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# Depressive symptoms, perceived control and quality of life among patients undergoing coronary artery bypass graft: a prospective cohort study

Mohannad Eid AbuRuz<sup>1\*</sup> and Ghadeer Al-Dweik<sup>2</sup>

## Abstract

**Background:** Coronary artery bypass graft surgery (CABG) is an intervention directed toward improving the Quality of Life (QoL) for patients with coronary artery disease. Depression can affect QoL negatively among this population. Perceived control (PC) decreased the effect of anxiety on QoL, however, this effect has not been well-studied regarding depression. Therefore, the purpose of this study was to check the effect of depression on QoL among CABG patients and to determine if preoperative PC moderates this effect.

**Methods:** This was a prospective observational cohort study conducted on a consecutive sample of 200 patients from three hospitals in Amman, Jordan. Depression Anxiety and Stress Scale, Short-Form Health Survey-36, and Arabic version of the Control Attitude Scale-Revised were used to measure depressive symptoms, QoL and PC respectively. Data were analyzed using t test and step wise multiple regression followed by simple slope analysis.

**Results:** Postoperative Physical Component Summary (PCS) was better than preoperative PCS (mean  $\pm$  SD:  $38.2 \pm 9.4$  vs.  $36.6 \pm 9.5$ ,  $P < 0.001$ ). Postoperative Mental Component Summary (MCS) was better than preoperative MCS (mean  $\pm$  SD:  $44.3 \pm 11.5$  vs.  $41.4 \pm 11.4$ ,  $P < 0.001$ ). Preoperative depression was higher than postoperative depression; (mean  $\pm$  SD:  $12.8 \pm 6.8$  vs.  $11.1 \pm 6.7$ ,  $P < 0.01$ ). Simple slope analysis was significant (simple slope = 0.41,  $t = 6.1$ ,  $P < 0.001$ ), indicating the moderating effect of PC.

**Conclusion:** Patients undergoing CABG surgery had poor QoL and high levels of depression. Perceived control moderated this relationship and improve QoL. Assessing depression levels and implantation of interventions to enhance perceived control levels prior to operation might improve QoL.

**Keywords:** Coronary artery bypass graft surgery, Depression, Quality of life, Perceived control

## Background

Coronary artery bypass graft surgery (CABG) is a well-known operation for the treatment of coronary artery disease in both developed and developing countries [1,

2]. Due to the technological development and advancement in the (pre and post) operative care, mortality rates after CABG have declined over decades with 98% survival rate during the first 4 months after surgery [2–4]. However, mortality rates alone do not reflect the appropriate outcome measures post CABG [2, 3, 5]. Thus, the goals of coronary artery disease treatment should be more dedicated not only on prolonging life, but also on relieving symptoms, improving physical and

\*Correspondence: mohannadeid@yahoo.com

<sup>1</sup> Department of Nursing, Faculty of Health Sciences, University of Sharjah, Sharjah, United Arab Emirates

Full list of author information is available at the end of the article



mental functional status, and performing daily activities [2]. Most of these outcomes are measured subjectively through Quality of Life (QoL) [2, 6]. For this reason, researchers start to have much interest regarding QoL after CABG [3, 7–10].

It has been shown that CABG was associated with benefits that include symptom relief, improvement in QoL, reduce disability, and extended survival [1, 4, 11–14]. Contrary, other studies have shown that CABG might lead to undesirable consequences of lengthy or poor recovery, problems of physical activity, sleep disturbances, increase morbidity ending with poor QoL post operatively [3, 11, 15, 16]. Estimates indicated that a percentage between 15.7 to more than 25% of post CABG patients reported that their QoL decreased compared to preoperative period [4, 17–20]. It is worthy to note that also some studies reported that QoL did not changed after the operation [17, 21]. Therefore, it is necessary to identify factors that might affect outcomes, namely QoL, after surgery accordingly appropriate interventions can be implemented.

Quality of Life is a multi-dimensional aspect of the human's perception of the physical, psychological and social aspects of life which might be affected by a disease process and its treatment [3, 8]. Also, QoL may be changed by a person's experiences, attitudes, anticipations, and perceptions. In addition, specifically, post CABG, QoL might be affected by: age, gender, length of stay (LoS), depression, perceived control (PC), and many others.

There are inconsistent results regarding the effect of gender on QoL post CABG. Some investigators reported that female gender was a predictor for poor QoL, while others reported the opposite [7, 22]. Male gender was an improvement predictor to QoL in other studies [5, 23, 24]. Other investigators found that there was no significant difference in QoL based on gender [25]. Longer LoS was associated with lower levels of functional capacity which in turn decreased QoL [26]. In a systemic review checking if CABG could improve QoL in elderly patients; it was found that ICU LoS greater than 2 days was associated with lower levels of QoL [8].

