905	.069	.411	.522
Occupational classification	-.038	.485	.521	.046	.349	.568	.034	1.221	.698
Difficulty burden change	.136	.805	**.026**	.255	.571	**.002**	-.323	1.965	**<.001**
R^2	.701			.385			.348		

The next model returned to using total burden as the independent variable predicting physical component score. Total burden change and covariates together accounted for 54.1% of the variance in physical component score (Table 7-21). However, baseline scores were the only significant predictor of physical component score at T2 and therefore no post-hoc analyses with the components of caregiver burden were conducted.

Table 7-21 Total burden predicting T2 physical outcomes

	PCS		
	β	SE	P
Step 1			
Age	-.181	.123	.053
Ethnicity	.038	4.481	.601
Baseline	.670	.083	<.001
EuroSCORE	.043	.362	.631
Occupational classification	-.046	1.090	.530
Total burden change	.005	.115	.946
R^2	.541		

7.7 The relationship between support and caregiver burden variables

The analyses from the previous section (section 7.6) revealed that social support predicted post-surgery mood but no other relationships between support variables and outcome variables. However, total caregiver burden change scores predicted all emotional outcomes, and change in difficulty burden was identified as the key component explaining this. While caregiver burden scores were seen to significantly increase, all the support variables significantly decreased after surgery, with the exception of negative marital functioning. A number of further analyses were conducted to attempt to elucidate the relationship between support and caregiver burden.

In the first part of these analyses, hypothesis IIIa, that the increase in caregiver burden explains the decrease in support was examined using multivariate analyses. Models predicting post-surgery levels of the three support variables which decreased over time (social support, practical marital support and emotional marital support) were created, and total burden change and covariates (including baseline levels of each support variable) were entered in one step. Together these accounted for 46.2% of the variance in social support, 8.4% for practical marital support and 32.2% for emotional marital support. Baseline levels of support were significant predictors of outcomes in all models, however total burden change was a significant predictor of social support alone (β = -.184, p =.022). A smaller increase in total caregiver burden predicted a smaller decrease in social support after surgery (Table 7-22), in support of the hypothesis IIIa.

Table 7-22 Total burden predicting T2 support outcomes

	Social support			Practical MF			Emotional MF		
	β	**SE**	**P**	**β**	**SE**	**P**	**β**	**SE**	**P**
Step 1									
Age	.019	.062	.846	-.029	.029	.820	.070	.058	.521
Ethnicity	.030	2.284	.706	-.026	1.100	.803	-.040	2.207	.653
Baseline	.651	.088	<.001	.254	.089	.014	.552	.087	<.001
EuroSCORE	-.051	.186	.606	-.106	.088	.403	-.020	.177	.856
Occupational classification	-.030	.556	.701	.058	.260	.567	.061	.525	.490
Total burden change	-.184	.058	**.022**	-.037	.028	.718	-.104	.056	.243
R^2	.462			.084			.322		

Individual models of time burden and difficulty burden change were used to predict T2 social support. In the first model, time burden change and covariates accounted for 46.3% of the variance in social support, and as well as baseline scores, time burden change scores independently predicted social support (β = -.187, p =.022). A greater increase in the time burden predicted larger decreases in social support (Table 7-23).

Table 7-23 Time burden predicting T2 social support

	Social support		
	β	SE	P
Step 1			
Age	.037	.061	.712
Ethnicity	.042	2.297	.602
Baseline	.662	.087	<.001
EuroSCORE	-.058	.185	.557
Occupational classification	-.048	.545	.539
Time burden change	-.187	.647	**.022**
R^2	.463		

In the second model, difficulty burden and covariates explained 45.2% of the variance in social support, however difficulty burden change did not significantly predict post-surgery social support (Table 7-24). The increase in the amount of time performing caregiving tasks after surgery, as opposed to the increased difficulty, explained the decreases in social support.

Table 7-24 Difficulty burden predicting T2 social support

	Social support		
	β	SE	P
Step 1			
Age	.015	.062	.884
Ethnicity	.015	2.279	.845
Baseline	.643	.088	<.001
EuroSCORE	-.042	.187	.675
Occupational classification	-.009	.549	.908
Difficulty burden change	-.147	.889	.068
R^2	.452		

In the second part of the analyses, hypothesis IIIb, that caregiver burden would be related to emotional outcomes differently for the participants with low and high levels of social support was tested. A binary variable was created for social support based on a median split (≤29<), distinguishing participants in the 'high' and 'low' social support groups. Initially, in multivariate analysis, the sample was split on the binary social support variable, and the caregiver burden regression analyses predicting depression symptoms, anxiety and mood were run separately for the low and high support groups. Variables were entered in the same fashion as described in section 7.6.3.

Table 7-25 Total burden predicting T2 depression for high/low social support

	Depression – high social support			**Depression – low social support**		
	β	**SE**	**P**	**β**	**SE**	**P**
Step 1						
Age	.096	.053	.262	.012	.118	.933
Ethnicity	-.136	2.012	.095	-.056	4.394	.578
Baseline	.922	.082	<.001	.797	.108	<.001
EuroSCORE	-.081	.176	.361	-.003	.335	.983
Occupational classification	-.023	.576	.764	-.005	.949	.962
Total burden change	.330	.073	**<.001**	-.012	.093	.911
R^2	.804			.628		

In the model predicting depression symptoms, total burden change and covariates together explained 80.4% of the variance in depression symptoms for the high social support group, and 62.8% for the low social support group. For both groups, baseline depression symptoms were predictors of T2 depression symptoms. For the high social support group, total burden change was also a significant predictor (β = .330, p =<.001), but not for the low social support group (Table 7-25). Caregiver burden change predicted depression symptoms only in participants with high social support, supporting hypothesis IIIb.

Table 7-26 Total burden predicting T2 anxiety for high/low social support

	Anxiety – high social support			Anxiety – low social support		
	β	**SE**	**P**	**β**	**SE**	**P**
Step 1						
Age	.156	.054	.331	-.378	.061	.015
Ethnicity	.143	2.041	.343	.289	.175	.011
Baseline	.496	.108	.002	.639	.095	<.001
EuroSCORE	-.084	.109	.636	.343	.175	.033
Occupational classification	.035	.591	.812	.197	.481	.093
Total burden change	.121	.077	.431	.140	.046	.198
R^2	.288			.572		

In the anxiety model, total burden change and covariates explained 28.8% of the variance in anxiety for the high support group, and 57.2% for the low support group. In the high social support group, only baseline anxiety predicted T2 anxiety. In the low support group, baseline anxiety scores, ethnicity and the patients' EuroSCORE were the only independent predictors. Total burden change did not predict T2 anxiety in either the high or low social support group (Table 7-26), though the model on the full sample showed it to be a significant predictor (see Table 7-18). Splitting the sample by social support level showed caregiver burden was not associated with anxiety for either group.

Table 7-27 Total burden predicting T2 mood for high/low social support

	Mood – high social support			**Mood – low social support**		
	β	**SE**	**P**	**β**	**SE**	**P**
Step 1						
Age	-.191	.197	.231	.053	.211	.767
Ethnicity	.067	7.365	.654	.167	7.768	.195
Baseline	.483	.157	.002	.559	.135	<.001
EuroSCORE	.041	.672	.811	-.084	.592	.648
Occupational classification	.133	2.153	.363	-.118	1.646	.392
Total burden change	.067	.282	**.029**	-.066	.158	.608
R^2	.307			.397		

In the model predicting mood, total burden change and covariates accounted for 30.7% of mood in the high support group and 39.7% in the low support group. For both groups, baseline mood predicted T2 mood, however in the high support group only, total burden change was also a significant predictor (β = .067, p =.029) (Table 7-27). Again, caregiver burden change predicted mood only in participants with high social support, supporting hypothesis IIIb.

For both depression symptoms and mood, caregiver burden change was a significant predictor for only participants with high T1 social support. To further illustrate these findings, a binary variable was created for total burden change based on a median split (≤3.75<), distinguishing participants with a 'high burden increase' indicating a large increase in burden, and 'low burden increase' indicating a smaller increase or a decrease. Consequently, I created four groups:

1) High social support + low burden increase
2) High social support + high burden increase
3) Low social support + low burden increase
4) Low social support + high burden increase

Figure 7-2 T2 Depression by social support and burden change groups

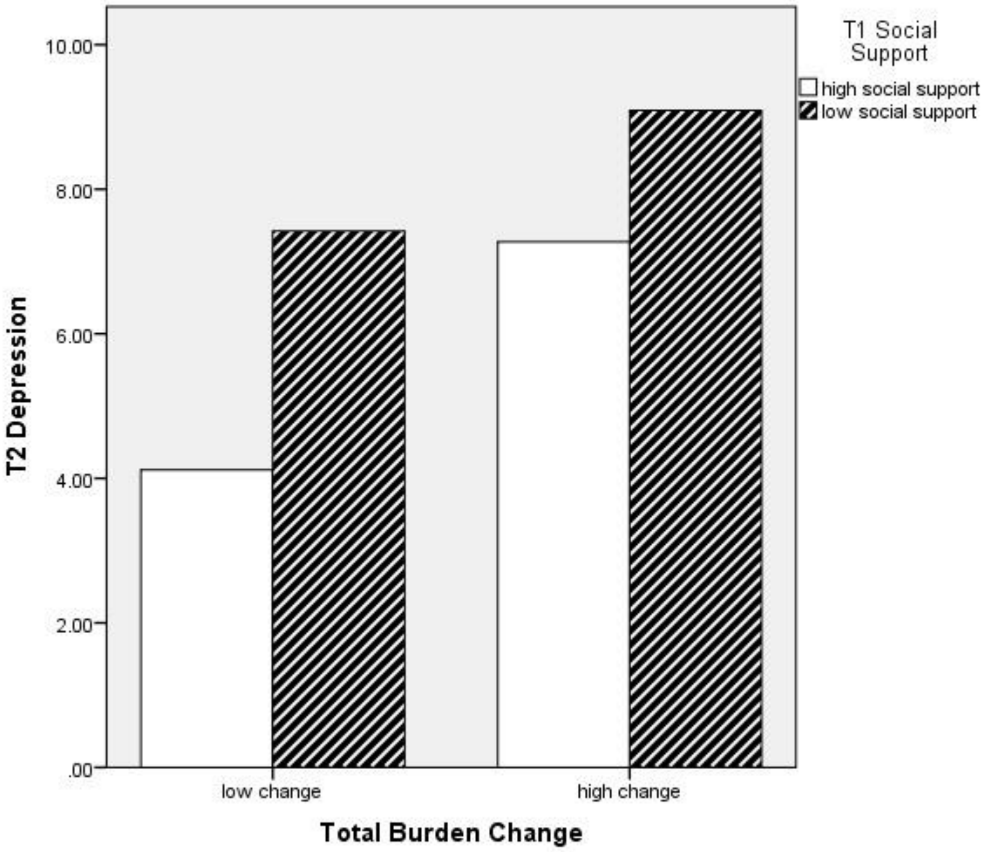


Figure 7-2 illustrates that participants with a larger increase in caregiver burden experienced greater depression symptoms at T2 than those with a smaller increase. Those with lower social support experienced greater depression symptoms than those with higher social support. In order for social support to have a particular benefit for participants with a larger increase in caregiver burden (stress-buffering), the mean depression symptom increase with greater burden would need to be smaller in the high support group. However this is not demonstrated in the data, so the interaction was not as predicted.

Figure 7-3 T2 mood by social support and burden change groups

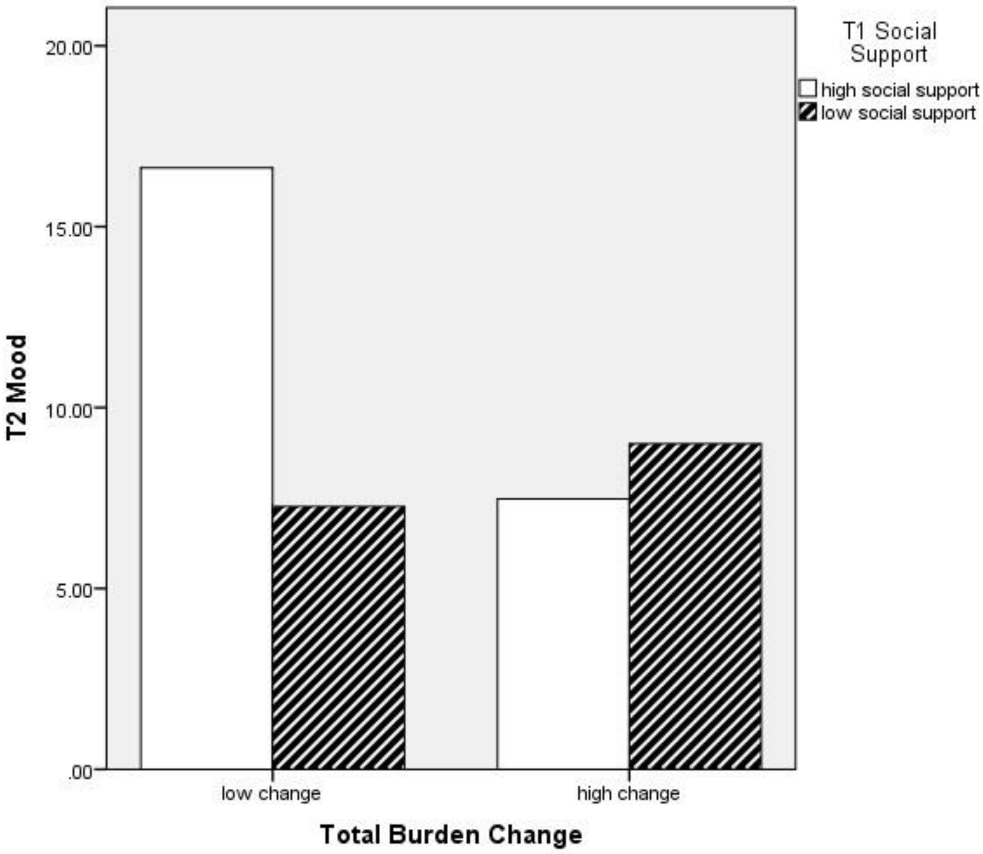


Figure 7-3 also reveals unexpected results; participants with low social support experienced little difference in mood with low or high caregiver burden. However, participants with high social support who reported larger increases to burden had much lower mood than those with a smaller increase. As with depression symptoms, high social support did not provide a particular benefit for those with a greater increase to burden compared to a smaller increase.

7.8 Comparing patients and partners

Comparisons were made between the 99 partners and their corresponding patients for all emotional and support variables at baseline and T2 using t-tests. Mean scores, standard deviations (presented in parentheses) and p-values are presented in Table 7-28.

Table 7-28 Comparing patients and partners

	Time 1			Time 2		P-value
	Patients	**Partners**	**P-value**	**Patients**	**Partners**	
Emotional variables						
Depression	7.82 (5.88)	7.35 (6.05)	.549	6.24 (5.12)	7.00 (6.00)	.285
Anxiety	5.59 (3.92)	6.24 (3.98)	.263	3.77 (3.54)	5.44 (3.15)	**<.001**
Mood	9.57 (10.38)	8.89 (9.75)	.717	13.51 (9.82)	10.64 (10.02)	**.031**
Support variables						
Social support	31.45 (3.47)	28.40 (4.51)	**<.001**	32.02 (2.94)	25.73 (5.05)	**<.001**
Marital functioning						
Negative support	6.33 (2.22)	7.20 (2.29)	**.017**	5.40 (1.68)	7.36 (2.32)	**<.001**
Practical support	8.76 (2.54)	8.04 (2.12)	**.029**	9.56 (2.13)	5.63 (1.84)	**<.001**
Emotional support	22.60 (3.97)	21.71 (4.27)	.105	23.52(3.89)	16.85 (4.27)	**<.001**

At baseline, partners had significantly higher levels of negative marital functioning and lower levels of practical marital support and general social support than patients. At T2, partners were significantly more anxious and had lower mood and worse scores for all support variables than the patients, in support of hypothesis IV. Partners had consistently lower levels of general and positive marital support than the patients.

7.9 Additional analyses

Some additional analyses were conducted to address some important issues arising from the literature and the data. Results are reported in full in Appendix 4. Because a large proportion of partners (35.7%) were caring for another family member or friend prior to surgery, this may have influenced the impact that adopting the caregiver role for the patient had on their emotional distress. Therefore, the models in which caregiver burden change predicted outcomes (Table

7-18) were repeated separately for those who reported giving care to others before surgery and those who did not. Caregiver burden change predicted depression symptoms only in those who were not giving care to others. However, caregiver burden change predicted anxiety in both groups, but predicted mood in neither group. Post-hoc analyses revealed that difficulty burden predicted depression symptoms in those not giving care. Difficulty burden also predicted anxiety in those who *were* giving care, while time burden predicted anxiety in those *not* giving care. In addition, the model in which time burden predicted decreases in social support (Table 7-23) was repeated splitting the sample according to whether or not they were employed to evaluate whether having other roles contributed to this association. Time burden predicted T2 social support only in those who were employed.

7.10 Summary

In summary, the results for analyses of a sample of predominantly middle aged, white, educated, female partners of CABG surgery patients are depicted in Table 7-29.

Table 7-29 Summary of partner results

	Finding
Changes over time	Anxiety improved and depression symptoms and mood remained stable after surgery. Physical component scores worsened after surgery. Social support, practical and emotional marital functioning worsened after surgery. Negative marital functioning remained stable. Time burden, difficulty burden and overall caregiver burden worsened after surgery.
Correlations	Worse baseline levels of emotional and physical distress were associated with older age, being unemployed, a lower occupational classification and a longer relationship duration. Worse emotional and physical outcomes were associated with older age, lower social support, more negative marital functioning, and a greater increase in difficulty burden.
Regressions	Social support predicted mood, but marital functioning did not predict outcomes, and no support variables predicted depression symptoms, anxiety or physical component score. Total caregiver burden, and difficulty burden in particular predicted all emotional outcomes, but time burden did not predict outcomes and no burden variables predicted physical component score.
Interactions	Total caregiver burden, and time burden in particular predicted the decrease in social support but not in marital functioning. Total caregiver burden predicted depression symptoms and mood for partners with high social support only. High levels of support did not provide a particular benefit for partners with a greater increase in caregiver burden.
Comparing patients and partners	At baseline, partners had significantly worse social support and negative and practical marital support than patients. At T2, partners had significantly higher anxiety, lower mood and worse scores for all support variables than patients.