The outcomes and recovery after acute cardiac events/procedures (i.e. CABG and acute myocardial infarction) depend on diverse physiological and psychological factors. The role that psychological factors play in the recovery was as important as or even more important than physiological factors [11, 27–29]. Depression is one of the most prevalent psychological factors in the pre-operative period that affecting QoL post-operatively. Among CABG patients, the reported rates of pre-operative depression ranged from 14 to 60% [11, 13, 14, 30–33]. Despite that, health care providers failed in screening

more than 50% of their patients undergoing CABG for depressive symptoms [11, 34, 35].

Different studies have shown that preoperative depression increased anginal pain, occurrence of delirium, and prolonged postoperative LoS [4, 11–14, 34, 36]. Studies checking the effect of pre-operative depression on QoL early after CABG are limited [37]. Per-operative depression was correlated with poor QoL post CABG including bodily pain, vitality, social functioning, emotional role function and general health [37]. Other studies showed that per-operative depression was associated with poor QoL on the long term up to 5 years after the operation [4, 16, 19, 20, 38, 39]. Therefore, identifying factors that has a moderating effect on the relationship between depression and QoL is important.

Perceived control has been defined as “an individual's belief that he or she has the resources required to cope with negative events in a way that positively influences their adverse nature” [40]. It has been shown that PC has positive effects among diverse cardiac populations including post CABG, acute myocardial infarction, cardiac transplant and heart failure [1, 28].

Higher levels of PC were associated with better QoL and lower levels of depressive symptoms among 149 CABG patients 6–8 weeks following the operation after controlling for all covariates [4]. Moreover, high levels of PC in the per-operative period, were associated with lower levels of anxiety and depression post operatively among 155 CABG patients [41]. In addition, PC moderated the relationship between anxiety and LoS among 250 post CABG patients [1]. Together, these results indicate that PC plays a key feature in the immediate recovery for those patients, affecting their QoL positively. On the other hand, lower levels of PC were associated with poor QoL and higher levels of depressive symptoms [42]. Furthermore, to our knowledge, only one study reported that PC did not predict depressive symptoms nor QoL after cardiac surgery. However, this study included small sample size of only 56 patients [43]. Therefore, the major purpose of this study was to check the effect of depression on QoL among CABG patients and to determine if preoperative PC moderates this effect.

### Research hypotheses

(H1) preoperative depression is higher than postoperative depression; (H2) postoperative QoL is better than preoperative QoL; (H3) prior and after; surgery female patients have higher levels of depression and lower levels of QoL compared to male patients; (H4) preoperative depression and PC predict postoperative QoL after controlling for sociodemographic and clinical variables; (H5) preoperative PC moderates the relationship between depression and QoL.

## Methods

### Design, sample, and setting

This was a prospective observational cohort study conducted at (one governmental, one teaching, and one private) hospitals in Amman, Jordan. A consecutive sample of all patients who met the following inclusion criteria were included: (1) adult patients older than 18 years, (2) elective CABG operation, (3) free from depression diagnosis (as confirmed by a psychiatrist), (4) not on anti-depressant medications, (5) able to read and write in Arabic. Patients with other chronic diseases including rheumatoid arthritis, multiple sclerosis, and Parkinson were excluded. Furthermore, all open heart surgeries other than CABG were excluded.

Power analysis was used to make sure that sample size was enough to run the appropriate statistical tests which were: paired t test for H1 and H2, independent t test for H3, and multiple regression for hypotheses 4 and 5, with 13 independent variables. Other assumptions were alpha coefficient of 0.05, power of 0.95, and a medium effect size between depression and QoL. Based on that, the needed sample size was 54 patients for H1 and H2, 198 patients for H3, and 184 patients for H4 and 5. Recruitment continued until the sample reached 200 patients (Fig. 1). No significant differences were found between those who responded and those who were excluded in terms of sociodemographic and clinical characteristics.