Additional analyses	Caregiver burden predicted depression symptoms only in those not caring for others before surgery, and anxiety both in those caring and not caring for others. Time burden predicted social support only in those in employment.

Table 7-30 depicts the results in relation to the hypotheses.

Table 7-30 Partner results in relation to hypotheses

Finding	In relation to hypothesis
Social support was a significant predictor of mood. Social support did not predict depression symptoms, anxiety or physical health status. Marital functioning did not predict outcomes.	Hypothesis I – support variables are predictors of adjustment following surgery.
Total and difficulty caregiver burden were significant predictors of depression symptoms, anxiety and mood. Time burden did not predict outcomes.	Hypothesis II – caregiver burden variables are predictors of adjustment following surgery.
Total and time caregiver burden predicted reductions in social support. Total caregiver burden predicted depression symptoms and mood only for partners with high levels of support. Caregiver burden did not predict anxiety in high or low social support groups. High social support did not improve emotional distress in those with large increases to caregiver burden.	Hypothesis III – caregiver burden influences support and support influences the impact of caregiving on adjustment following surgery.

Partners reported lower emotional well-being after surgery, and less support both at baseline and after surgery. Patients and partners did not differ in post-operative depression symptoms or pre-surgery emotional distress.	Hypothesis IV – partners experience worse levels of emotional and support variables than patients.

7.11 Discussion

This study investigated the influences of support (both giving and receiving) on post-surgery psychological and physical adjustment in the partners of CABG patients. It aimed to test whether support and caregiving factors contributed to the partners' risk of distress, and how these two influences were related.

7.11.1 Discussion of the data

The sample was dependent on the recruitment and retention of patients in the ARCS study. Partners were excluded if the corresponding patient did not participate or remain in the study, consequently the response rates were somewhat lower and attrition rates higher than for the patient sample. Surprisingly, patients with less favourable support were more likely to have participating partners, suggesting that partners perceived as giving more support were potentially underrepresented in this sample.

The participants were on average slightly older than in many of the other CABG partner studies. The majority were retired and not living with young children, suggesting a smaller risk of competing roles, but a greater risk of difficulty with caregiving in terms of older age. The physical health of the sample was not notably poor in terms of chronic conditions, but the frequent health service use suggests the presence of some baseline health problems. The corresponding patients were representative of the whole sample, with variation in factors determining how they might recover. For example, the wide range in length of stay demonstrated variability in the stage of recovery at which partners take on the caregiving role. However, variation in the length of time between surgery and the completion of T2 questionnaires (mean 61 days) limits the ability to draw conclusions on the basis of the stage of the patient's recovery.

Pre-surgery levels were assessed on average 29 days before surgery, minimising the risk of proximity to the procedure inflating distress scores. Baseline mean levels of emotional distress were relatively low; depression symptom scores (mean 7.35) were lower than those reported by de Klerk et al (2006) (the only other study reporting BDI scores in CABG partners – 14.80), though their assessments made one day before surgery were likely to be inflated. No studies which used the HADS to measure anxiety reported mean scores, but my scores (mean 6.24) were slightly higher than norms of healthy women of a similar age (HADS 5.37-5.64 - (Gale et al., 2010)). However, approximately a fifth of the sample (20.2%) had elevated depression symptoms (≥10), and a quarter (25.3%) elevated anxiety (≥8) (anxiety prevalence is comparable to Davies et al (2000) - 24%), indicating that a notable proportion of partners were emotionally distressed prior to surgery. However, the large proportion of partners reporting positive mood (>0; 80%) indicates that scores were high, though comparisons to other samples are not possible with this measure. Physical health status scores (mean 49.84) were similar to population norms for the physical component score of the SF-12 (49.54 - women aged 18-64 (Jenkinson et al., 1999), 50.9 – healthy adults aged 18-74 (Gandek et al., 1998)), but slightly lower than women with no longstanding illness (53.64 - (Jenkinson et al., 1999)). Thus some partners had elevated emotional and physical distress at baseline, suggesting a higher risk of post-surgery distress.

The post-surgery assessments taken 61 days (8 weeks) after the procedure revealed that anxiety (mean 5.44) significantly improved to levels comparable with population norms (HADS 5.37-5.64 - (Gale et al., 2010)), confirming the findings of Langeluddecke et al (1989) who saw declines in anxiety after compared to before surgery. However, depression symptoms and mood scores were stable; elevated depression symptoms continued to affect 21.2% of the sample, and mood scores improved but not significantly, contradicting a number of previous studies which showed improvements (Langeluddecke et al., 1989; Nieboer et al., 1998; Ruiz et al., 2006). Physical health status scores decreased, but the significance value of $p = .05$

should be interpreted with caution. However, for all outcomes, there is evidence of variability across the sample. For example, some partners' depression symptom scores increased by 10 points while others decreased by 8, and mood scores saw similar fluctuations (increases and decreases of 36 and 27 points, respectively). Consequently, though scores did not worsen on average, significant proportions experienced post-surgery distress, so this will be a relevant sample upon which to test the hypotheses of this PhD.

Regarding the risk factors of interest, baseline social support levels were high (mean 28.40), though no studies which used the ESSI in partners of cardiac patients reported mean scores, making comparisons difficult. Marital functioning scores were mostly positive (negative - 7.20, practical - 8.04, emotional - 21.67), similar to other studies (K. B. King et al., 1993; Langeluddecke et al., 1989), but were slightly less favourable than those of healthy adults (Whitehall II data, negative - 6.78, practical – 8.67, emotional – 22.46, see Footnote 4 in Chapter 6). The support data was positively skewed and there was an element of variability across all variables, with some participants giving the lowest scores on some measures.

Levels of caregiving variables were low before surgery, though no other authors using this scale measured pre-surgery burden, making comparisons impossible. A very small proportion (0% and 6.1%) crossed the thresholds (≥3), and the number of hours spent giving care were considerably lower than typically reported in caregivers of patients with chronic conditions such as cancer (Yabroff & Kim, 2009). The finding is notable in view of the fact that some patients would have been quite disabled by their cardiac symptoms before surgery, but evidently did not require much direct care. Interestingly I observed that a number of partners were regularly giving care to other family members or friends, a factor which was controlled for in additional analyses. All caregiving variables increased after surgery, but only one other study has reported pre-surgery caregiver burden levels in CABG patients. Ruiz et al (2006) found no significant differences in burden following surgery, though their time scale is not comparable to mine (pre-surgery and 18 months post), so this is the first study to statistically show increases in caregiving in early recovery compared to before surgery.

The post-operative burden levels compared interestingly with other studies using the Oberst Caregiver Burden Scale (OCBS). Time burden scores were higher than those of Stolarik et al (2000) and Park et al (2013) (a cross-sectional, descriptive study of 35 CABG partners using the OCBS), but lower than those of Halm et al (2006), and the reverse is true for time burden. These studies took measurements at increasing distance from surgery ((Stolarik et al., 2000) at 1 week, (Park et al., 2013) at 3 weeks, my study at 2 months and (Halm et al., 2006) at 7.5 months). So the differences between studies could be due to the possibility that time burden increases over time and difficulty decreases, but this will be influenced by variability in time point of the assessment. The mean age of these samples also increased ((Stolarik et al., 2000) - 51-60, (Park et al., 2013) - 60, this study - 66 and (Halm et al., 2006) - 67), and so scores may differ because of the possibility that younger partners find caregiving more difficult but less time-consuming. The types of tasks perceived as most time-consuming and difficult are reflective of the restrictions placed on patients during acute recovery such as not lifting or driving for the first weeks, and probable emotional and informational needs, and are similar to those reported in other studies (Halm et al., 2006; Park et al., 2013). These preliminary findings illustrate that a proportion of partners are at risk of distress after surgery, and variation in their levels of support and increases in their perceptions of caregiver burden imply these may be relevant risk factors.

7.11.2 Discussion by hypothesis

I. Social relationships measured prior to CABG surgery will predict post-surgery partner emotional and physical adjustment.

The regression analyses identified that a higher level of social support before surgery was an independent predictor of post-operative mood. This confirms the findings of King et al (1993), the only other study to find that social support predicted everyday mood, and advances them by also controlling for covariates aside from support. Interestingly, no marital functioning subscales significantly predicted any emotional outcomes in my study, unlike Ruiz et al (2006) who found pre-surgery marital satisfaction predicted post-operative depression symptoms.

Despite explaining between 27.3% and 69.5% of the variance in emotional outcomes, of the variables in the models only baseline distress significantly predicted post-operative scores. These findings suggest that the quality of the marital relationship has perhaps a smaller influence on the partner's well-being than their assessment of global support from all sources. Rantanen et al (2008) also found the social network was the most important source of support for partners, though not in comparison to the spouse, and no studies measuring marital and global support reported them to have distinct influences on outcomes. This may have important implications for interventions.

Notably, I did not find any support variables were relevant for anxiety, depression symptoms or physical health status levels, in line with the study by Thomson et al (2011), but in contrast with findings from other studies (K. B. King et al., 1993; Ruiz et al., 2006; Thomson, 2008). Only partner factors (pre-surgery distress and ethnicity) were significant predictors, but, to a certain extent social relationships are relevant to partners' adjustment, providing some support for this hypothesis and arrow 3 of the conceptual model (Chapter 3, section 3.9).

II. The burden of caring for the patient will predict post-surgery emotional and physical adjustment.

I wanted to test whether the increase in caregiving for (or giving support to) the patient during their recovery was a risk factor for the partner's distress, and found that it was. Regression analyses revealed that the change in caregiver burden predicted all three post-operative emotional distress variables. Thus a larger increase in overall burden predicted smaller improvements to depression symptoms, anxiety and mood after surgery. This confirms findings from the study by Nieboer et al (1998) who also took into account changes in the amount of caregiving and found they were related to depression symptoms. My study has the advantage of comparing post-surgery caregiving to pre-surgery levels, emphasising the relevance of entering into a caregiving role for distress. No other studies assessed the potential outcomes of caregiver burden, so these findings bring new information regarding its influence on emotional distress.

Interestingly, in additional analyses I observed that the increase in caregiver burden was related to depression symptoms only in partners who were not giving care to others. This suggests that it is those who are not accustomed to caregiving who find the increase most distressing. However, the increase in caregiver burden is related to anxiety regardless of whether the partner was previously giving care to others. Mood, on the other hand, was not related to the change in caregiver burden unless assessed across the whole sample.

Post-hoc tests on the whole sample showed that increases to difficulty burden specifically were related to worsening emotional distress, where increases in time burden did not significantly predict emotional outcomes. It can be inferred from this that it is the perception of tasks as being more difficult than before surgery (as opposed to how much time they take) which contributes to emotional distress levels after surgery. This connection, though logical, contradicts the findings of Halm and Bakas (2007), who did not find associations between difficulty burden and depression symptoms. The authors attributed this null finding to difficulty burden scores sharing variance with the partner-reported patient health status, which may have been inflated. Perhaps the use of an objective indicator of the patient's clinical cardiac severity in my study meant the size of its contribution to the partner's well-being was not inflated, and instead showed task difficulty to be a significant predictor. Alternatively, my use of a change score may not be comparable to the findings of other studies. However, Nieboer et al (1998) found that the change in the *number* of tasks (comparable to time burden) predicted depression symptoms, which also contradicts my findings. However, as Nieboer et al (1998) did not report a subjective assessment of caregiving difficulty, it is not possible to distinguish their contributions.

Once again no relationships were found with physical health status, suggesting that pre-surgery levels are more influential than caregiving factors. Aside from this null finding, a number of my results provide support for this hypothesis and for arrow number 4 in the conceptual model (Chapter 3, section 3.9).

III. Caregiver burden variables influence support, and support influences the impact of caregiver burden on emotional and physical adjustment following surgery.

I addressed this hypothesis in two distinct ways, to see whether a relationship exists between receiving and providing support (caregiving) that is relevant in this context. The first tested whether changes in the amount of caregiving influence the quality of partners' social relationships. The second assessed whether social relationships influence the impact of caregiver burden on distress.

IIIa. The change in caregiver burden after surgery will predict post-surgery levels of support.

After surgery, all support variables (with the exception of negative marital functioning) significantly worsened. Follow-up social support scores (mean 25.73) were lower than in cardiac patients following MI (29.9 - (P. H. Mitchell et al., 2003)), and positive marital functioning scores (practical – 5.63, emotional – 16.85) were markedly lower than norms for healthy adults (Whitehall II data, practical – 8.67, emotional – 22.46, see Footnote 4 in Chapter 6). Only negative marital functioning remained stable, but otherwise partners perceived a decline in the quality of their marital relationship. My results consolidate those of others (Artinian, 1991; K. B. King et al., 1993; Kneeshaw et al., 1999; Monahan et al., 1996) which found various aspects of social relationships to decline around 6 weeks after surgery.

The regression analysis confirmed that the change in caregiver burden significantly predicted the decline in social support but not in marital functioning. This suggests that the increases in caregiving were detrimental to the perceptions of global support from the social network, but not to the support received within the marital relationship specifically. Post-hoc analyses revealed that increases in the time spent caregiving rather than the difficulty of the tasks were instrumental in reducing perceived global support, particularly for those in employment. No previous studies assessed the influence of caregiver burden on social variables, so this study contributes new information on the outcomes of burden. These findings suggest that caregiving is detrimental to social as well as emotional aspects of the partner's adjustment after surgery. It can be inferred that the time-related caregiving factors reduce the quality of the partners' social relationships (arrow 5 in the conceptual model, Chapter 3, section 3.9). These social relationships influence the partner's experience during the patient's recovery, possibly increasing their susceptibility to distress.

> IIIb. Caregiver burden is related to outcomes differently for partners with high and low social support.

Splitting the sample according to the level of social support showed that caregiver burden influenced emotional distress only for partners with high levels of baseline social support. Perhaps contradictory to what might be expected and the buffering-effects found by Rankin and Monahan (1991), partners with better support were at *greater* risk of caregiving disrupting their emotional adjustment. Ruiz et al (2006) also reported a controversial finding that those with higher pre-surgery marital satisfaction experienced more caregiver strain. However, the authors did not offer an explanation, but their inclusion of patient personality traits may be relevant. Rankin and Monahan (1991) found that partners with high social support had less mood disturbance at increased levels of caregiver burden, but aside from the patient's illness severity, did not include covariates in the model. My results may also differ because I used pre-surgery support; their post-surgery score is likely to have stronger associations with post-surgery mood, and their findings do not illustrate the influence of baseline social support. So while this finding does support the hypothesis, it is not in the expected direction.

Additionally splitting the sample by high and low increase in caregiver burden further illustrated how greater support did not reduce the effect of burden on distress. Depression symptom scores were not lower for partners with high burden and high support than for those with low support (Figure 7-2). The findings for mood were further contradictory, as of the partners with a larger increase in burden, those with more support had lower mood than those with low support (Figure 7-3). Effectively, higher support was a risk factor for poor mood in those with more caregiver burden. The implications of these findings for theory and intervention will be discussed in Chapter 8. Thus the arrow number 5 in the conceptual model, (from support to caregiving factors) is not supported.

IV. Partners will experience worse levels of emotional and support variables than patients.

The intentions behind this hypothesis were to begin preliminary investigations into dyadic coping to reveal more about the relationship between patient and partner variables. Comparisons of means revealed that prior to surgery, partners and patients did not differ in terms of emotional distress, but after surgery, partners were significantly more anxious and had lower mood than patients. This evidence of worse psychological adjustment in partners contributes to a confused existing literature. The lack of significant differences in depression symptoms corresponds with several other studies (Bergh et al., 2002; Bruggemans et al., 1995; Conway et al., 1994; Lenz & Perkins, 2000; Ruiz et al., 2006) but clarifies the findings of a number of others which do not test whether emotional distress is *significantly* higher in partners (Allen et al., 1991; Carroll, 2011; Lenz & Perkins, 2000). These findings suggest that with the exception of depression symptoms, this stage of the recovery period is more emotionally distressing for partners than the patients. This contradicts Hartford et al's (2002) findings that partners were less anxious than patients, but perhaps the timing of their assessment (one day before discharge) explains the disparities from my findings.

Interesting differences in levels of support variables may act as a feasible explanation. With the exception of emotional marital support, partners had less favourable levels of all support variables than patients prior to surgery. These findings are similar to those of several other studies (e.g. (Gortner et al., 1988; Rankin & Monahan, 1991; Rantanen, Tarkka, et al., 2009)), but with the advantage of testing the difference statistically. The lack of differences in emotional marital support is similar to the findings by Ruiz et al (2006) who found no differences in marital quality, and Thomson et al (2011) who found differences according to type of support.

These findings are in favour of the notion that poor pre-surgery support is a risk factor for worse post-surgery adjustment, and the partners are at a significantly greater risk. Most interestingly, I found that after surgery partners report significantly worse scores for all support variables compared with patients. This implies that one spouse (the patient) benefits from increased levels of support while the other (the partner) suffers from decreasing levels. Thus it can be inferred that partners provide more support than they receive, contributing to the discussion about the relationship between the giving and receiving of support.

Chapter 8 Discussion

8.1 Introduction

This chapter summarises the findings from this research and offers some interpretations. The implications of the findings are combined with current practices to form recommendations for interventions. The strengths and limitations of this research are outlined, followed by directions for future research and conclusions.

8.2 Summary of findings

This PhD aimed to assess the role of support in social relationships for psychological adjustment and physical recovery in CABG patients and their partners. The objectives were to investigate the relationship between support and surgery outcomes in patients, while also clarifying distinctions between positive and negative types of relationships, and marital from global support. In partners, the objectives were to evaluate the influence of support, both receiving (global and marital support) and providing (caregiver burden) on adjustment, as well their relationship with one another, and differences between patients and partners.