### Procedure

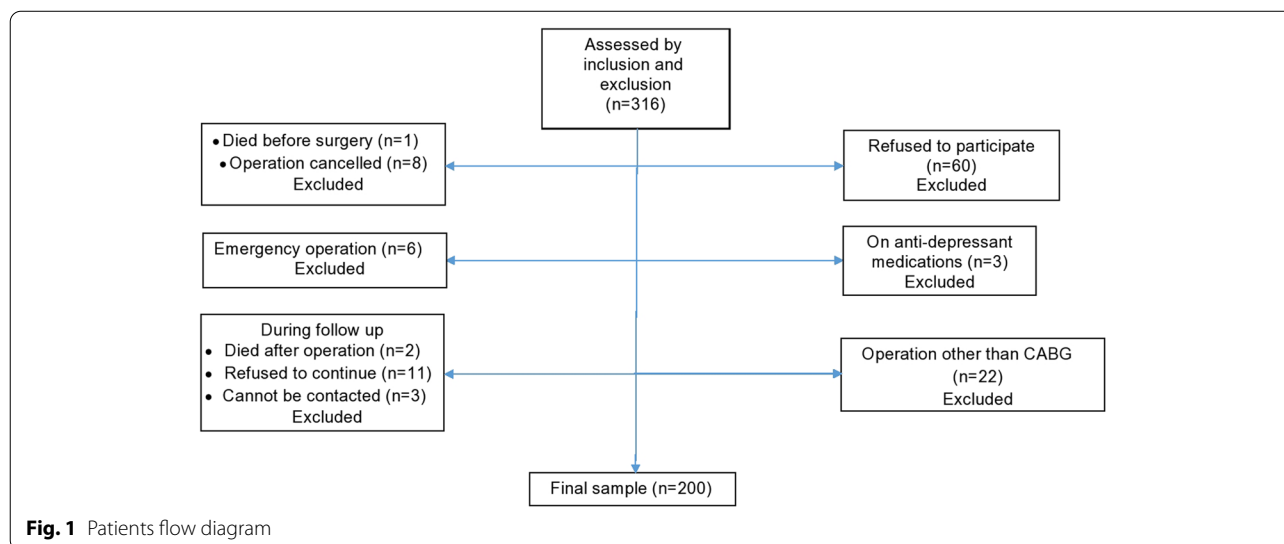
At the cardiology clinics of the selected hospitals, trained cardiovascular research assistants holding a master’s degree in critical care approached every patient for planned open heart surgery and screened them using the inclusion and exclusion criteria. If the patient met

the criteria, research assistants explained the study in detailed and let the patients sign an informed consent form including a permission to review their medical records. At this meeting (within 1 week prior to operation), the patients answered sociodemographic questionnaire about age, gender, (marital, smoking and working) status, the Depression Anxiety and Stress Scale (DASS-21), Control Attitude Scale-Revised (CAS-R), and Short-Form Health Survey-36 (SF36). Post discharge, research assistants reviewed medical records to measure hospital length of stay, history of comorbidities (i.e. Diabetes Mellitus (DM), Hypertension (HTN), previous angina previous myocardial infarction), Left Ventricular Ejection Fraction (LVEF), and body mass index (BMI; kg/m<sup>2</sup>). Three months later, research assistants called the patients by phone and filled with them the DASS and the SF 36 as a follow up measure.

### Measurement of variables

**Depression:** was measured using the Arabic version of DASS-21 which is a 21-item self-report instrument. The original instrument was developed by Lovibond and Lovibond (1995) [44]. The instrument has three subscales each one consists of 7 items with 4 Likert scale options measuring depression, anxiety and stress symptoms over the last week. The scores for each subscale ranges from 0 to 21 with higher scores indicating higher symptoms frequency and severity. For this study, only the depression subscale was used. The cutoff points for depression subscale are 0–4 normal, 5–6 mild, 7–10 moderate, ≥ 11 sever.

The original instrument was found to be valid and reliable with Cronbach’s alpha for depression subscale was 0.91 [45]. The Arabic version psychometric proprieties



were supported at different studies with different populations. In Jordan, where the current study was performed, two studies supported the psychometric proprieties of the DASS, with depression's subscale Cronbach's alpha ranged from 0.77–0.88 in the first study [46] and 0.90 in the second [47]. Among 220 immigrant participants in Sydney, Australia, the study supported the validity and reliability of the DASS using factor analysis, the universality of depression across cultures, and the ability to use the English norms for Arab populations [48]. In this study Cronbach's alpha was 0.91.

*Perceived Control*: was measured by the Arabic version of the CAS-R. This instrument has been used in previous studies among CABG patients. This version demonstrated sound psychometric properties with Cronbach's  $\alpha$  of 0.75 [1, 28]. In this study the Cronbach's alpha was 0.89. This instrument is composed of eight Likert scale items with five-option answers from 1 "totally disagree" to 5 "totally agree". The possible range for the total score is from 8 to 40. Higher scores reflect greater levels of PC [1, 28]. Median has been used by researchers to classify participants with high and low PC since there are no published mean norms [1, 28].

*Quality of Life*: was measured by the Arabic version of the SF36 which a generic measure of 8 domains of health namely: physical functioning, role physical functioning, role emotional functioning, mental health, vitality, role social functioning, bodily pain, and general health. The raw scores of each domain is transformed to 0–100 scale with higher scores indicating better QoL in each domain. If patients scored below 47, then they were considered to have poor QoL [49–51].

For the purposes of this study we used the two major summaries of the QoL measured from these domains: The Physical component summary (PCS) including (physical functioning, role physical functioning, body pain, and general health), and the Mental Component Summary (MCS), representing; role emotional functioning, vitality, mental health, and social functioning [49–51]. The minimum Cronbach's  $\alpha$  for the Arabic version was 0.71 and the highest was 0.94 [49–52].

*Ethical consideration*: The study was approved by the institutional review board committee at Applied Science Private University, Amman, Jordan and from all institutions before data collection. Informed consent was signed by all participants who agreed to participate including a permission to review their medical records. Patients were ensured that their participation is totally voluntary, and they can withdraw at any time. Confidentiality was maintained by assigning identification numbers to participants, keeping data in a locked cabinet with access only by the principle investigator, and the use of aggregate data for publication.

## Data analyses

SPSS version 25 was used for the analysis. H1 (preoperative depression is higher than postoperative depression) and H2 (postoperative QoL is better than preoperative QoL) were tested by paired t test. H3 (prior and after surgery; female patients have higher levels of depression and lower levels of QoL compared to male patients) was tested by independent sample t test. H 4 (preoperative depression and PC predict postoperative QoL after controlling for sociodemographic and clinical variables) and H5 (preoperative PC moderates the relationship between depression and QoL) were tested by stepwise multiple regression, followed by simple slope analysis of  $\pm 1$  SD from the mean. In the first model, PC scores, depression scores, and all sociodemographic and clinical variables were entered. In the second model, the interaction between centralized PC and depression scores was included.

## Results

### Clinical and sociodemographic characteristics

Among the 200 participants, 70 (35%) were females, and 155 (77.5%) were married. Most of the sample had angina and nearly half of them had previous AMI. On the other hand, more than half of the sample were currently smokers. Other characteristics are presented in Table 1.

### Hypotheses testing

H1 (preoperative depression is higher than postoperative depression) and H2 (postoperative QoL is better than preoperative QoL) were tested by paired t test. The results showed that preoperative depression was higher than postoperative depression; (mean  $\pm$  SD:  $12.8 \pm 6.8$  vs.  $11.1 \pm 6.7$ ,  $P < 0.01$ ). Postoperative PCS was better than preoperative PCS (mean  $\pm$  SD:  $38.2 \pm 9.4$  vs.  $36.6 \pm 9.5$ ,  $P < 0.001$ ). Postoperative MCS was better than preoperative MCS (mean  $\pm$  SD:  $44.3 \pm 11.5$  vs.  $41.4 \pm 11.4$ ,  $P < 0.001$ ). H3 (prior and after surgery; female patients have higher levels of depression and lower levels of QoL compared to male patients) was tested by independent sample t test. The results are shown in Table 2. It is worthy to note that there were no differences between female and male patients in any of sociodemographic and clinical characteristics expect for levels of LVEF and length of stay. Compared to male patients; female patients have lower levels of LVEF and longer length of stay; (mean  $\pm$  SD:  $46.1 \pm 9.1$  vs.  $48.6 \pm 8.5$ ,  $P < 0.05$ ), and (mean  $\pm$  SD:  $12.7 \pm 12.3$  vs.  $10.5 \pm 9.7$ ,  $P < 0.05$ ) respectively. H 4 (preoperative depression and PC predict postoperative QoL after controlling for sociodemographic and clinical variables) and H5 (preoperative PC moderates the relationship between depression and QoL) were tested using

**Table 1** Clinical and sociodemographic characteristics (N= 200)

Characteristics	Mean ± SD or n (%)
Age	63.7 ± 8.4
Gender	
Male	130 (65.0)
Female	70(35.0)
Marital status	
Married	155 (77.5)
Single/divorced/widowed	45 (22.5)
Currently working	80 (40.0)
History of HTN	166 (83.0)
History of DM	121 (60.5)
History of previous AMI	103 (51.5)
History of previous angina	187 (93.5)
Smoking History	
Never smoked	50 (25.0)
Current smoker	110 (55.0)
Former smoker	40 (20.0)
Post-operative hospital LOS	11.2 ± 10.4
BMI (kg/m <sup>2</sup> )	25.8 ± 4.4
LVEF	47.5 ± 8.9
Total CAS-R	21.3 ± 4.3
Pre-operative depression	12.8 ± 6.8
Normal	35 (17.5)
High	165 (82.5)

*Abbreviations:* AMI Acute myocardial infarction, BMI Body mass index, CAS-R Control attitude scale revised, DM Diabetes mellitus, HTN Hypertension, SD standard deviation

multiple regression followed by simple slope analysis. The results of the regression analysis are presented in Tables 3 and 4.