166 married CABG patients and 99 corresponding female partners participated in a prospective, longitudinal study providing self-reported indicators of support, emotional distress, health status and demographics, and objective clinical and hospital data 1 month before and 2 months after surgery.

In patients, on the whole depression symptoms, anxiety and mood improved after surgery but some experienced poor emotional adjustment. Physical health status significantly worsened though angina levels improved. Levels of social support and marital functioning were generally high before surgery but varied across the sample. In linear and logistic regression analyses, pre-surgery social support significantly predicted length of post-operative hospital stay after controlling for demographics, illness severity, and risk factors for prolonged length of stay. Negative marital functioning predicted worse emotional distress after surgery after controlling for positive marital support, general social support, baseline distress levels, demographics and illness severity. No support variables predicted physical health status and positive aspects of the marital relationship did not predict any of the measured outcomes.

In partners, only anxiety improved after surgery, and a proportion of partners experienced emotional distress and poor physical health status. Levels of general and marital support varied before surgery and significantly worsened after. In regression models, pre-surgery social support significantly predicted post-surgery mood after controlling for baseline mood, demographics and the patient's cardiac clinical severity. No other support variables predicted any outcomes. The change in caregiver burden (difficulty as opposed to time associated with caregiving) significantly predicted all emotional distress variables after surgery, after controlling for covariates. Neither support nor caregiving variables predicted physical health status. The increase in caregiver burden (in this case, time) predicted decreases in social support, and caregiver burden predicted depression symptoms and mood only in partners with high levels of pre-surgery support. Finally, partners experienced less favourable levels of depression symptoms and mood after surgery than patients, and less favourable levels of support both before and after surgery.

8.3 Discussion of findings

8.3.1 Post-surgery outcomes

Patients

On the whole patients saw improvements to their emotional well-being after surgery, which suggests that the procedure was perceived by most as a 'resolution event' that removed negative circumstances that were causing distress (Finlay-Jones & Brown, 1981). The sample's improvements to angina symptoms and the overall high success rate of CABG surgery for improving symptoms and functional status (Coronary Artery Surgery Study (CASS) Principle Investigators, 1983; European Coronary Surgery Study Group, 1982; Grover et al., 1990) correspond with the concept that the change was related to the procedure. The decreases to self-reported physical health contradict this hypothesis, but they do correlate with this stage of recovery which is typically characterised by pain and reduced physical functioning. It is possible that for at least some patients, the surgery did not succeed in relieving previous cardiac symptoms. Alternatively, perhaps many were not substantially affected by pre-surgery symptoms to realise much improvement, and instead were affected by the discomfort and restrictions resulting from the procedure. Thus the corresponding improvements to emotional well-being may not have resulted from improvements to physical functioning, but rather the relief of pre-surgery anticipatory distress. For those who did not experience improvements to their emotional well-being, the surgery and the related discomfort may have been perceived as negative changes to their lives, disrupting important aspects of their lives and goals. Similarly, post-surgery outcomes may have been influenced by the characteristics of the patient sample. For example, older adults are hypothesised to cope better with illness (Berg & Upchurch, 2007), perhaps for reasons suggested in Chapter 1 (section 1.6.2). Correspondingly, younger age was identified as a risk factor for anxiety in some models. Similarly, the male predominance may explain these positive outcomes, as women typically report poorer outcomes, and female sex significantly predicted markers of physical and emotional recovery.

Partners

Partners generally saw improvements to anxiety but not to other emotional variables, suggesting that they had reduced feelings of threat regarding the patient's life, but that their experience at this stage of the patient's recovery was to an extent emotionally difficult. The perception of the patient's surgery as an event that disrupted the norms for their life (as they had to adjust to their new role as well as the patient's illness), may have resulted in feelings of loss (of the patient as they previously were) or threat (regarding the future), which were portrayed as poor emotional adjustment. Alternatively, the post-surgery distress levels may have been typical for these particular individuals, and the difficulties faced by the partner were not necessarily abated following treatment. There is the possibility that the levels of emotional distress were not necessarily connected to the patient's illness, and may instead have been the reflection of something unrelated to this event. However, the fact that partners completed these measures for research related to their spouse's surgery might increase the likelihood that their responses were reflective of their feelings about this event.

The borderline significant decrease in partners' physical health status suggests that they were doing more physical work related to caregiving and possibly taking on some of the patient's roles, but perhaps not to the extent that it significantly altered their perceptions of their health in this short space of time. It is perhaps unlikely they would feel the physical effects of the prolonged strain of caregiving seen in chronic informal caregivers such as for patients with dementia (Vitaliano et al., 2003). Thus it can be interpreted that neither through the activiation of physiological mechanisms nor the physical acts of caregiving was their health significantly impacted. As with emotional distress, it is not necessarily the case that levels of physical health status were related to the patient's surgery, which is also reflected in the findings that no examined variables except baseline health significantly predicted post-surgery levels.

The caregiver burden measure was useful in showing that not only did partners spend more time caregiving after surgery, but they also found it more difficult. The low burden levels before surgery support the a priori assumption that partners were not typically performing the role of caregiver for the patient prior to surgery. Correspondingly, there was an increase in the difficulty of caring for the patient even in partners who were caring for others before surgery.

As with the patients, it is possible the individual characteristics such as age and sex influenced partner outcomes, though age was not consistently related to outcomes and it was not possible to draw conclusions on the basis of sex as a predictor. However, the partner findings may merely be a reflection of the short-term nature of the recovery period for cardiac surgery. The difficulties these partners face may not be comparable with those of partners caring for patients with longer-term illnesses. For example, due to the short-term nature of CABG recovery, the caregiving tasks for CABG partners are likely to be less burdensome, the disruptions to social relationships and ability to work shorter-lasting, and negative illness perceptions regarding the length of the illness less severe than for partners of chronically ill patients. Therefore the outcomes may be a consequence of the acute nature of the situation rather than related to the identified predictor variables. This may also be the case for the patient outcomes.

8.3.2 Support predicting outcomes

Patients

The key finding from my research was that social support predicted the length of patients' hospital stay. Perceptions of better quality support from the social network were associated with a shorter time spent in hospital after controlling for covariates. Length of stay is a marker of the speed of the earliest stages of recovery, and a longer stay reflects slower healing and recuperation. This may be due to complications, comorbidities, a more extensive procedure or a riskier patient both in cardiac and non-cardiac surgery patients. Even after controlling for these key risk factors for prolonged length of stay, social support explained a significant amount of the variance in length of stay. Quite a large proportion (43.2%) experienced a 'prolonged' stay (6 days or more), so for a significant number disrupted support may have been a contributing factor. Evidently, social support can affect health in a measurable and clinically relevant way, contrary to what has been suggested by some (Umberson et al., 2006).

I did not test for possible mechanisms, but by controlling for demographics and clinical severity, I can assume that they were not linked exclusively via these variables. It is plausible that social support is linked to hard outcomes such as this through a mechanism that is not related to baseline health (Holt-Lunstad et al., 2010). Patients with more favourable social support prior to surgery may have subsequently had better in-hospital support (Kulik and Mahler (1989) found a greater number of hospital visits predicted shorter length of stay) and greater encouragement towards recovery behaviours which directly improved their short-term recovery.[6] From a stress-buffering perspective, better supported patients may have had a reduced emotional or physiological response to the stress of the surgery, possibly decreasing the inflammatory response to surgery, and thus the risk of infection and slower wound healing (Poole et al., In press). From a social-strain perspective, patients with lower support may have had a greater number of relationships characterised by negative features, possibly resulting in greater physiological reactivity and encouragement towards less healthy behaviours, slowing recovery. Even though a number of alternative risk factors were accounted for, non-medical determinants may have influenced length of stay such as bed availability, social housing or surgery scheduling. However, issues such as the suitability of the home recovery environment could have been reflected in their perceptions of poor support, and thus are not necessarily distinct from the variables measured in this study. For example, patients will probably be discharged more quickly from hospital if there is someone available to take care of them at home.

Correspondingly, a more negative perception of the marital relationship predicted depression symptoms and anxiety in patients after surgery. In line with the social-strain perspective, relationships characterised by stress, worry and a lack of sufficient support resulted in worse psychological adjustment after surgery, even when levels were generally improved. Marital conflict is strongly implicated in psychological distress (Fincham & Beach, 1999; C. E. Ross et al., 1990), and in the context of illness (Kiecolt-Glaser & Newton, 2001). Chronic marital problems can be termed ‘chronic strains’ (Brown & Harris, 1978), which rather like poor housing conditions and continued financial difficulties, increase the chances that a major life event such as this would initiate, maintain or increase feelings of depression, for example (Stansfeld & Rasul, 2006). In this study, marital functioning scores reflected difficulties experienced in the past year, so can be considered a chronic

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[6] Regular walking culminating in being able to climb and descend stairs, controlled coughing, deep breathing and eating and drinking sufficiently are all behaviours which promote a quicker recovery on the ward, and are indicators to the medical staff of the patient’s fitness to be discharged.

problem. These findings suggest that the patient draws on the quality of their marital relationship to enable them to effectively cope with the illness event (Coyne & Smith, 1991), and thus negative elements of the relationship limit their resources for positive adjustment. Essentially, the negative features of the patient's marriage restrict their ability to experience the benefits which surgery have for emotional well-being, and may have activated destructive behavioural or psychological responses resulting in emotional distress. This suggests that even in relationships with high levels of positive support, negative aspects are risk factors for emotional distress. Therefore, high marital support does not eliminate the deleterious effects of negative aspects, as seen in some previous studies (Kiecolt-Glaser et al., 1997; Kiecolt-Glaser et al., 1993; Kiecolt-Glaser et al., 1996). Thus, there are elements of the marital relationship which are distinct from general social support, emphasising the importance of measuring both separately. Alternative factors may explain these associations such as age, education and income which affect both marital quality and health (Wickrama et al., 1997) or the length of marriage. However these were controlled for in analyses, confirming that the quality of the relationship is important regardless of these.

There remains the possibility that the matching negative valence of emotional distress and negative marital functioning is the reason for this seemingly independent relationship. The finding that mood (a mostly positive variable) was the only emotional outcome not predicted by negative marital functioning lends further support to this hypothesis. However, correlations (see Chapter 6, Table 6-11) between negative marital functioning and negative emotions (depression symptoms and anxiety), though significant were relatively low, and were no higher than the associations with mood. Alternatively, negative aspects of relationships may be more strongly associated with well-being because the emotions they activate, such as anxiety, tend to be stronger than positive support (De Vogli et al., 2007). These findings contribute to the social support literature, revealing that negative aspects of relationships are stronger predictors of outcomes. They also suggest that perhaps emotional support is not the most important determinant of well-being, in contrast with what has been proposed in a great deal of the previous literature (House, 1981; Waltz, 1986). It could be that emotional support has a direct effect on well-being regardless of the presence of stress (Helgeson, 1993) and thus was not identified as having a notable impact in this relatively stressful situation.

The fact that social support predicted a marker of physical recovery and marital functioning predicted emotional adjustment could have some theoretical meaning. Perhaps a source of support outside of the marriage is particularly important for physical recovery while the relationship with the partner has a greater influence on emotions. Possibly, the marriage is primarily a source of stress and beneficial support comes instead from outside the marriage.

As an alternative to this explanation regarding the source of support, it could be helpful to consider the temporal elements of support and health (Cohen & Syme, 1985). Perceptions of strong global support could be helpful for encouraging healthy behaviours in hospital, buffering the stress reaction to surgery, thus promoting fast early recovery. The quality of the marital relationship, however, may be more influential on emotions in the weeks after surgery, because it reflects the home environment in which patients undergo adjustment. Functional support can be considered relatively transient (Cohen et al., 1994). Accordingly, social support was measured from a short-term perspective (respondents were not asked to think back over a period of time, rather give an 'on-the-spot' answer). Comparatively, marital functioning can be considered a more stable relationship situation (Orden & Bradburn, 1968), and correspondingly was measured over the course of 12 months.

The fact that married patients had significantly higher perceptions of social support than unmarried patients is in line with Coyne and DeLongis's (1986) suggestion that even if global and marital support are distinct, married individuals have better perceptions of their social relationships in general. The independence of marital functioning as a predictor of outcomes in a model including general social support indicates that the quality of the marital relationship is associated with psychological health regardless of whether one has supportive relationships outside the marriage, as suggested by Lieberman (1982).

These complexities in the findings emphasise the point that structural indices of support do not give a detailed picture of how various relationships and types of support may differentially affect well-being. However, these findings do not negate the importance of social integration during a time of illness, and instead highlight the importance of good quality relationships within the network.

Partners

There were fewer positive findings for support and outcomes in partners, perhaps suggesting that relationships provide more benefits for patients during illness than their partners. Social support predicted sustained levels of everyday mood, implying a buffering effect during the stressful event. Alternatively, feeling supported may have directly improved partners’ mood, which was sustained after surgery (this perspective complies with the possibility that partners’ emotions were not related to the surgery event). The fact that social support did not predict depression symptoms or anxiety implies that support is less relevant for the more negative emotional reactions to the recovery symptoms. However, it could be that depression symptoms and anxiety scores were not sufficiently high for support variables to affect them, or did not have sufficient variance for differences to be detected.

The fact that no marital functioning subscales predicted outcomes in partners could mean that the extra-marital support captured by the social support measure was especially beneficial for partners, where the marital relationship was not influential on outcomes. Perhaps, the marital relationship is less focal for the partner than it is for the patient, either reflecting the theory that marriage provides more benefits to husbands than to wives (House et al., 1988; Stroebe & Stroebe, 1983), or their role as the patient rather than the caregiver. Unfortunately these samples limited the ability to separate gender from role.

Alternatively, there may have been too little variance in the remaining support measures to predict variance in outcomes, or there may be a threshold for support above which associations are not seen (Berkman & Syme, 1979; House, 1981). These may also explain the null findings of positive marital functioning in the patients. An alternative explanation for null findings is a mismatch between the types of support and the support needs at a given moment. Thus according to the specificity theory (Chapter 2, section 2.5), in this situation support did not provide benefits for health outcomes. It is possible that for the partners, support factors were not the key determinants of distress, relative to other possible risk factors.

8.3.3 Caregiving predicting outcomes

The consistency of the finding that caregiver burden predicted partner distress indicates that CABG partners experience enough burden to be distressing, and implies that providing support may be a more important determinant of distress than receiving it. The increase in caregiving difficulty predicting emotional distress suggests that the unfamiliar role of caregiver for the patient is distressing. Using a stress-coping framework suggests that the difficulty of caregiving outweighs the partners' resources for coping which results in distress. The evidence that increases in burden predicted declines in relationship quality suggests that reduced support may be a pathway linking them. However, caregiving may influence a number of areas of the partner's life which result in distress (e.g. finances, cognitions, ability to work etc.). It is possible that difficulty burden and emotional distress are in fact two components of the same construct, explaining this association. However, the correlations between the two, though significant, are only small, suggesting a conceptual independence between them.

Interestingly, in partners who were already providing care for others before surgery, the increase in difficulty did not significantly predict depression symptoms and mood (Chapter 7, section 7.9). This suggests that it is the newly adopted role as caregiver which is a risk factor for distress. This was not the case for anxiety, as the increase in *difficulty* predicted anxiety in those caring for others and the increase in *time* was a predictor for those not caring for others. Thus it was harder for those not accustomed to caregiving to adjust to the increase in time spent[7] caregiving, but for partners who needed to spread themselves between caring for the patient and others found the increased difficulty harder to adjust to. There is a possibility these contrasts arose from different numbers of participants in the subsamples, and post-surgery burden levels were not considerably high. However, these findings are important in indicating that being new to caregiving is a risk factor for increased distress, and therefore CABG partners are a large population of individuals at risk. They also illustrate the importance of assessing whether partners are caring for others, and providing particular support on the basis of this.

These findings can be understood in terms of the 'caregiving career' which partners undertake during their spouse's illness (Savundranayagam & Montgomery, 2010). According to caregiver identity theory (Montgomery & Kosloski, 2000), the partners in this situation are taking on a caregiving role which emerges out of the context of a spousal relationship. The concept of the caregiving career suggests that after surgery, the patient's needs increase and the partner adapts their behaviour, thus the relationship changes from a spousal to a caregiving relationship. However, the partner's caregiving behaviours are incongruent with the spousal identity and role they have internalised. Unless they can regain congruence between their behaviours and their identity standards, the partner experiences distress. Partner caregivers for patients with chronic care needs (e.g. Alzheimer's) often have an ambiguous transition into the caregiving role, but partners of CABG (or similar surgery) patients may experience an abrupt role change for which they may not be prepared. After CABG surgery, partners will have a great deal of adjustment to make, and this is confounded by having to adjust to their new role as caregivers. This change is enough to result in significant emotional distress, and also disrupt their relationships with their social network. Partners with experience of caring for

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[7] Increased time burden scores may also reflect an increase in the *number* of tasks performed, as partners may have scored 0 for a task they did not perform before surgery but 1 or more if they then performed it after surgery, increasing their time burden score.

others are less susceptible to this distress, further emphasising the relevance of taking on a caregiver identity.

8.3.4 The relationship between receiving and giving support

For both spouses, this illness situation is one in which both the receiving and provision of support are especially important and likely to be different from usual. Taken together, my findings could be interpreted as showing that providing support to the patient is a risk factor for distress. This corresponds with the evidence that the patients are affected by the quality of the relationship with the partner. The improvements experienced by the patients to their emotional well-being and quality of relationships compared to the deterioration of partners' relationship quality and lack of improvement to some types of emotional distress suggests this: patients benefit from the support provided by the partner while the partners suffer as a consequence. Looking from this dyadic perspective, a lack of reciprocity and imbalance in the relationship between the patient and their partner may be benefitting the recipient at the detriment of the support provider. This might explain why partners had worse emotional distress and support than partners (though there may be several other explanations[8]), or why patients appeared to be more influenced by their social relationships than the partners. Pearlin (1983) stated that when caregiving becomes the dominant component in a close relationship, the relationship changes to one which is unidirectional. The dramatic change to this central relationship is in itself a source of distress for partners. If partners perceive a lack of mutual support it can be destructive to the relationship and their well-being (Knudson-Martin, 2013; Thompson et al., 1995; Ybema et al., 2002). Correspondingly, social support improves patients' length of stay, but a shorter hospital stay is not always beneficial for partners. They will have less time to prepare for and learn about their caregiving role, and begin their role at a more

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[8] Differences in the spouses' experiences that are unrelated to support may be an alternative explanation of why partners were more distressed than patients. As suggested in Chapter 3, lack of perceived control may explain partners' greater distress (Moser & Dracup, 2004). The prominent focus on the patient's concerns, and aftercare (GP and clinic visits) continuing to be directed only on the patient may also explain this disparity, as well as factors related to gender vs. role.

acute stage of the patient's recovery, though the evidence for this is mixed (Riegel et al., 1996; Stolarik et al., 2000).