Being female reduced PCS by 0.17 unit. Everyone unit increase in preoperative depression level reduced PCS by 0.35 unit. PC has a positive effect; everyone unit increase in PC increased PCS by 0.25 units. The interaction term in Model 2 was significant. Furthermore, the R<sup>2</sup> change between Model 1 and Model 2 was significant ( $\Delta R^2 = 0.10, P < 0.01$ ). These results indicated

that PC was a significant moderator in the relationship between preoperative depression and QoL/PCS.

Being female reduced MCS by 0.31 unit. Everyone unit increase in preoperative depression level reduced MCS by 0.22 unit. PC has a positive effect; everyone unit increase in PC increased MCS by 0.17 units. The interaction term in Model 2 was significant. Furthermore, the R<sup>2</sup> change between Model 1 and Model 2 was significant ( $\Delta R^2 = 0.13, P < 0.01$ ). These results indicated that PC was a significant moderator in the relationship between preoperative depression and QoL/MCS.

In simple slope analysis; when the effect of the independent variable (preoperative depression) on the dependent variable (QoL/PCS) when the moderator (PC) is high (1 SD) above and low (1 SD) below the mean was done, preoperative depression decreased QoL/PCS when the moderator (PC) was low (simple slope = 0.41,  $t = 6.1, P < 0.001$ ), and this turns to be insignificant when the moderator (PC) was high. These results indicated that PC worked as a moderator between preoperative depression and QoL/PCS. The same results we found when that was checked in relation to the MCS, (simple slope = 0.42,  $t = 6.9, P < 0.001$ ) which also indicated that PC worked as a moderator between preoperative depression and QoL/MCS.

**Discussion**

This is the first study that was designed specifically to check if PC moderated the effect of depression on QoL after CABG in a developing country. Also, it aimed to check if preoperative depression was higher than post-operative one, and whether it predicted QoL after the operation. Similarly, the study checked if postoperative QoL was higher than preoperative QoL. Additionally, the study aimed to determine if there were differences in QoL and depression based on gender. The results indicated that: (1) PC moderated the effect of depression on QoL, (2) preoperative depression was higher than post-operative depression and higher levels of depression worsen the QoL after operation, (3) postoperative QoL

**Table 2** (Pre and post) operative comparison of depression and quality of life between men and women using independent sample t test (N= 200)

	Preoperative			Postoperative		
	Mean ± SD		P value	Mean ± SD		P value
	Male	Female		Male	Female	
<b>Depression</b>	11.3 ± 6.6	14.6 ± 7.6	<0.001	9.4 ± 6.4	13.1 ± 6.9	<0.001
<b>PCS</b>	39.0 ± 8.9	33.6 ± 9.3	<0.001	41.1 ± 8.9	34.3 ± 8.7	<0.001
<b>MCS</b>	44.0 ± 10.4	38.0 ± 11.6	<0.001	46.5 ± 10.4	40.6 ± 11.7	<0.001

*Abbreviations:* PCS physical component summary, MCS mental component summary, SD standard deviation



**Table 3** Predictors of postoperative quality of life/PCS by stepwise regression analysis (N = 200)

Variable	Model 1		Model 2	
	Standardized β	t	Standardized β	t
Female gender	-.18*	2.6	-.17**	-2.5
Pre-op depression	-.31**	5.3	-.35**	-6.5
PC scores	.26**	4.9	.25**	4.31
Depression scores × PC			.37**	6.6
Adjusted R <sup>2</sup>	0.28		0.38	
F	8.0		11.61	

Abbreviations: BMI body mass index, DM diabetes mellitus, LVEF Left Ventricular Ejection Fraction; myocardial infarction, PC perceived control, PCS physical component summary

\*p < 0.05; \*\*p < 0.01. In the first step, gender, age, working status, marital status, history of hypertension, DM, previous MI, previous angina, BMI, PC scores, LVEF, and preoperative depression scores were entered as independent variables. In the second step, the interaction between centered PC and preoperative depression was included

**Table 4** Predictors of postoperative quality of life/MCS by stepwise regression analysis (N = 200)

Variable	Model 1		Model 2	
	Standardized β	t	Standardized β	t
Female gender	-.26**	-2.9	-.31**	-4.0
Pre-op depression	-.25**	-2.8	-.22**	-2.4
PC scores	.16*	1.9	.17*	2.2
Depression scores × PC			.35**	4.3
Adjusted R <sup>2</sup>	0.26		0.39	
F	7.0		13.8	

Abbreviations: BMI body mass index, DM diabetes mellitus, LVEF Left Ventricular Ejection Fraction; myocardial infarction, PC perceived control, MCS mental component summary

\*p < 0.05; \*\*p < 0.01. In the first step, gender, age, working status, marital status, history of hypertension, DM, previous MI, previous angina, BMI, PC scores, LVEF, and preoperative depression scores were entered as independent variables. In the second step, the interaction between centered PC and preoperative depression was included

was better than preoperative QoL, and (4) females had higher levels of depression and therefore had lower levels of QoL compared to males.