However, patients may have perceived their relationship especially positively for reasons other than the partner's caregiving. Partners may have been on their 'best behaviour' (Kulik & Mahler, 2006) being particularly supportive after surgery or engaged in protective buffering to minimise disagreements with the patient.[9] In addition, the patient's relatively positive perception may be a result of attempting to reduce cognitive dissonance, or an indication of patients who are dependent on the partner as they focus on the positive elements of the relationship (Burman & Margolin, 1992). These potentially confounding factors may also be an explanation for why partners did not seem to benefit from support as much as the patients did. Considered dyadic analysis could further clarify whether the partner's caregiving necessarily benefitted the patients in terms of their perceived support, to further elucidate the relationship between the partner giving and the patient receiving support.

Logically, my findings that increases in time burden predicted decreases to social support in partners suggest that the time spent caring for the patient reduced the amount of time available to commit to others in the network, thus reducing the support received from them. This explanation is supported by the fact that this effect was found only in partners who were employed (Chapter 7, section 7.9). However, the decreases in relationship quality may not have resulted exclusively from increases in caregiving. Partners' perceptions of their relationships may have been distorted by the strain of the caregiving situation. Alternatively these findings could indicate that the social support measure mostly captured perceptions of support from the patient. Deterioration of the marital relationship after a cardiac event is not uncommon, and partners may miss their 'former' spouses, and struggle with the new asymmetry in their intimate relationship (Arenhall, Kristofferzon,

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[9] If this were the case then it might explain why negative aspects were particularly pertinent predictors of distress, as they would be unexpected in the context of illness.

Fridlund, & Nilsson, 2011). However, this interpretation does not correspond with the null finding for burden predicting decreases to positive marital functioning. These are probably better explained by the assumption that during the patient's recovery they are in a lesser position to provide support to the partner.

The interrelationship between social support and caregiver burden in the inverse direction (support influencing burden) has proved to be less straightforward. The finding that depression symptoms were lower for partners (with both high and low levels of caregiver burden), if they had higher rather than lower support (Chapter 7, Figure 7-2), could be understood as a direct effect of support on distress, as the presence of stress was not relevant. However, the fact that partners with more support had lower mood than those with less support when caregiver burden was high (Chapter 7, Figure 7-3) suggests that having more support could be considered as a risk factor for distress. From a stress-buffering perspective, perceived positive support should reduce the negative impact of a stressful situation such as caregiver burden on well-being. Thus it would be expected that burden would be less distressing for those with greater support, but the inverse was found. This is most logically interpreted as partners accustomed to better support finding the increases in caregiving more detrimental to their well-being, because they are more negatively affected by the deterioration of their social relationships. Alternatively, this evidence against a stress-buffering effect may contribute to the inconsistent evidence found across the literature (see Chapter 2), or possibly an unmeasured variable could explain this unexpected relationship. The loss of the association between caregiver burden and anxiety when splitting the sample by level of support provides some backing for this argument.[10]

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[10] I found that age and EuroSCORE were significant predictors of anxiety only in the partners with low social support. This may explain why caregiver burden was no longer a significant predictor of anxiety when the sample was split by the level of social support. These other variables were explaining a greater amount of variance and were stronger determinants of anxiety than caregiver burden. From this it can be inferred that in partners with low social support, being younger or caring for a patient with greater clinical cardiac severity significantly increases the risk of anxiety after surgery.

Instead, perhaps the receiving and provision of support may have independent relationships with distress (Chappell & Reid, 2002). Though caregiving influences support, support does not appear to influence caregiving in a way that might be expected. Jarrott et al (2005) found that increases in formal but not informal support benefitted caregiver distress, so perhaps the social support measure captured informal support where formal support may have been more beneficial. My findings have illustrated that the relationship between the two is a complex one which needs greater clarification. If caregiving is a proxy for the provision of support, then receiving support is not necessarily beneficial for emotional well-being in this particular situation. Instead, support may have benefits for partners in a way that does not relate to the actual experience of caregiving. This suggests a greater emphasis on either the direct effects of support on distress, or that support and distress are related through another aspect of the recovery experience. These preliminary interpretations might be clarified by more extensive dyadic analyses.

8.3.5 Predicting physical health status

None of the models predicting post-surgery physical health status found anything but baseline scores (i.e. pre-existing health) and gender to be a significant predictor in either patients or partners. It could be that this represents a genuine effect, suggesting that the illness situation was not stressful enough for either spouse to need to draw on their social relationships for support. In partners, it indicates that the short-term increase in caregiver burden was not sufficient to have influenced their physical health, where prolonged strain might have a greater effect. This may be an illustration of the differences between these partners and those of chronically ill patients, and is in line with very recent evidence that partners of cardiovascular disease (stroke) patients are not at an increased risk of early mortality in comparison with matched non-caregivers (Roth et al., 2013). Alternatively, the explanation may be that these consistent null findings resulted from the study's methodology, such as a lack of sensitivity of the scale (SF-12) to detect associations, or variables not included in the models potentially being more predictive than those included. Possibly a more specific measure, such as a disease-specific scale for patients, and a physical stress symptoms scale for partners may have provided more significant results.

8.4 Implications

Evidence that some patients experience poor recovery and adjustment has important implications. Prolonged length of stay and emotional distress predict future morbidity, cardiac recurrence and early mortality (Chapter 1, section 1.5.3), and there are also cost implications for prolonged hospital stay. Evidence of partners experiencing distress and burden also has ramifications in terms of cost from lost income (N. Townsend et al., 2012), and their ability to care for the patient. Thus, poor surgery outcomes have important consequences and their prevalence needs to be reduced.

It can be concluded from the findings of this PhD that CABG patients and their partners will benefit from good quality relationships for their recovery and adjustment after surgery. There is an inferred conceptual distinction between general feelings of social support and marital functioning, and between positive and negative aspects of relationships. As married individuals perceive higher levels of support generally, the marriage may be an appropriate relationship to target. Partners will also benefit in terms of their emotional and relationship outcomes from a smaller increase in their caregiving activities. Finally, partners suffer from more emotional distress and feel themselves to be in poorer quality relationships than the patients.

As pre-surgery factors were identified as relevant to outcomes (or in the case of caregiver burden, a change from before surgery), individuals with these risk factors can be identified and targeted for intervention before surgery. The current procedures for the screening of risk factors and treatment for poor outcomes in CABG patients and partners will undoubtedly vary across hospitals and even individual health care professionals. Here I use the procedures at the study site (St George’s hospital) to illustrate those relevant to my study sample, but can be used as an example of a large London hospital.

Patients

At St George's, the only assessment of social relationships is when patients are asked at their pre-surgery appointment if there will be someone at home to look after them for the first week after discharge. Patients are advised they must not be left alone for more than 2 hours in the first week. For 6 weeks, they are greatly restricted in what they can carry (no more than the weight of a kettle half filled with water) and are not permitted to drive. Thus patients are advised to have someone to help them with housework and transport, but there is no assessment of their pre-surgery social relationships of any kind. As discussed, global support and specific marital functioning should be measured separately, and positive and negative aspects of relationships should also be distinguished. Screening for low global support and high negative aspects of marital functioning should be conducted in patients before surgery (at pre-assessment) using measures similar to those used in this study to identify those at increased risk of worse outcomes. It can be inferred that improving the quality of pre-surgery social relationships will have benefits for recovery and adjustment, and those with low levels of support, or high levels of negative aspects of their relationships should be targeted to make improvements to these. Alternatively, patients identified as having poorer social relationships should be targeted for additional professional support.

Several authors have made recommendations regarding social support interventions for CABG patients, based on what has been observed from the literature. For example, health care professionals should mobilise the patient's own sources of support as well as providing a supportive relationship with the patient themselves (Elizur & Hirsh, 1999). The family's existing resources should be used, changed and supplemented where the deficits become apparent (Dimond & Jones, 1983).

Several CABG patient interventions have been reported in the literature, though few have focused on improving feelings of perceived support. Three key intervention studies based on social comparison theory showed that hospital visits or sharing a room with recovered CABG patients reduces anxiety and improves physical recovery to an extent (Kulik & Mahler, 1987; Parent & Fortin, 2000; Thoits, Hohmann, Harvey, & Fletcher, 2000). However, these interventions do not address issues relating to the quality of existing relationships and require training and particular hospital ward structures to be effective. Similarly, studies of post-operative peer support groups are numerous but show mixed findings in terms of producing better outcomes compared to controls (Song, Lindquist, Windenburg, Cairns, & Thakur, 2011) possibly due to them increasing negative downwards comparisons. My findings suggest that intervening *prior* to surgery may be effective at reducing the risk of poor surgery outcomes. However, the findings for pre-surgery interventions are also mixed (Ettema, Van Koeven, Peelen, Kalkman, & Schuurmans; Furze et al., 2009), and do not necessarily improve feelings of perceived support (Arthur, Daniels, McKelvie, Hirsh, & Rush, 2000).

In terms of interventions to change perceptions of marital quality, there is evidence that the three main types of couple therapy (Behavioural Couple Therapy, Cognitive Behavioural Couple Therapy and Emotion-focused Couple Therapy) are effective at improving marital satisfaction in the short-term (Christensen & Heavey, 1999). Couples therapy has been shown to improve specific disorders such as depression (N. S. Jacobson, Dobson, Fruzzetti, Schmaling, & Salusky, 1991) and anxiety (Barlow, O'Brien, & Last, 1984), but there are no known studies which have attempted to change perceptions of marital quality in the timeframe of acute surgical recovery (Kulik & Mahler, 2006).

The limited evidence for support interventions and the associated impracticalities point towards alternative interventions in which patients with poorer social relationships are targeted for additional professional care. I recommend that poor social relationships should be considered a risk factor for poorer surgery outcomes, and thus high risk patients might benefit from a delayed hospital discharge, home visits from a district nurse or professional psychological support.

Partners

Although at St George's partners are invited to join patients at the pre-assessment appointment, the discharge talk before leaving the ward, and cardiac rehabilitation, they are not the focus of any particular concern or support. All information is targeted at the patients and partners are not explicitly addressed, and certainly not assessed for their social support. The National Institute for Clinical Excellence guidelines for cardiac rehabilitation state that there should be provision to involve partners or carers in the rehabilitation programme if the patient wishes (Cooper et al., 2007). However, a general lack of focus on partners has been attributed to causes such as: a lack of resources, interest and knowledge among staff, and practical and psychological barriers among patients and partners (Nissen, Madsen, Kjøller, Waldorff, & Olsen Zwisler, 2008).

Partners should be screened and targeted before surgery in a similar way to the patients (or contacted at home if they do not attend the pre-assessment) for low levels of global social support.[11] A recent systematic review has revealed that a modest number of intervention studies targeting CHD partners' well-being have shown trends towards improvements to psychological outcomes (Reid, Ski, & Thompson, 2013). However, a review of interventions focusing on social relationships during the recovery period reveals mixed findings (Van Horn, Fleury, & Moore, 2002). The interventions tested are generally better at improving distress outcomes than aspects of social relationships, and few have relationship factors as an outcome variable (Gilliss et al., 1990; Gortner et al., 1988). It should be kept in mind that high levels of pre-surgery support were not beneficial for reducing distress in partners with a high degree of caregiver burden. However, social support may have benefits for partner well-being that are not related to caregiver burden (Chappell & Reid, 2002). There are some difficulties relating to increasing support in partners, such that they may not be receptive to support, especially if

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[11] According to my findings, the marital relationship does not predict outcomes so I cannot infer directly that it should be measured or targeted.

they are distressed (Thomson et al., 2011). Thus focusing on reducing caregiver burden may be more important and effective in CABG partners.

From my observations at St George's, the partners are not explicitly told they will need to increase the amount of caregiving they will do for the patient. If partners do not attend the hospital, there is no specific outreach to prepare them for the patients' recovery. Consequently, no advice is given to partners of how to cope with the changes to their caregiving and how to reduce the increase in feelings of burden. Though pre-surgery support is not necessarily beneficial, being taught how to mobilise their post-surgery support systems, asking for help, and speaking to other partners in a similar situation may reduce the feelings of burden. In some cases, as partners get better at caregiving they are less willing to share it out with others (Boland & Sims, 1996) so they may benefit from being taught how to accept help. Partners transferring from the role of spouse to caregiver (especially those not previously caring for others) may benefit by identifying themselves as a carer, and where to find additional support and information should be indicated. It may be that improving the positive aspects of caregiving such as satisfaction are in need of being improved, as this is linked to better psychosocial outcomes (Savundranayagam, 2013) and can be improved through enhanced counselling and support interventions (Roth, Mittelman, Clay, Madan, & Haley, 2005). Face-to-face psycho-educational interventions are thought to most effective (Beinart, Weinman, Wade, & Brady, 2012).

Much of this advice is given in the BHF booklet 'Caring for someone with heart disease' (British Heart Foundation, 2010), though it is quite general. Carers are not told explicitly the restrictions on the patient or that they will need to increase their provision of support in a particular way after CABG surgery. Written information is beneficial only on the condition that individuals have sufficient health literacy, so in isolation is not a sufficient form of communication. Increasing the focus on partners will hopefully reduce the gap between patient and partners in terms of their relationships and their emotional outcomes of surgery.

My recommendations for changes to hospital procedures are summarised in Table 8-1 below. Nurses conducting pre-assessment appointments and facilitating rehabilitation should be trained to incorporate these aspects into their conversations with patients and partners.

Table 8-1 Recommendations for changes to hospital procedures

Recommendations	How/when
Screening for patients and partners for the quality of their social relationships	Utilising separate social support and marital functioning tools; at the pre-assessment appointment
Targeting patients and partners with low levels of social support and negative aspects of their marital relationship	Provide additional professional support such as delayed hospital discharge, or increased medical and psychological support after surgery
Preparing partners for their role as caregivers and warning of changes to their personal relationships	Explicitly addressing partners at pre-assessment (or contacting them individually if they do not attend) explaining their role after surgery, advising how to mobilise support and decrease feelings of burden
Supporting partners identified as experiencing increased caregiver burden	Screening for caregiver burden at cardiac rehabilitation (or contacting individually if they do not attend) and repeating pre-surgery advice or a post-surgery caregiver burden intervention

In summary, it appears in general that the measurement of support in patients, and support, caregiver burden and distress in partners is something which occurs in research but less so in reality. This would be an important first step towards targeting important risk factors of poor recovery and adjustment after surgery. The importance of social relationships needs to be brought into practice in hospitals in the UK, and could feasibly be applied to other patient and partner groups.

8.5 Strengths

There are a number of strengths to this research. Firstly, pre-surgery assessments are a rare commodity used in only a proportion of previous studies. The longitudinal, prospective design of this study with pre- and post-surgery measurements allowed for assessments for change over time, controlling for baseline levels of outcomes, and identifying pre-surgery variables which can be manipulated to reduce risk of poor outcomes. One of the limitations of previous studies is the use of scores measured too close to surgery (Ravven et al., 2013). On the basis of this, for the most part, scores were reported neither in the week before or the two weeks after surgery. Thus pre-surgery scores hopefully were not too greatly influenced by imminence of surgery, and post-surgery scores reflected adjustment rather than an acute emotional reaction which might have spontaneously improved. All participants were recruited from a single site, which is a benefit, as multi-site data collection limits comparability, and the relatively high recruitment and low dropout rates meant that sample sizes were larger than those necessary according to the power calculation.

To broaden our understanding of psychosocial factors relevant to patients and partners around the time of surgery, I measured a large number of factors using well-established validated scales combined with objective clinical data. My selected measures tested several domains of social support and emotional and physical well-being allowing for analysis of different subtypes. For example, through separating the two subscales of the depression symptoms scale (BDI), I was able to reduce the potential overlap between somatic symptoms of depression and of illness. Associations between support variables and depression symptoms remained significant with the somatic symptoms removed. The marital functioning measure (CPQ) distinguished between positive and negative aspects of relationships, including subtypes of functional support within the marriage rather than just global marital satisfaction. Thus the connections between marriage and well-being are slightly clearer, and I addressed an issue prevalent in marital functioning research (Kiecolt-Glaser & Newton, 2001).

I was also able to control for potential confounders, such as the number of years married and pre-surgery anti-depressant treatment, and found that these did not account for the relationships between variables. Additionally I was able to control for a range of important aspects of clinical cardiac severity; the EuroSCORE encompasses many variables related to surgery outcomes, so including it in every regression model meant several important factors were accounted for in both patient and partner analyses. Similarly, the strength of the findings was increased by the use of an objective indicator of CABG recovery which has been linked with social support in very few previous studies (K. B. King & Reis, 2012; Kulik & Mahler, 1989; Kulik & Mahler, 1993, 2006; Sorensen & Wang, 2009). There is a possibility that all the variables measured by self-report (including physical health status) may share a subjective, psychological component, so revealing a link between support and an objective marker of recovery has a particular strength in reducing this risk.

Including baseline levels of emotional distress in models ensured relationships were not confounded by negative affectivity. I included both continuous and dichotomous descriptions of data, and used recommended cut-offs for scales increasing comparability with other studies, and contributing to the smaller number of studies reporting continuous depression scores. Using a hospital scale of anxiety increased its relevance to an illness event, and similarly, including a measure of caregiver burden in a study of partner distress improved the ability to associate the partners' distress with the surgery. The self-report psychosocial measures had the merits of being easy to use, and measuring subclinical levels of psychological distress, distinguishing them from diagnostic interviews.

As discussed, CABG partners are a relatively under studied but wide reaching population that could make an important contribution to the caregiving literature. This study was one of the first to assess a number of the measured variables, to consider the outcomes of caregiving and to measure physical health systematically and describe it in a meaningful way in CABG partners, to name a few examples.

With the design and chosen measures I was able to test a novel conceptual model of partner distress, contributing to the discussion of the risk factors for poor adjustment. This study has hopefully in some way improved the caregiving literature in general by increasing the quality and quantity of studies examining the specific situation faced by CABG partners (Biegel & Schulz, 1999). It has also shown that they are a useful population for measuring the early stage of taking on the caregiving role which is otherwise difficult to measure in caregivers of chronically ill patients. The findings have also contributed to our understanding about the relationship between support and caregiving.

This is one of the first studies measuring both social support and marital functioning together in CABG patients and partners. Hopefully this will enable future support research to use clearer conceptualisations to investigate potential explanatory pathways to health outcomes, and will be useful for designing interventions. My research identified some important pre-surgery risk factors for poor surgery outcomes which can be targeted for intervention prior to the event, and in some ways clarified the relationship between support and recovery and adjustment. Using this methodological design I hope to have made some improvements to and updated an important literature, touching on some of the most widely impacting issues related to illness, including the leading cause of death (CHD), one of the most frequently performed procedures in the world (CABG), the top mental health cause of global disease burden (depression) and a life situation affecting 1 in 8 people in the UK (Carers UK, 2012b) (caregiving).

8.6 Limitations

Despite these strengths there are several limitations to my research. Firstly, the findings indicate that conducting dyadic analysis would have been insightful, and the design lends itself towards it. I did not do so because I was restricted by time and space, and also I was specifically interested in the relationships between the individual's perceptions of their social relationships and their adjustment after surgery. However, the other spouse's distress is likely to have been an influence on their own (Thomson et al., 2011), and dyadic analysis would further elucidate the associations between giving and receiving support and the differences between patients and partners. The comparative analyses between patients and partners were an introduction towards dyadic analyses, which I recommend for future research (section 8.7).

There were a number of variables which were not measured which may have contributed to our understanding of the findings. For example, I did not account for personality factors as I did not have a comprehensive set of personality measures. Patients' and partners' personality traits have been associated with their own and each other's post-surgery adjustment (Duits et al., 1999; Patrick & Hayden, 1999; Ruiz et al., 2006) as well as social relationships (Caughlin, Huston, & Houts, 2000) and caregiving (Reis, Gold, Andres, Markiewicz, & Gauthier, 1994). An individual's personality style may be an important determinant of their ability to adjust, and on sociability factors such as the ability to obtain and maintain social support. Additionally, I did not take health behaviours into account as only crude measures taken on only one occasion were available, and these are potentially unreliable. Patients' adoption of healthy behaviours may have influenced recovery, and may also have been influenced by support factors, so could have been examined as a potential pathway linking support and outcomes. A number of other variables may have been relevant, such as perceived stress or coping, markers of changes to physiological processes, or other outcomes of surgery influencing the partner's recovery experience (forming the link in the conceptual model between the risk factors and distress) but were not included due to reduce the risk of measurement burden.

Another important influence on recovery and adjustment which was not accounted for was participation in cardiac rehabilitation, which for the majority reduces the risk of poor recovery (Oldridge, 2012) and improves quality of life (Engblom, Korpilahti, Hamalainen, Ronnemaa, & Puukka, 1997). This may have been an important determinant of post-surgery adjustment, though the effects on depression are inconsistent (Engblom et al., 1997), and only a proportion (~42% of MI and revascularisation patients) are reported as attending rehabilitation (National Audit of Cardiac Rehabilitation, 2011). It was not measured because at the time of the post-treatment assessment, not all patients had yet been invited to attend. At St George's hospital, all patients are invited to attend cardiac rehabilitation between 6 and 10 weeks after their surgery. For many this would be after they had completed T2 and would be restricted by availability at their local hospital. Participation in rehabilitation will be measured in the one year follow-up. Another limitation was that other potential determinants of length of stay were not accounted for, including those mentioned in section 8.3.2, but possibly others as well.

Furthermore, I did not account for cognitive factors such as illness perceptions which I identified as a risk factor for poor adjustment in Chapter 1. These data were collected from patients and partners but were not included due to the pressure of space. Instead these could be considered an interesting direction for future research. Also, cognitive decline before (or after) surgery may have influenced how participants responded to questionnaires, but this was taken into account only at patient recruitment, and due to time restrictions, no screen was conducted on partners.

There are other possible determinants of caregiving outcomes which are indicators of caregiving ability, such as self-efficacy, mastery and competence (Halm & Bakas, 2007; Halm et al., 2006), which I did not measure to reduce participant burden. Correspondingly, I may have missed the opportunity to identify some positive outcomes of caregiving, such as personal growth which are reported in some studies (e.g. (Halm et al., 2006)), though these may have been reflected in the mood score. Although I tested a number of factors in the proposed partner conceptual model I did not account for a number of patient factors such as their receptiveness to receiving support, something likely to influence the partner's motivation and ability to provide care.

Though I intentionally chose the ESSI as a global measure of social support, I was unable to make distinctions between subtypes of functional support which were not specific to the marital relationship. In addition, while I was able to draw conclusions regarding the source of support in the marital functioning measure, it was not possible to make distinctions between sources of global social support. It is unclear what support was received from community-based programmes or other sources which may have benefitted patients' recovery and influenced the partners' necessity to provide care. However, though the availability and content of these are likely to have varied widely. This limits the information available for informing interventions, but aids understanding of the relevance of global measures of support.

I did not measure participants' marital history; transitions in and out of relationships statuses such as past divorces and whether or not they were in their first marriage may have been an important influence on their perceptions of marital functioning as well as influencing their risk of, for example, depression (Tavares & Aassve, 2013). Similarly, the participants' identification of the 'partner' was based on their own evaluation is likely to have led to inconsistencies in definition, and details of the nature of the relationship was not assessed at the point of recruitment. A proportion of the 'married' sample did not list themselves as married but as living as married or with a partner (17 patients, 10.2%) and the length of the relationship ranged widely (2 – 61 years, mean 38.22 years). However, when the number of years married was controlled for in supplementary analyses it did not remove the significance of any findings.

In addition to variables which were not measured, there were a number of measurement issues which may limit the findings. Firstly, due to some patients being reluctant to complete the questionnaires soon after receiving them, there was a wide range in the number of days between the T1 assessment and surgery, and surgery and the T2 assessment. This limited my ability to draw conclusions based on the stage of the recovery being considered, and the extent to which the T1 assessment was taken during what Oxman and Hull described as "a sufficiently calm milieu to obtain comprehensive psychosocial assessment before the event of function-changing surgery" (Oxman & Hull, 1997) p4. There is also a risk that participants suffered from measurement burden resulting from the lengthy questionnaire booklet, which may have influenced responses or acted as a deterrent for participation or continuation in the study.

Though scores, where possible, were compared to norms for healthy adults, the absence of control groups limits the ability to interpret them as being sufficiently different from normal to require intervention. Particularly in the case of the partners, having no control group limited the extent to which distress scores can be related to the patient's surgery and recovery. The self-report scores may have been susceptible to reporting bias, though measures were not completed with a researcher present. However, though participants were encouraged to complete the questionnaires individually, responses to the support measures may have been influenced by the involvement of their partners. Also, criticisms of some of the measures limit the extent to which the scores can be considered as early indicators of psychiatric disorders. For example, the anxiety measure (HADS) has been critiqued for including too few items relating to the DSM-IV diagnostic criteria for anxiety disorders (Coyne & van Sonderen, 2012). However, it has been validated as a screening tool for anxiety disorders (Frasure-Smith & Lespérance, 2008). Similarly, the BDI has been criticised as worse than other measures at detecting depression symptoms in cardiac patients (Di Benedetto, Lindner, Hare, & Kent, 2006; Doyle, McGee, De La Harpe, Shelley, & Conroy, 2006), although it has also been found to be as effective as diagnostic interview for predicting 6 month mortality in cardiac patients (Frasure-Smith, Lespérance, & Talajic, 1995). The absence of an objective measure of partners' physical health restricted the ability to validate self-reported findings.

The gender split of the two samples limited the possibility of assessing gender differences, yet women spend more time thinking about the negative aspects of their marital relationship (Burnett, 1987; M. Ross & Holmberg, 1990), and female physiology and health are more likely to be adversely affected by negative spousal relationships than men (Coyne et al., 2001; Hibbard & Pope, 1993). Women also have different CABG experiences from men, for example, female patients have been reported as having a significantly longer length of stay than men (Kulik & Mahler, 2006), which is speculated as resulting from them wanting to delay their return home, as women get less help from their spouse than men (Revenson, 2003). The limited number of female patients being referred for surgery during the study period restricted how many could be approached and recruited onto the study. Consequently, the small number of male partners and the subsequent decision to exclude them eliminated the ability to distinguish the relative influences of role and gender on outcomes. Thus, findings for the partners may have been a result of female gender only. Similarly, the differences in levels and changes to support and distress between patients and partners may have been explained predominantly by gender differences (all partners were in heterosexual relationships so the corresponding patient sample was exclusively male). Arguably, the effects of gender and role are confused for caregivers of a number of patient groups (Berg & Upchurch, 2007), though some authors have distinguished them (Gilliss, 1984).

Due to the restrictions of the inclusion criteria, the findings are limited to patients who did not have emergency, or minimally invasive surgery or were too ill to participate and their partners. The findings are also limited to a relatively restricted sample in terms of their demographics, and while homogeneity is good for consistency, it limits generalisability. Although the sample sizes were acceptable and an improvement on several previous studies, the attrition rate (approx. 20% for both samples) and only 60% of married patients' partners providing data indicates a potential selection effect, and there is a possibility that null findings resulted from a lack of power. These findings are also limited only to patients and their partners, and neglect the impact on other family members or individuals within the social network.

In addition, these findings are restricted to this particular stage of the patient's recovery, and do not inform of the longer-term effects on both spouses. It is not possible from the observational design of this study in which no experimental manipulations were undertaken, to determine whether there were any cause and effect relationships between variables. Though this study had the advantage of longitudinal design in which predictor variables were assessed prior to a health event, the direction of the relationship may not be from support or caregiving to post-surgery emotional or physical health (social causation). It may have been that the participant's health determined the quality of their relationships (social selection), as people with better health may have been better at engaging support

(Renne, 1971). Alternatively, those with greater physical dependence may have been more likely to mobilise the support they needed (Wortman & Conway, 1985). Some previous studies linking support and health have taken the direction of causality into consideration. For example, Wickrama et al (1997) considered temporal ordering and found marital quality measured prior to illness predicted later physical illness. However, Kulik and Mahler (1993) tested for reverse causality and found that changes in one type of emotional distress did predict subsequent decreases in support, while other types did not. Thus even with temporal ordering, it is difficult to single out the support as the determining factor, and the support and surgery outcomes may have developed from the same sources (physical, behavioural, environmental) and may not be causally linked (Kivimäki et al., 2006).

8.7 Suggestions for future research

There are several improvements which can be made to this study, and future research might aim to address the limitations where possible. In addition, the findings highlight a number of opportunities for further research. First and foremost, further work could extend these findings with dyadic analysis, using, for example the actor-partner interdependence model (Kenny, Kashy, & Cook, 2006) in which the patient and partner predictors are regressed on the patient and partner outcomes in a single model. This would enable the examination of the influences of one spouse's distress on the other's, and also how the support variables of one impact those of the other.

In a broader sense, the distinctions between different types of social relationships are in need of further clarification with additional studies. It might be beneficial to test whether these distinctions are also seen in other samples to determine their generalisability. If these associations were found across more diverse samples, such as patients undergoing non-cardiac surgery and their partners, it would help to determine if these findings are relevant not just in this specific surgery situation. In one particular example, future studies could compare the relationships between changes in caregiver burden and distress in cardiac surgery partners with partners caring for patients with chronic illness. This could reveal whether these findings are related to the abrupt adoption of the caregiving role, as hypothesised. The notion that the partner's adoption of the caregiving role is a risk factor for worse distress could be transferred across to the wider caregiving literature. Before firm recommendations can be made regarding assessing the partner's stage within the caregiving journey, we need more conclusive evidence that this is something that can be measured in partners with a less clear transitional event such as cardiac surgery. The findings could also be broadened to other markers of emotional distress, such as PTSD or generalised distress, and markers of physical health such as longer-term mortality, or indeed more general consequences.

A more careful examination of the mechanisms linking support and outcomes is necessary. In particular, examination of the cortisol or inflammatory markers might help to clarify whether shorter length of stay results from larger endocrine responses or less inflammation in the patients with more social support. This data has recently become available for these patients, so additional work could examine these as potential mediators. Future research may also wish to examine health behaviours as a possible mechanism, particularly the behaviours conducted on the ward to advance recovery and discharge (section 8.3.2). Additional psychological factors such as illness perceptions, perceived stress or coping styles could also be analysed as potential pathways linking support, or caregiving, to outcomes. A clearer knowledge of the mechanisms would enhance the general understanding of how social support links with health.

Randomised controlled intervention studies could complement the current understanding of what types of interventions are effective in improving support and decreasing caregiver burden, and whether this has subsequent effects on well-being (see section 8.4 for intervention recommendations). They may also further disentangle the distinctions found between different aspects of social relationships. For example, a trial in which one group received an intervention focused on general perceptions of support and another on the marriage specifically might reveal whether this distinction has relevance in a real life practical setting. Similarly, an intervention focusing on enhancing positive support compared with one specifically altering negative aspects could also increase clarification of this distinction. In addition, it might be interesting to test couple therapy interventions in the context of preparing couples for an illness event. Future studies could extend the current research to increase our understanding of the risk factors for poor social relationships, so these individuals can be targeted for intervention. Finally, an intervention study would significantly increase our understanding of whether the relationship between support and health is causal.

8.8 Conclusions

Feeling connected to other people through positive, nurturing relationships is an integral component of well-being. Through the benefits they have for behavioural choices, psychological health and reactivity to stress, supportive relationships may also be important determinants of how people adjust during a challenging time, such as illness. The findings from the two sets of analyses conducted for this PhD suggest that the marital relationship is multifaceted; it has influences on health and well-being which go beyond the impact of general perceptions of feeling supported by ones social contacts. The presence of worry and inadequacies within this relationship has repercussions for emotional and physical health independently of positive factors. Within this relationship, the necessity to provide support that extends beyond the typical situation may be detrimental to a spouse's adjustment to an individual's illness. It may be as a result of differing perceptions of relationships that patients and their partners have emotionally disparate experiences during illness. These various propositions imply that the nature of an individual's relationships is a dimension worthy of closer attention during a time of illness.

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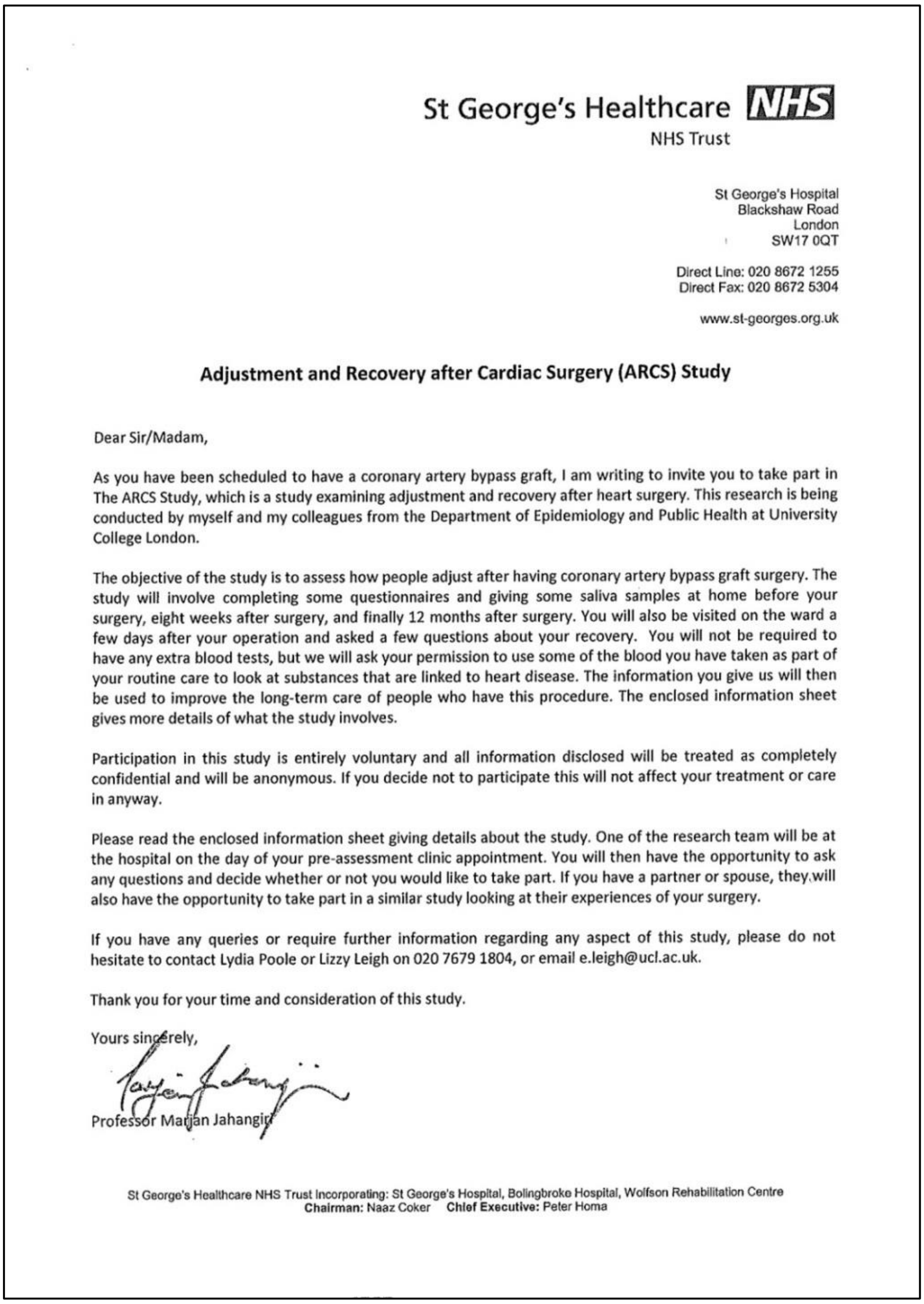
Appendices

Appendix 1. Patient research materials

Appendix 1.1 Patient letter of invitation



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Adjustment and Recovery after Cardiac Surgery (ARCS) Study

Dear Sir/Madam,

As you have been scheduled to have a coronary artery bypass graft, I am writing to invite you to take part in The ARCS Study, which is a study examining adjustment and recovery after heart surgery. This research is being conducted by myself and my colleagues from the Department of Epidemiology and Public Health at University College London.