**Depression and QoL post CABG**

The results showed that higher levels of depression were associated with lower levels of QoL. This result is consistent with previous studies [16, 20, 37–39]. Even in one study depression has been shown to have a powerful effect compared to ejection fraction and ischemia [53]. Similarly, depression has been shown to have negative effect on QoL even when the operation itself was successful [54]. Possible explanations why depression might

lead to lower levels of QoL include but not limited to: (1) physiologically, depression increased the incidence of inflammation due to an increase in the secretion of pro-inflammatory cytokines by stimulating hypothalamic pituitary adrenal access [11, 13, 14, 55]. Moreover, high levels of depression were associated with higher incidence of delirium [37, 56–58], (2) Socially or inter-actively, patients with high levels of depression showed behavioral alterations as poor hygiene, unhealthy nutritional habits including drinking large amount of alcohol and lack of medication adherence [13, 37, 55, 59].

The results of this study also showed that the preoperative depression levels were high and higher than those in the postoperative period. This result is consistent with previous studies [11, 13, 14, 55]. Usually, patients who are planned for CABG surgery will be physically tried and complaining form diverse symptoms that affect their abilities to perform activities of daily living as angina, shortness of breath and fatigue. Generally, CABG operation will result in resolving these symptoms gradually, and therefore postoperative depression levels were lower. In addition to that, the successful performance of the operation itself will enhance the reduction of depression among those patients.

**Quality of life before and after CABG**

Consistent with previous studies, this study indicated that postoperative QoL was better than preoperative QoL for both men and women [5, 8, 22, 24, 60, 61], and this is affecting MCS more than PCS [25]. Despite that, it is worthy to note that both QoL were lower than the cut-off point of 47 indicating that the QoL for those patients still poor. Possible explanations why there was improvement in the QoL might be: (1) reduction of the level of depression at the postoperative period, and since higher levels of depression were associated with lower levels of QoL it is expected that postoperative QoL will be higher than preoperative one, (2) previous studies indicated that CABG operation will result in resolving of major signs and symptoms of coronary artery disease, like angina, shortness of breath and fatigue [1, 4, 11–14]. Resolution of these symptoms help patients participating more in activities of daily living, socialization and returning to work earlier. These in turn might help in improving QoL.

Other studies, however, showed that there was a reduction in QoL in the postoperative period [4, 62] or there was no change at all in the QoL [21]. For instance, Kidd at al [4] showed that there was a reduction in the PCS in the postoperative period compared to the preoperative one. A possible explanation for this difference might be the timing when data collection was performed in these studies. In current study, data were collected 3 months after the operation, while in Kidd et al. study this was

6-8 weeks after the operation. Patients post CABG, in the early phase (up to 2 months), usually complain from problems of physical activity, socialization, and sleep disturbances [3, 15]. In a literature comparing the QoL after CABG versus PCI, it was found that the QoL for patients 1 month after the procedure was better for PCI patients compared to CABG. However, this was the opposite for 6 months period. Moreover, as depression decrease over-time after surgery, QoL usually improved since high levels of depression were associated with lower QoL.

In a literature review [60] including 45 studies about postoperative QoL of older people following cardiac surgery, among which 9 only were prospective studies, the majority of the results indicated that there was an improvement in the QoL postoperatively. However, 8–19% of these studies showed that there was a decline in the QoL postoperatively. This difference might be due to the enrollment of the old-aged people and the nature of the design which is mostly retrospective compared to the current prospective one.

#### **Gender, depression and QoL**

The results of this study showed that female patients have higher levels of depression and lower levels of QoL compared to male patients. Diverse studies among cardiac populations including CABG [11, 34], acute myocardial infarction and heart failure showed that females had higher levels of depression compared to males [11, 27, 29, 34, 63–65]. Reasons behind that might be: (1) the inverse association between depression and left ventricular ejection fraction that has been demonstrated among coronary artery disease [65, 66], heart failure [65, 67], and acute myocardial infarction [65, 68]. In this study, males had significantly higher levels of left ventricular ejection fraction compared to females; (2) among cardiac populations, females have higher levels of fatigue compared to males, which has a positive correlation with depression; (3) new research area is focusing on the association between fetal exposure and depression; and (4) higher perioperative depression levels among females compared to males; which might explain the higher levels at the postoperative period.