The objective of the study is to assess how people adjust after having coronary artery bypass graft surgery. The study will involve completing some questionnaires and giving some saliva samples at home before your surgery, eight weeks after surgery, and finally 12 months after surgery. You will also be visited on the ward a few days after your operation and asked a few questions about your recovery. You will not be required to have any extra blood tests, but we will ask your permission to use some of the blood you have taken as part of your routine care to look at substances that are linked to heart disease. The information you give us will then be used to improve the long-term care of people who have this procedure. The enclosed information sheet gives more details of what the study involves.

Participation in this study is entirely voluntary and all information disclosed will be treated as completely confidential and will be anonymous. If you decide not to participate this will not affect your treatment or care in anyway.

Please read the enclosed information sheet giving details about the study. One of the research team will be at the hospital on the day of your pre-assessment clinic appointment. You will then have the opportunity to ask any questions and decide whether or not you would like to take part. If you have a partner or spouse, they will also have the opportunity to take part in a similar study looking at their experiences of your surgery.

If you have any queries or require further information regarding any aspect of this study, please do not hesitate to contact Lydia Poole or Lizzy Leigh on 020 7679 1804, or email e.leigh@ucl.ac.uk.

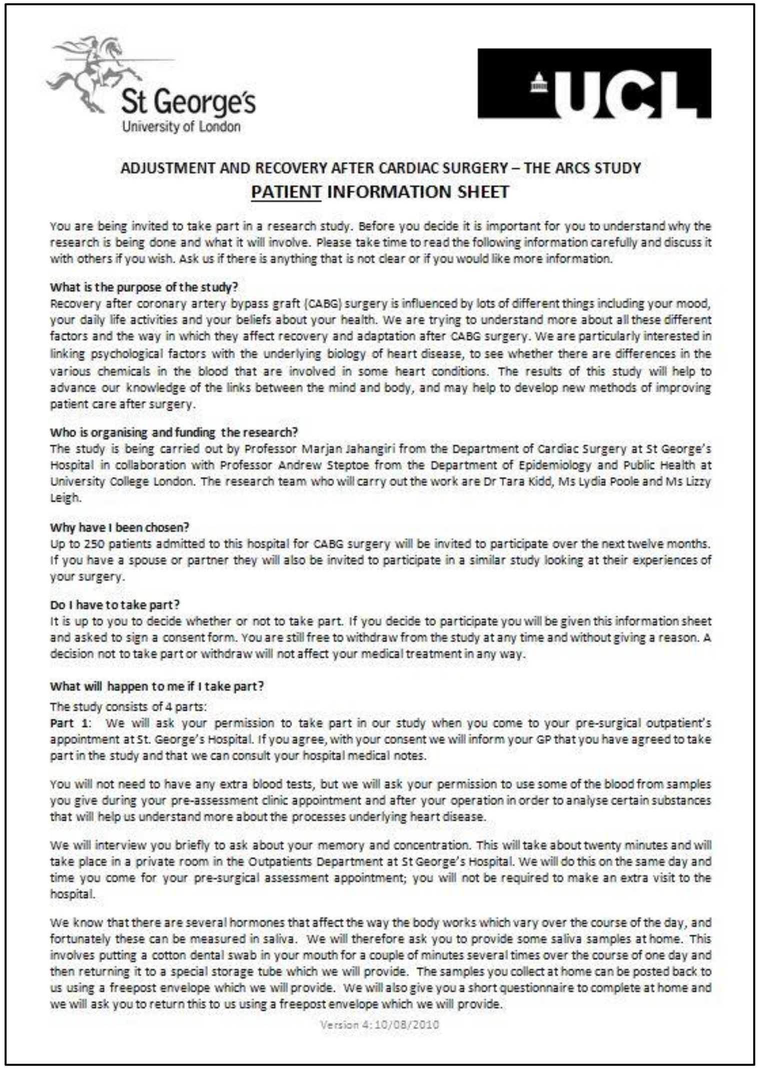
Thank you for your time and consideration of this study.

Yours sincerely,

Professor Marjan Jahangiri

St George's Healthcare NHS Trust Incorporating: St George's Hospital, Bolingbroke Hospital, Wolfson Rehabilitation Centre
Chairman: Naaz Coker **Chief Executive:** Peter Homa

Appendix 1.2 Patient information sheet



St George's
University of London

UCL

ADJUSTMENT AND RECOVERY AFTER CARDIAC SURGERY – THE ARCS STUDY

PATIENT INFORMATION SHEET

You are being invited to take part in a research study. Before you decide it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask us if there is anything that is not clear or if you would like more information.

What is the purpose of the study?
Recovery after coronary artery bypass graft (CABG) surgery is influenced by lots of different things including your mood, your daily life activities and your beliefs about your health. We are trying to understand more about all these different factors and the way in which they affect recovery and adaptation after CABG surgery. We are particularly interested in linking psychological factors with the underlying biology of heart disease, to see whether there are differences in the various chemicals in the blood that are involved in some heart conditions. The results of this study will help to advance our knowledge of the links between the mind and body, and may help to develop new methods of improving patient care after surgery.

Who is organising and funding the research?
The study is being carried out by Professor Marjan Jahangiri from the Department of Cardiac Surgery at St George's Hospital in collaboration with Professor Andrew Steptoe from the Department of Epidemiology and Public Health at University College London. The research team who will carry out the work are Dr Tara Kidd, Ms Lydia Poole and Ms Lizzy Leigh.

Why have I been chosen?
Up to 250 patients admitted to this hospital for CABG surgery will be invited to participate over the next twelve months. If you have a spouse or partner they will also be invited to participate in a similar study looking at their experiences of your surgery.

Do I have to take part?
It is up to you to decide whether or not to take part. If you decide to participate you will be given this information sheet and asked to sign a consent form. You are still free to withdraw from the study at any time and without giving a reason. A decision not to take part or withdraw will not affect your medical treatment in any way.

What will happen to me if I take part?

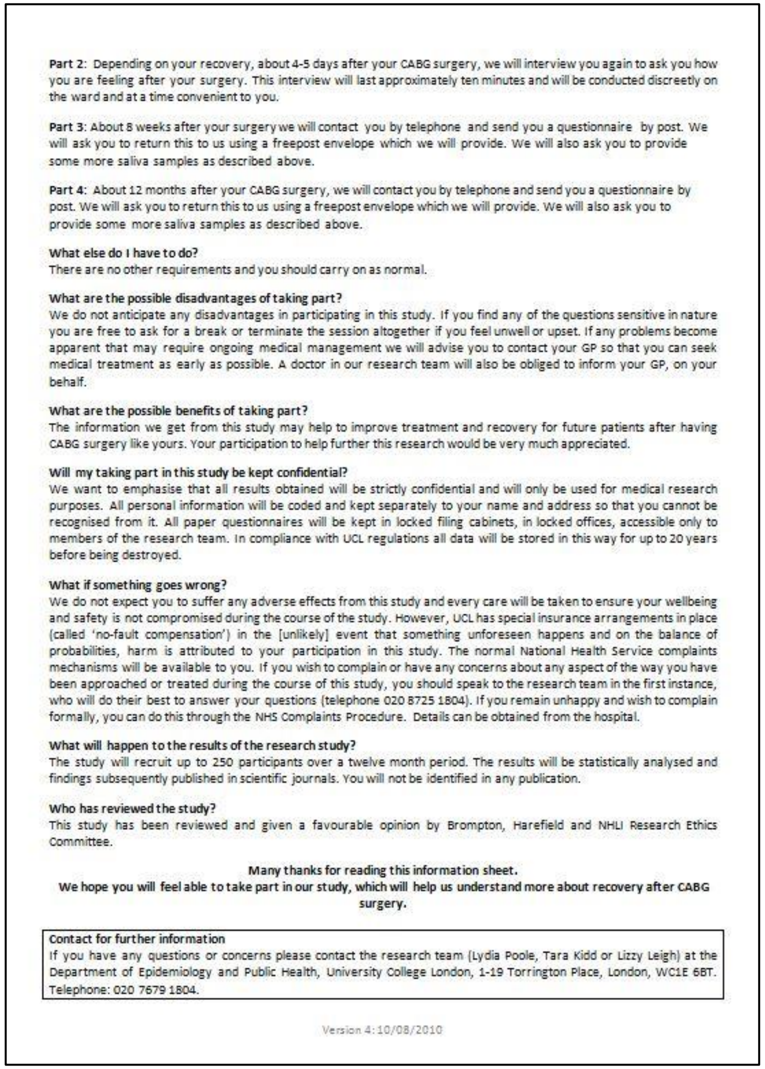
The study consists of 4 parts:
Part 1: We will ask your permission to take part in our study when you come to your pre-surgical outpatient's appointment at St. George's Hospital. If you agree, with your consent we will inform your GP that you have agreed to take part in the study and that we can consult your hospital medical notes.

You will not need to have any extra blood tests, but we will ask your permission to use some of the blood from samples you give during your pre-assessment clinic appointment and after your operation in order to analyse certain substances that will help us understand more about the processes underlying heart disease.

We will interview you briefly to ask about your memory and concentration. This will take about twenty minutes and will take place in a private room in the Outpatients Department at St George's Hospital. We will do this on the same day and time you come for your pre-surgical assessment appointment; you will not be required to make an extra visit to the hospital.

We know that there are several hormones that affect the way the body works which vary over the course of the day, and fortunately these can be measured in saliva. We will therefore ask you to provide some saliva samples at home. This involves putting a cotton dental swab in your mouth for a couple of minutes several times over the course of one day and then returning it to a special storage tube which we will provide. The samples you collect at home can be posted back to us using a freepost envelope which we will provide. We will also give you a short questionnaire to complete at home and we will ask you to return this to us using a freepost envelope which we will provide.

Version 4: 10/08/2010



Part 2: Depending on your recovery, about 4-5 days after your CABG surgery, we will interview you again to ask you how you are feeling after your surgery. This interview will last approximately ten minutes and will be conducted discreetly on the ward and at a time convenient to you.

Part 3: About 8 weeks after your surgery we will contact you by telephone and send you a questionnaire by post. We will ask you to return this to us using a freepost envelope which we will provide. We will also ask you to provide some more saliva samples as described above.

Part 4: About 12 months after your CABG surgery, we will contact you by telephone and send you a questionnaire by post. We will ask you to return this to us using a freepost envelope which we will provide. We will also ask you to provide some more saliva samples as described above.

What else do I have to do?
There are no other requirements and you should carry on as normal.

What are the possible disadvantages of taking part?
We do not anticipate any disadvantages in participating in this study. If you find any of the questions sensitive in nature you are free to ask for a break or terminate the session altogether if you feel unwell or upset. If any problems become apparent that may require ongoing medical management we will advise you to contact your GP so that you can seek medical treatment as early as possible. A doctor in our research team will also be obliged to inform your GP, on your behalf.

What are the possible benefits of taking part?
The information we get from this study may help to improve treatment and recovery for future patients after having CABG surgery like yours. Your participation to help further this research would be very much appreciated.

Will my taking part in this study be kept confidential?
We want to emphasise that all results obtained will be strictly confidential and will only be used for medical research purposes. All personal information will be coded and kept separately to your name and address so that you cannot be recognised from it. All paper questionnaires will be kept in locked filing cabinets, in locked offices, accessible only to members of the research team. In compliance with UCL regulations all data will be stored in this way for up to 20 years before being destroyed.

What if something goes wrong?
We do not expect you to suffer any adverse effects from this study and every care will be taken to ensure your wellbeing and safety is not compromised during the course of the study. However, UCL has special insurance arrangements in place (called 'no-fault compensation') in the [unlikely] event that something unforeseen happens and on the balance of probabilities, harm is attributed to your participation in this study. The normal National Health Service complaints mechanisms will be available to you. If you wish to complain or have any concerns about any aspect of the way you have been approached or treated during the course of this study, you should speak to the research team in the first instance, who will do their best to answer your questions (telephone 020 8725 1804). If you remain unhappy and wish to complain formally, you can do this through the NHS Complaints Procedure. Details can be obtained from the hospital.

What will happen to the results of the research study?
The study will recruit up to 250 participants over a twelve month period. The results will be statistically analysed and findings subsequently published in scientific journals. You will not be identified in any publication.

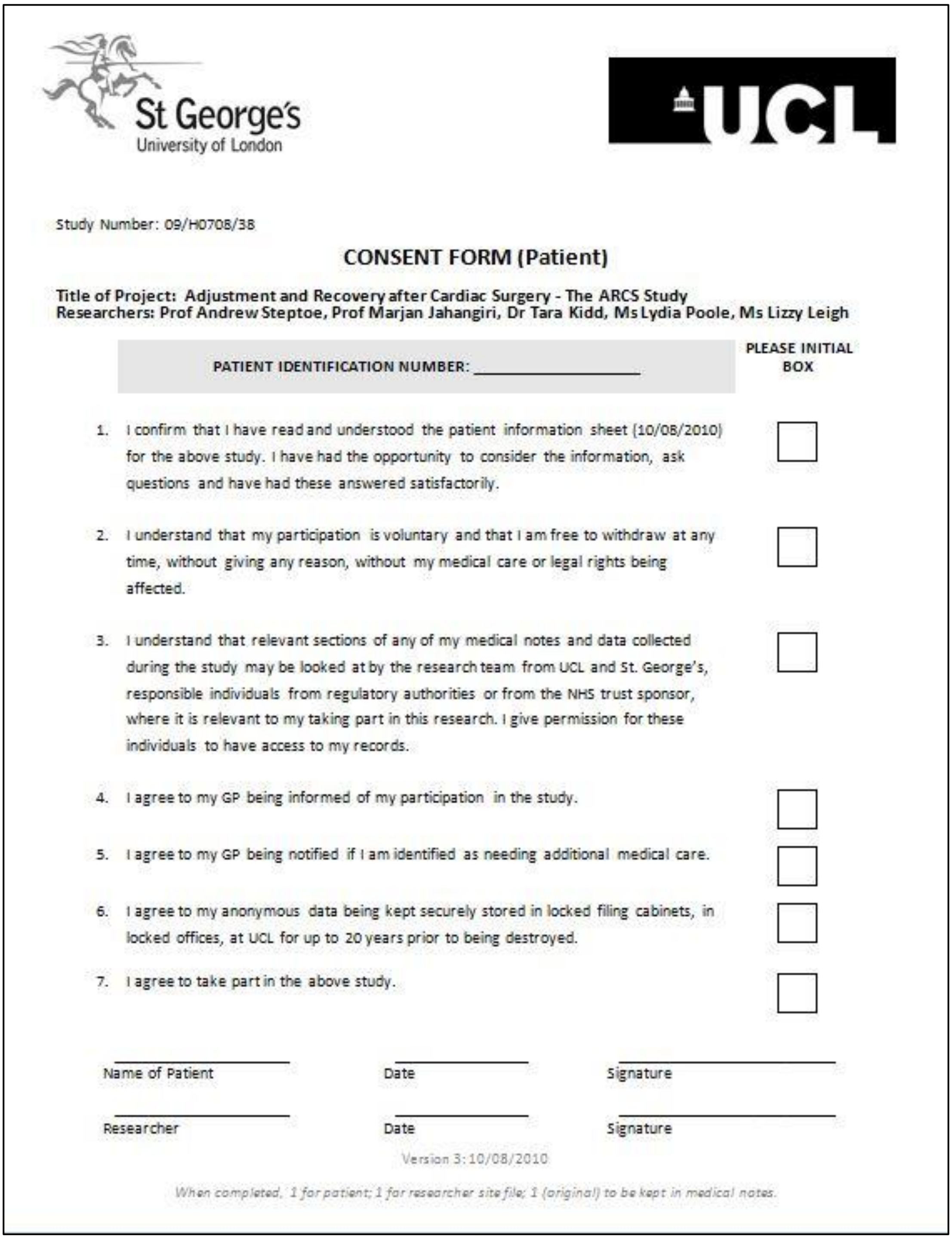
Who has reviewed the study?
This study has been reviewed and given a favourable opinion by Brompton, Harefield and NHLI Research Ethics Committee.

Many thanks for reading this information sheet.
We hope you will feel able to take part in our study, which will help us understand more about recovery after CABG surgery.

Contact for further information
If you have any questions or concerns please contact the research team (Lydia Poole, Tara Kidd or Lizzy Leigh) at the Department of Epidemiology and Public Health, University College London, 1-19 Torrington Place, London, WC1E 6BT. Telephone: 020 7679 1804.

Version 4: 10/08/2010

Appendix 1.3 Patient consent form



St George's
University of London

UCL

Study Number: 09/H0708/38

CONSENT FORM (Patient)

Title of Project: Adjustment and Recovery after Cardiac Surgery - The ARCS Study
Researchers: Prof Andrew Steptoe, Prof Marjan Jahangiri, Dr Tara Kidd, Ms Lydia Poole, Ms Lizzy Leigh

PATIENT IDENTIFICATION NUMBER: ______________

PLEASE INITIAL BOX

1. I confirm that I have read and understood the patient information sheet (10/08/2010) for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily. ☐
2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason, without my medical care or legal rights being affected. ☐
3. I understand that relevant sections of any of my medical notes and data collected during the study may be looked at by the research team from UCL and St. George's, responsible individuals from regulatory authorities or from the NHS trust sponsor, where it is relevant to my taking part in this research. I give permission for these individuals to have access to my records. ☐
4. I agree to my GP being informed of my participation in the study. ☐
5. I agree to my GP being notified if I am identified as needing additional medical care. ☐
6. I agree to my anonymous data being kept securely stored in locked filing cabinets, in locked offices, at UCL for up to 20 years prior to being destroyed. ☐
7. I agree to take part in the above study. ☐

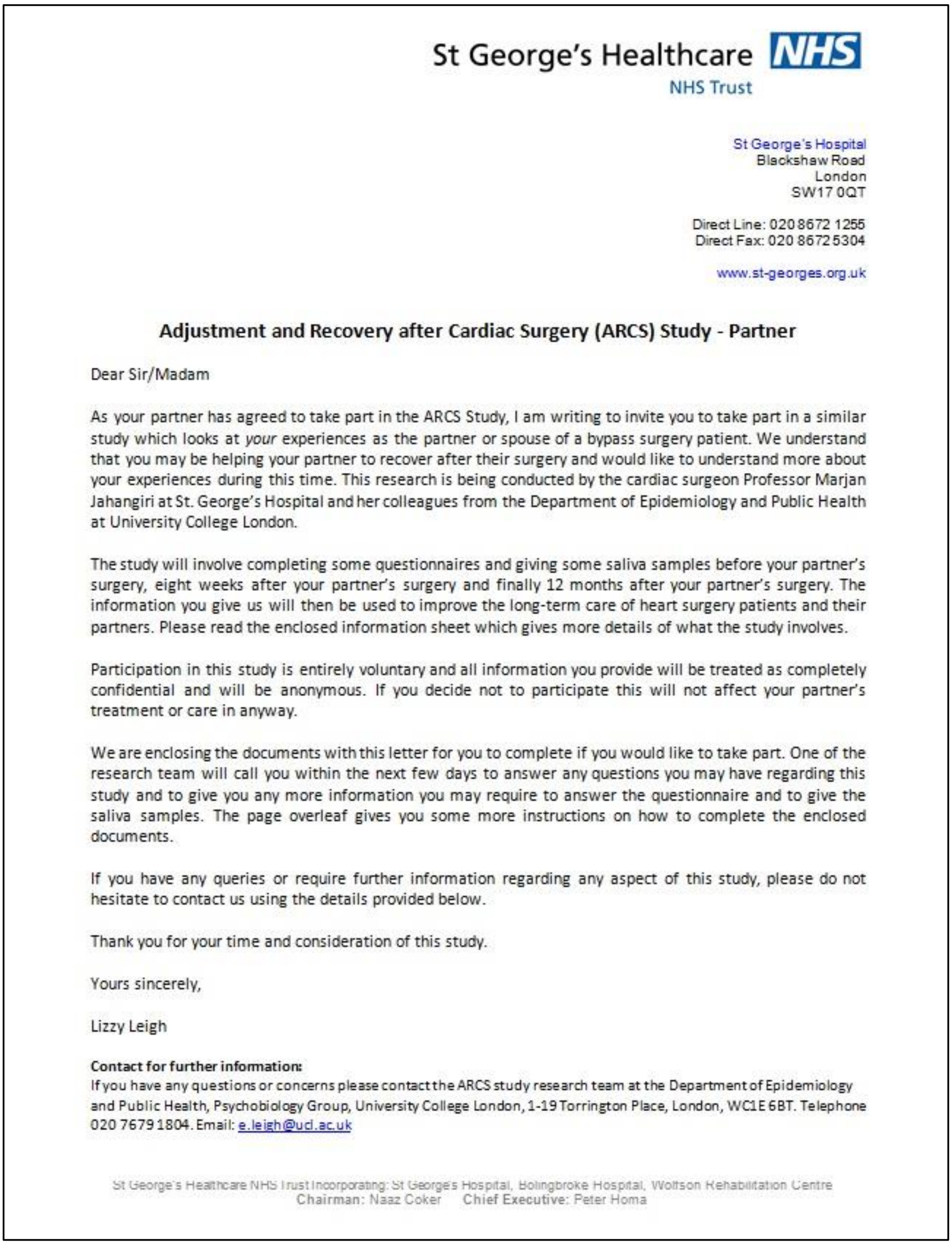
______________	______________	______________
Name of Patient	Date	Signature
______________	______________	______________
Researcher	Date	Signature

Version 3: 10/08/2010

When completed, 1 for patient; 1 for researcher site file; 1 (original) to be kept in medical notes.

Appendix 2. Partner research materials

Appendix 2.1 Partner letter of invitation



St George's Healthcare NHS
NHS Trust

St George's Hospital
Blackshaw Road
London
SW17 0QT

Direct Line: 020 8672 1255
Direct Fax: 020 8672 5304

www.st-georges.org.uk

Adjustment and Recovery after Cardiac Surgery (ARCS) Study - Partner

Dear Sir/Madam

As your partner has agreed to take part in the ARCS Study, I am writing to invite you to take part in a similar study which looks at *your* experiences as the partner or spouse of a bypass surgery patient. We understand that you may be helping your partner to recover after their surgery and would like to understand more about your experiences during this time. This research is being conducted by the cardiac surgeon Professor Marjan Jahangiri at St. George's Hospital and her colleagues from the Department of Epidemiology and Public Health at University College London.

The study will involve completing some questionnaires and giving some saliva samples before your partner's surgery, eight weeks after your partner's surgery and finally 12 months after your partner's surgery. The information you give us will then be used to improve the long-term care of heart surgery patients and their partners. Please read the enclosed information sheet which gives more details of what the study involves.

Participation in this study is entirely voluntary and all information you provide will be treated as completely confidential and will be anonymous. If you decide not to participate this will not affect your partner's treatment or care in anyway.

We are enclosing the documents with this letter for you to complete if you would like to take part. One of the research team will call you within the next few days to answer any questions you may have regarding this study and to give you any more information you may require to answer the questionnaire and to give the saliva samples. The page overleaf gives you some more instructions on how to complete the enclosed documents.

If you have any queries or require further information regarding any aspect of this study, please do not hesitate to contact us using the details provided below.

Thank you for your time and consideration of this study.

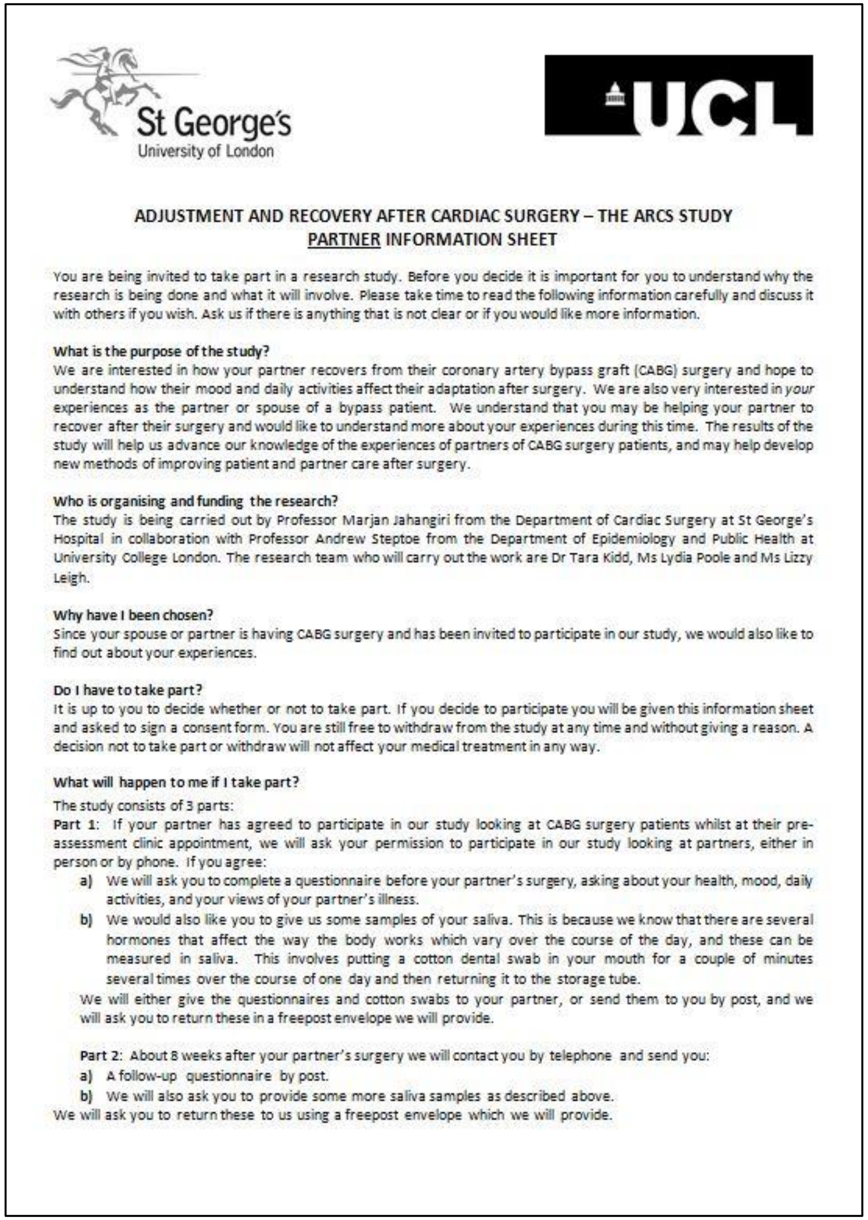
Yours sincerely,

Lizzy Leigh

Contact for further information:
If you have any questions or concerns please contact the ARCS study research team at the Department of Epidemiology and Public Health, Psychobiology Group, University College London, 1-19 Torrington Place, London, WC1E 6BT. Telephone 020 7679 1804. Email: e.leigh@ucl.ac.uk

St George's Healthcare NHS Trust Incorporating: St George's Hospital, Bolingbroke Hospital, Wolfson Rehabilitation Centre
Chairman: Naaz Coker Chief Executive: Peter Homa

Appendix 2.2 Partner information sheet



St George's
University of London

UCL

ADJUSTMENT AND RECOVERY AFTER CARDIAC SURGERY – THE ARCS STUDY
PARTNER INFORMATION SHEET

You are being invited to take part in a research study. Before you decide it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask us if there is anything that is not clear or if you would like more information.

What is the purpose of the study?
We are interested in how your partner recovers from their coronary artery bypass graft (CABG) surgery and hope to understand how their mood and daily activities affect their adaptation after surgery. We are also very interested in *your* experiences as the partner or spouse of a bypass patient. We understand that you may be helping your partner to recover after their surgery and would like to understand more about your experiences during this time. The results of the study will help us advance our knowledge of the experiences of partners of CABG surgery patients, and may help develop new methods of improving patient and partner care after surgery.

Who is organising and funding the research?
The study is being carried out by Professor Marjan Jahangiri from the Department of Cardiac Surgery at St George's Hospital in collaboration with Professor Andrew Steptoe from the Department of Epidemiology and Public Health at University College London. The research team who will carry out the work are Dr Tara Kidd, Ms Lydia Poole and Ms Lizzy Leigh.

Why have I been chosen?
Since your spouse or partner is having CABG surgery and has been invited to participate in our study, we would also like to find out about your experiences.

Do I have to take part?
It is up to you to decide whether or not to take part. If you decide to participate you will be given this information sheet and asked to sign a consent form. You are still free to withdraw from the study at any time and without giving a reason. A decision not to take part or withdraw will not affect your medical treatment in any way.

What will happen to me if I take part?
The study consists of 3 parts:
Part 1: If your partner has agreed to participate in our study looking at CABG surgery patients whilst at their pre-assessment clinic appointment, we will ask your permission to participate in our study looking at partners, either in person or by phone. If you agree:

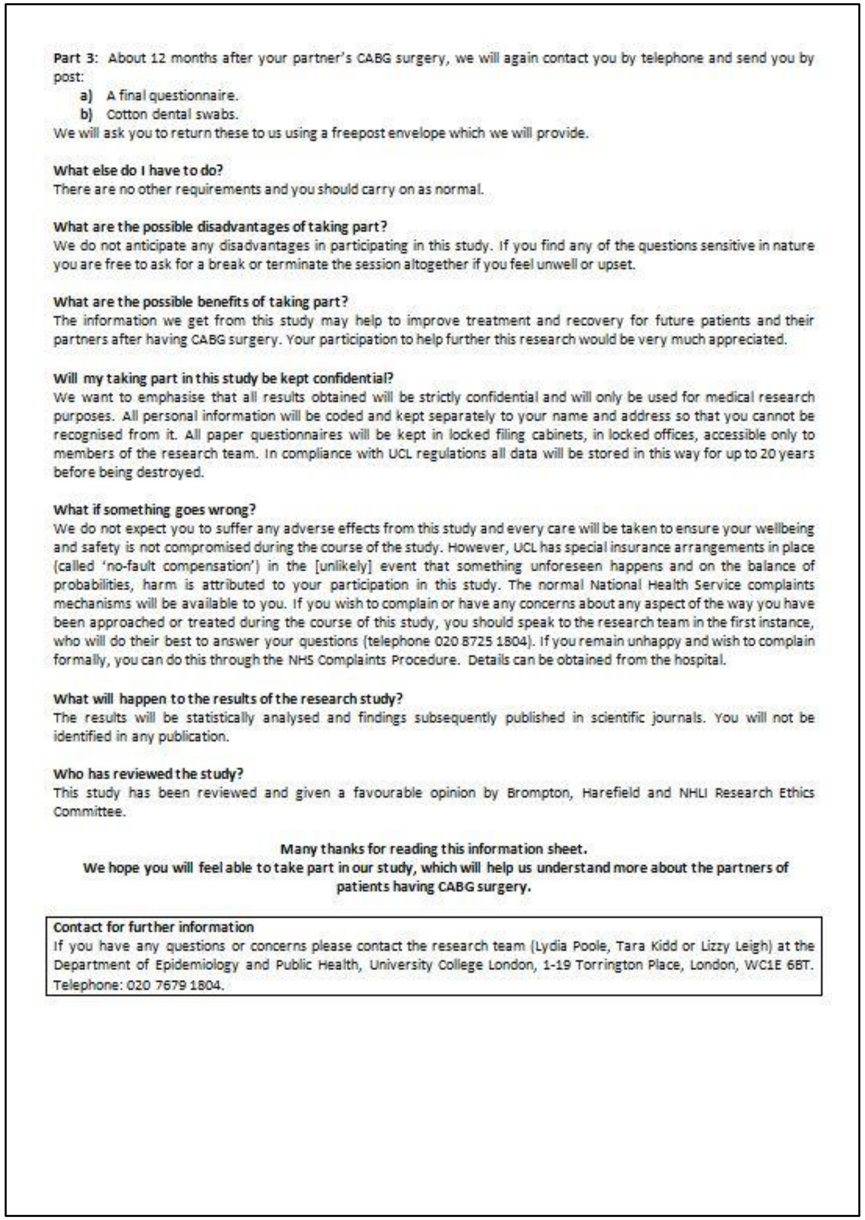
a) We will ask you to complete a questionnaire before your partner's surgery, asking about your health, mood, daily activities, and your views of your partner's illness.
b) We would also like you to give us some samples of your saliva. This is because we know that there are several hormones that affect the way the body works which vary over the course of the day, and these can be measured in saliva. This involves putting a cotton dental swab in your mouth for a couple of minutes several times over the course of one day and then returning it to the storage tube.

We will either give the questionnaires and cotton swabs to your partner, or send them to you by post, and we will ask you to return these in a freepost envelope we will provide.

Part 2: About 8 weeks after your partner's surgery we will contact you by telephone and send you:

a) A follow-up questionnaire by post.
b) We will also ask you to provide some more saliva samples as described above.

We will ask you to return these to us using a freepost envelope which we will provide.



Part 3: About 12 months after your partner's CABG surgery, we will again contact you by telephone and send you by post:

a) A final questionnaire.
b) Cotton dental swabs.

We will ask you to return these to us using a freepost envelope which we will provide.

What else do I have to do?
There are no other requirements and you should carry on as normal.

What are the possible disadvantages of taking part?
We do not anticipate any disadvantages in participating in this study. If you find any of the questions sensitive in nature you are free to ask for a break or terminate the session altogether if you feel unwell or upset.

What are the possible benefits of taking part?
The information we get from this study may help to improve treatment and recovery for future patients and their partners after having CABG surgery. Your participation to help further this research would be very much appreciated.

Will my taking part in this study be kept confidential?
We want to emphasise that all results obtained will be strictly confidential and will only be used for medical research purposes. All personal information will be coded and kept separately to your name and address so that you cannot be recognised from it. All paper questionnaires will be kept in locked filing cabinets, in locked offices, accessible only to members of the research team. In compliance with UCL regulations all data will be stored in this way for up to 20 years before being destroyed.

What if something goes wrong?
We do not expect you to suffer any adverse effects from this study and every care will be taken to ensure your wellbeing and safety is not compromised during the course of the study. However, UCL has special insurance arrangements in place (called 'no-fault compensation') in the [unlikely] event that something unforeseen happens and on the balance of probabilities, harm is attributed to your participation in this study. The normal National Health Service complaints mechanisms will be available to you. If you wish to complain or have any concerns about any aspect of the way you have been approached or treated during the course of this study, you should speak to the research team in the first instance, who will do their best to answer your questions (telephone 020 8725 1804). If you remain unhappy and wish to complain formally, you can do this through the NHS Complaints Procedure. Details can be obtained from the hospital.