Regarding QoL, females also have lower levels compared to males which might be due to higher levels of depression and lower levels of left ventricular ejection fraction. Given that females had higher levels of depression, and higher depression levels were associated with lower levels of QoL, it is suspected that they will have lower levels of QoL. Previous studies demonstrated that low levels of left ventricular ejection fraction were a strong predictor for poor QoL [49–51]. Again, since females had lower levels of left ventricular ejection

fraction, it is unsurprising that they have lower levels of QoL compared to males.

#### **PC, depression, and QoL (the moderating effect)**

Like previous studies checking the moderating effect of PC among CABG patients, and among depression [41, 55], this study showed that PC has a positive moderating effect on the relationship between depression and QoL. The association between PC and QoL is not well studied in the literature. However, studies have shown that low levels of PC were independent predictor of higher depressive symptoms [4]. Additionally, low levels of PC were associated with elevated stress and helplessness leading to negative feelings and communicative outcomes [4]. There is also considerable testimony that paucity of control has undesirable consequences on biological activities related to health, including cardiovascular activity, neuroendocrine responses, and immune processes [4]. Further research is warranted to explain how these processes function and affecting QoL in CABG patients.

Studies checking the moderating effect of PC on CABG patients are limited [1, 55]. The first study showed that PC moderated the relationship between depression and length of stay post CABG [55]. The second study showed the same results reading the relationship between anxiety and length of stay post CABG [1]. It is worthy to note that previous studies demonstrated a relationship between negative emotion and longer length of stay at the hospital. Reduction of hospital length of stay might have better outcomes on patients QoL explaining how PC worked in improving the QoL for those patients.

Among other cardiac populations, it has been shown that PC had a moderating effect on the relationship between depression and complications after acute myocardial infarction [69] and between anxiety and complications after acute myocardial infarction [28]. In Heart failure patients, PC controlled depressive symptoms and result in better QoL [70, 71].

#### **Conclusion and implication to practice**

Patients undergoing CABG surgery had poor QoL and high levels of depression. Being female and having high levels of depression negatively affecting the QoL for this population. PC moderated this relationship and improve QoL. Assessing depression levels and implantation of interventions to enhance PC levels prior to operation especially among females might improve QoL.

#### **Limitations**

Some of the information for this study was collected from medical records which depends on documentation from 3rd personnel. The duration of the follow up is only 3 months. Longer follow up duration is

recommended. Even it is out of the scope of this study, we did not scrutinize the specific underlying mechanism of how PC moderated the effect of depression on QoL for this population. Further studies covering this purpose is recommended.

#### Abbreviations

BMI: Body Mass index; CABG: Coronary artery bypass graft surgery; CAS-R: Control Attitude Scale-Revised; DASS: Depression Anxiety and Stress Scale; DM: Diabetes Mellitus; HTN: Hypertension; LVEF: Left Ventricular Ejection Fraction; LoS: Length of Stay; MCS: Mental Component Summary; PC: Perceived Control; PCS: Physical Component Summary; SF36: Short-Form Health Survey-36; QoL: Quality of Life.

#### Acknowledgements

The authors would like to thank the research assistants and the participants of this study.

#### Authors' contributions

MEA: was the primary investigator and contributed in all facets of the study including study conception/design, data collection, and was the lead author for all drafts of the manuscript. GD: contributed to study conception/design, revision and edited all drafts of the manuscript. Both authors read and approved the final manuscript.

#### Funding

This is a personal research without any type of funding.

#### Availability of data and materials

The datasets analyzed in the current study available from corresponding author on reasonable request.

#### Declarations

##### Ethics approval and consent to participate

All methods were performed in accordance with the Declaration of Helsinki. Ethical approval was received from the Institutional Review Board committee at the Applied Science Private University, Amman, Jordan. All participants received information about the study, including information that it was voluntary to participate and that they could withdraw their participation at any time with no further explanations. All participants signed an informed consent form.

##### Consent for publication

Not applicable.

##### Competing interests

The authors declare no competing interests.

##### Author details

<sup>1</sup>Department of Nursing, Faculty of Health Sciences, University of Sharjah, Sharjah, United Arab Emirates. <sup>2</sup>Faculty of Nursing, Applied Science Private University, Amman, Jordan.