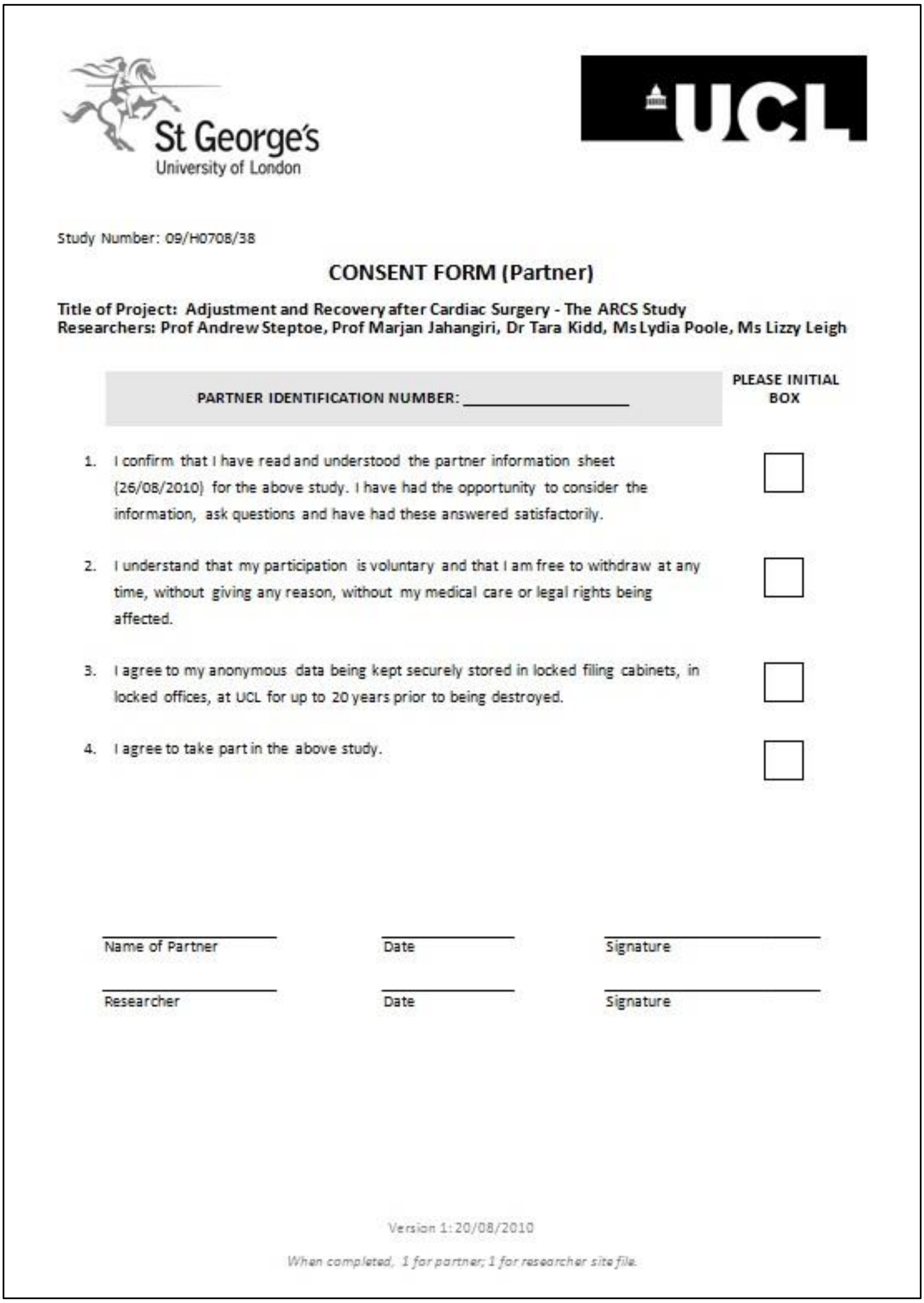
What will happen to the results of the research study?
The results will be statistically analysed and findings subsequently published in scientific journals. You will not be identified in any publication.

Who has reviewed the study?
This study has been reviewed and given a favourable opinion by Brompton, Harefield and NHLI Research Ethics Committee.

Many thanks for reading this information sheet.
We hope you will feel able to take part in our study, which will help us understand more about the partners of patients having CABG surgery.

Contact for further information
If you have any questions or concerns please contact the research team (Lydia Poole, Tara Kidd or Lizzy Leigh) at the Department of Epidemiology and Public Health, University College London, 1-19 Torrington Place, London, WC1E 6BT. Telephone: 020 7679 1804.

Appendix 2.3 Partner consent form



St George's
University of London

UCL

Study Number: 09/H0708/38

CONSENT FORM (Partner)

Title of Project: Adjustment and Recovery after Cardiac Surgery - The ARCS Study
Researchers: Prof Andrew Steptoe, Prof Marjan Jahangiri, Dr Tara Kidd, Ms Lydia Poole, Ms Lizzy Leigh

PARTNER IDENTIFICATION NUMBER: __________________	**PLEASE INITIAL BOX**
1. I confirm that I have read and understood the partner information sheet (26/08/2010) for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.	☐
2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason, without my medical care or legal rights being affected.	☐
3. I agree to my anonymous data being kept securely stored in locked filing cabinets, in locked offices, at UCL for up to 20 years prior to being destroyed.	☐
4. I agree to take part in the above study.	☐

Name of Partner	Date	Signature
Researcher	Date	Signature

Version 1: 20/08/2010

When completed, 1 for partner; 1 for researcher site file.

Appendix 3. Additional analyses from patient results

The following results relate to the additional analyses reported in Chapter 6, section 6.9.

Appendix 3.1 Logistic regression predicting binary length of stay

The model in which social support was found to predict length of stay was repeated modelling length of stay as a binary variable using a cut-off of 5 days. I conducted a logistic regression entering age, sex, ethnicity, EuroSCORE, occupational classification and T1 social support into the model (Table Appendix-1). The results showed that social support remained a significant predictor of length of stay after controlling for covariates (OR .893, 95% CI .816-.977, p = .014). For every unit decrease of social support, there was a 10.7% decreased risk of a length of stay longer than 5 days.

Table Appendix- 1 Logistic regression model predicting length of hospital stay

Model	OR	95% CI	P
Age	.976	.911-1.044	.476
Sex[a]	.939	.269-3.287	.922
Ethnicity[b]	1.356	.499-3.688	.551
EuroSCORE	1.372	1.064-1.769	.015
Occupational classification	1.152	.723-1.835	.551
Social support	.893	.816-.977	**.014**

Reference values are: [a]male, [b]white

List of abbreviations: confidence interval (CI), odds ratio (OR)

Appendix 3.2 Depression models controlling for somatic symptoms

The items relating to somatic depression symptoms (14-21) were removed from the BDI to create a scale of affective depression. The regression model in which negative marital functioning predicted depression symptoms was repeating using this score (T2 mean 2.25, range 0 – 19.5). All three types of marital functioning (negative, practical, emotional) were entered into the model with covariates (age, sex, ethnicity, baseline affective depression symptoms score, EuroSCORE, occupational classification). Together these variables explained 28.1% of the variance in T2 affective depression symptoms. Negative marital functioning significantly predicted T2 affective depression symptoms (β = .223, p = .012) (Table Appendix-2) (Model 1). Negative marital functioning remained a significant predictor of T2 affective depression symptoms when social support was added in the second step (β = .212, p = .022) (Model 2).

Table Appendix- 2 Marital functioning predicting affective depression symptoms

	Model 1			**Model 2**		
	β	**SE**	**P**	**β**	**SE**	**P**
Step 1						
Age	.076	.045	.527	.062	.047	.611
Sex	.120	.856	.107	.115	.864	.128
Ethnicity	-.085	.729	.277	-.087	.734	.272
Baseline	.413	.066	<.001	.399	.069	<.001
EuroSCORE	.013	.140	.910	.033	.152	.783
Occupational classification	.085	.306	.234	.086	.310	.237
Negative MF	.224	.123	**.011**	.212	.129	**.022**
Practical MF	.058	.112	.488	.064	.113	.451
Emotional MF	.063	.073	.492	.067	.077	.490
R^2	.282					
Step 2	-	-	-			
Social support	-	-	-	-.039	.073	.664
R^2	-	-	-	.282		
R^2 change	-	-	-	-		

Appendix 3.3 Depression models controlling for anti-depressants

One of the items in the health service use measure asked participants to list any medications they had taken in the previous 14 days. Participants who reported taking SSRIs, tricyclic or tetracyclic antidepressants were given a score of 1 on a depression medication variable. This variable was entered as covariate in models where marital functioning predicted depression symptoms and anxiety. In the depression symptoms model, all variables were entered together, and accounted for 31.5% of the variance in T2 depression symptoms. Negative marital functioning predicted depression symptoms after controlling for covariates including medication (an indication of a pre-existing emotional disorder that is being treated) (β = .206, p = .020) (Table Appendix-3). In the model predicting T2 anxiety, the same variables were entered and together predicted 35.1% of the variance in anxiety. Negative marital functioning predicted anxiety after controlling for covariates including medication (β = .230, p = .008) (Table Appendix-3).

Table Appendix- 3 Marital functioning predicting emotional outcomes controlling for medication

	Depression			**Anxiety**		
	β	**SE**	**P**	**β**	**SE**	**P**
Step 1						
Age	.088	.079	.472	.87	.051	.463
Sex	.137	1.560	.075	.012	.966	.872
Ethnicity	-.083	1.389	.295	-.098	.874	.210
Baseline	.403	.075	<.001	.477	.067	<.001
EuroSCORE	.110	.250	.359	.059	.165	.605
Occupational classification	.079	.557	.286	.206	.348	.004
Medication	.048	1.642	.520	.046	1.059	.528
Negative MF	.206	.220	**.020**	.230	.137	**.008**
Practical MF	.033	.203	.701	.005	.130	.952
Emotional MF	.024	.132	.802	.089	.083	.335
R^2	.315			.351		

Appendix 3.4 Controlling for number of marital years

The models in which marital functioning predicted depression symptoms and anxiety were repeated controlling for the number of years the participants had been married. The total number of years married were entered as a covariate in the models. The variables explained 33.4% of the variance in T2 depression symptoms and 34.2% of the variance in T2 anxiety (Table Appendix-4). Negative marital functioning significantly predicted depression symptoms (β = .197, p =.034) and anxiety (β = .253, p = .007) after controlling for covariates.

Table Appendix- 4 Marital functioning predicting emotional outcomes controlling for years married

	Depression			Anxiety		
	β	**SE**	**P**	**β**	**SE**	**P**
Step 1						
Age	.176	.090	.208	.166	.060	.224
Sex	.192	1.464	.017	.072	.954	.375
Ethnicity	-.052	1.313	.526	-.174	.867	.038
Baseline	.434	.071	<.001	.491	.068	<.001
EuroSCORE	.075	.246	.557	.037	.169	.763
Occupational classification	.042	.554	.594	.128	.368	.101
Marital years	-.067	.034	.450	-.106	.023	.234
Negative MF	.197	.223	**.034**	.253	.145	**.007**
Practical MF	.029	.203	.747	-.034	.138	.718
Emotional MF	.081	.130	.425	.132	.085	.184
R^2	.334			.342		

Appendix 4. Additional analyses from partner results

The following results relate to the additional analyses reported in Chapter 7, section 7.9.

Appendix 4.1 Controlling for caring for others

The sample was split on the basis of whether or not they were providing care to someone else before the patient’s surgery. The regression models in which caregiver burden predicted emotional distress were repeated on the partners who were providing care and those who were not, separately. In the model predicting depression symptoms, together the variables accounted for 78.6% of the variance in T2 depression symptoms for those caring for others, and 63.4% in those not caring for others. Total burden change significantly predicted depression symptoms only in those who were not caring for others before surgery (β = .183, p = .034) (Table Appendix-5).

Table Appendix- 5 Total caregiver burden predicting depression symptoms for caring/not caring

	Depression – caring			**Depression – not caring**		
	β	**SE**	**P**	**β**	**SE**	**P**
Step 1						
Age	-.057	.119	.672	.009	.061	.928
Ethnicity	-.045	3.588	.625	-.060	2.384	.471
Baseline	.816	.104	<.001	.745	.086	<.001
EuroSCORE	.178	.410	.195	-.064	.174	.518
Occupational classification	.076	1.079	.530	-.055	.608	.517
Total burden change	.097	.072	.304	.183	.076	**.034**
R^2	.786			.634		

Post-hoc tests using individual models of difficulty burden and time burden were conducted on the two subsamples and are reported in Table Appendix-7 and Table Appendix-8. In the difficulty burden model, together the variables explained 78.6% of the variance in T2 depression symptoms for those caring for others, and 63.4% in those not caring for others. Difficulty burden change significantly predicted depression symptoms only in those who were not caring for others (β = .168, p = .049) (Table Appendix- 6). An increase in the amount of difficulty associated with caregiving was associated with worse depression symptoms only in those who were not caring for others before surgery. In the time burden model, time burden change did not significantly predict T2 depression symptoms for either group (Table Appendix-8).

Table Appendix- 6 Difficulty burden predicting depression symptoms for caring/not caring

	Depression – caring			**Depression – not caring**		
	β	**SE**	**P**	**β**	**SE**	**P**
Step 1						
Age	-.402	.119	.755	.022	.061	.826
Ethnicity	-.403	3.525	.638	-.045	2.382	.587
Baseline	.805	.104	<.001	.741	.087	<.001
EuroSCORE	.175	.416	.200	-.081	.175	.419
Occupational classification	.062	1.080	.607	-.064	.608	.456
Difficulty burden change	.122	1.064	.214	.168	1.245	**.049**
R^2	.790			.629		

Table Appendix- 7 Time burden predicting depression symptoms for caring/not caring

	Depression – caring			**Depression – not caring**		
	β	**SE**	**P**	**β**	**SE**	**P**
Step 1						
Age	-.073	.119	.586	<.001	.061	.998
Ethnicity	-.039	3.631	.681	-.077	2.454	.369
Baseline	.828	.105	<.001	.751	.086	<.001
EuroSCORE	.183	.425	.188	-.052	.177	.609
Occupational classification	.091	1.087	.460	-.057	.613	.507
Time burden change	.059	.828	.521	.169	.819	.059
R^2	.781			.627		

The model predicting anxiety was repeated for the two groups separately, and together the variables accounted for 78.5% of the variance in T2 anxiety for those caring, and 31.3% of those not caring for others. Total burden change significantly predicted anxiety in both those caring (β = .239, p = .023), and those not caring for others (β = .288, p = .016) (Table Appendix-8).

Table Appendix- 8 Caregiver burden predicting anxiety for caring/caring

	Anxiety – caring			**Anxiety – not caring**		
	β	**SE**	**P**	**β**	**SE**	**P**
Step 1						
Age	-.312	.065	.027	-.067	.045	.621
Ethnicity	.037	1.993	.694	.161	1.776	.165
Baseline	.815	.094	<.001	.379	.080	.002
EuroSCORE	.266	.231	.058	.031	.130	.824
Occupational classification	.109	.533	.321	-.092	.444	.427
Total burden change	.239	.043	**.023**	.288	.056	**.016**
R^2	.785			.313		

Post-hoc analyses using the difficulty and time burden subscales revealed that difficulty burden significantly predicted T2 anxiety symptoms only in those caring for others (β = .283, p = .006) (Table Appendix-9), and time burden significantly predicted T2 anxiety symptoms only in those *not* caring for others (β = .351, p = .004) (Table Appendix-10).

Table Appendix- 9 Difficulty burden predicting anxiety for caring/not caring

	Anxiety – caring			**Anxiety – not caring**		
	β	**SE**	**P**	**β**	**SE**	**P**
Step 1						
Age	-.282	.063	.037	-.048	.046	.732
Ethnicity	.046	1.874	.601	.189	1.805	.110
Baseline	.782	.085	<.001	.400	.081	.001
EuroSCORE	.259	.221	.054	.002	.132	.988
Occupational classification	.078	.518	.467	-.109	.453	.357
Difficulty burden change	.283	.573	**.006**	.211	.936	.075
R^2	.8.3			.279		

Table Appendix- 10 Time burden predicting anxiety for caring/caring

	Anxiety – caring			Anxiety – not caring		
	β	SE	P	β	SE	P
Step 1						
Age	-.355	.070	.018	-.090	.044	.499
Ethnicity	.063	2.149	.536	.114	1.778	.325
Baseline	.785	.108	<.001	.366	.078	.002
EuroSCORE	.282	.248	.061	.067	.128	.621
Occupational classification	.176	.547	.124	-.084	.435	.458
Time burden change	.124	.557	.274	.351	.594	**.004**
R^2	.752			.343		

In the model predicting mood, the variables accounted for 51% and 19.4% of the variance in T2 mood for those caring and not caring, respectively. Total burden change did not significantly predict mood for either group, so no further analyses were conducted (Table Appendix-11).

Table Appendix- 11 Caregiver burden predicting mood for caring and not caring

	Mood – caring			Mood – not caring		
	β	SE	P	β	SE	P
Step 1						
Age	-.029	.274	.890	-.088	.175	.533
Ethnicity	-.062	7.789	.661	.117	6.795	.325
Baseline	.447	.147	.008	.429	.125	.001
EuroSCORE	-.127	.923	.548	.059	.501	.678
Occupational classification	-.332	2.199	.052	.136	1.718	.258
Total burden change	-.246	.158	.097	-.198	.217	.103
R^2	.510			.194		

Appendix 4.2 Controlling for employment

The model in which time burden predicted decreases in social support was repeated separately for partners who were employed and those who were not at the time of surgery (Table Appendix-12). Time burden significantly predicted T2 social support only in those who were employed (β = -.360, p = .004).

Table Appendix- 12 Time burden predicting social support in employed/not employed

	Social support – employed			**Social support – not employed**		
	β	**SE**	**P**	**β**	**SE**	**P**
Step 1						
Age	.236	.114	.180	.002	.101	.987
Ethnicity	-.084	3.402	.447	.086	2.989	.434
Baseline	.865	.135	<.001	.571	.121	<.001
EuroSCORE	-.157	.496	.349	-.088	.217	.499
Occupational classification	-.291	1.031	.036	-.008	.737	.945
Time burden change	-.360	.064	**.004**	-.123	.057	.269
R^2	.345			.688		