Received: 19 October 2021 Accepted: 28 March 2022

Published online: 12 April 2022

#### References

- AbuRuz ME, Al-Dweik G, Al-Akash HYJ. Checking the moderating effect of perceived control on the relationship between anxiety and postoperative hospital length of stay among coronary artery bypass graft patients. *Int J Gen Med*. 2019;12:79–85.
- Kulik AJ. Quality of life after coronary artery bypass graft surgery versus percutaneous coronary intervention: what do the trials tell us? *Curr Opin Cardiol*. 2017;32(6):707–14.
- Rawashdeh RA, Alshraideh JAJ. Physiological and Psychological Determinants of Quality of Life for Patients after Cardiac Surgery and the Associated Factors. *Open J Nurs*. 2019;9(10):1022.
- Kidd T, Poole L, Leigh E, Ronaldson A, Jahangiri M, Steptoe A. Health-related personal control predicts depression symptoms and quality of life but not health behaviour following coronary artery bypass graft surgery. *J Behav Med*. 2016;39(1):120–7.
- Peric V, Stolic R, Jovanovic A, Grbic R, Lazic B, Sovtic S, et al. Predictors of quality of life improvement after 2 years of coronary artery bypass surgery. *Ann Thorac Cardiovasc Surg*. 2017;23(5):233–8.
- Jokinen JJ, Hippeläinen MJ, Turpeinen AK, Pitkänen O, Hartikainen JEJ. Health-related quality of life after coronary artery bypass grafting: a review of randomized controlled trials. *J Cardiac Surg*. 2010;25(3):309–17.
- Ay Y, Kara I, Aydin C, Ay NK, Inan B, Basel H, et al. Comparison of the health related quality of life of patients following mitral valve surgical procedures in the 6-months follow-up: a prospective study. *Ann Thorac Cardiovasc Surg*. 2013;19(2):113–9.
- Baig K, Harling L, Papanikitas J, Attaran S, Ashrafian H, Casula R, et al. Does coronary artery bypass grafting improve quality of life in elderly patients? *Interact Cardiovasc Thorac Surg*. 2013;17(3):542–53.
- Yang L-X, Zhou Y-J, Wang Z-J, Li Y-P, Chai MJ. Impact of invasive treatment strategy on health-related quality of life six months after non-ST-elevation acute coronary syndrome. *J Geriatr Cardiol: JGC*. 2014;11(3):206.
- Vincelj J, Bitar L, Jendričko T, Udovičić M, Petrovečki MJ. Health-related quality of life five years after coronary artery bypass graft surgery. *Int J Cardiol*. 2015;182:68–9.
- AbuRuz MEJ. Pre-operative depression predicted longer hospital length of stay among patients undergoing coronary artery bypass graft surgery. *Risk Manag Healthc Policy*. 2019;12:75.
- Ravven S, Bader C, Azar A, Rudolph JL. Depressive symptoms after CABG surgery: a meta-analysis. *Harv Rev Psychiatry*. 2013;21(2):59–69.
- Poole L, Leigh E, Kidd T, Ronaldson A, Jahangiri M, Steptoe A. The combined association of depression and socioeconomic status with length of post-operative hospital stay following coronary artery bypass graft surgery: data from a prospective cohort study. *J Psychosom Res*. 2014;76(1):34–40.
- Poole L, Kidd T, Leigh E, Ronaldson A, Jahangiri M, Steptoe A. Depression, C-reactive protein and length of post-operative hospital stay in coronary artery bypass graft surgery patients. *Brain Behav Immun*. 2014;37:115–21.
- Deutsch MA, Krane M, Schneider L, Wottke M, Kornek M, Elhmidi Y, et al. Health-Related quality of life and functional outcome in cardiac surgical patients aged 80 years and older: a prospective single center study. *Journal of Cardiac Surgery: Including Mechanical Biological Support for the Heart Lungs*. 2014;29(1):14–21.
- Middel B, El Baz N, Pedersen SS, van Dijk JP, Wynia K, Reijneveld SAJ. Decline in health-related quality of life 6 months after coronary artery bypass graft surgery: the influence of anxiety, depression, and personality traits. *J Cardiovasc Nurs*. 2014;29(6):544–54.
- Verwijmeren L, Noordzij PG, Daeter EJ, van Zaane B, Peelen LM, van Dongen EPAJ. Preoperative determinants of quality of life a year after coronary artery bypass grafting: a historical cohort study. *J Cardiothorac Surg*. 2018;13(1):1–8.
- Blumenthal JA, Lett HS, Babyak MA, White W, Smith PK, Mark DB, et al. Depression as a risk factor for mortality after coronary artery bypass surgery. *Lancet*. 2003;362(9384):604–9.
- Burg MM, Benedetto MC, Rosenberg R, Soufer R. Presurgical depression predicts medical morbidity 6 months after coronary artery bypass graft surgery. *Psychosom Med*. 2003;65(1):111–8.
- Mallik S, Krumholz HM, Lin ZQ, Kasl SV, Mattern JA, Roumain SA, et al. Patients with depressive symptoms have lower health status benefits after coronary artery bypass surgery. *Circulation*. 2005;111(3):271–7.
- Usta E, Elkrinawi R, Ursulescu A, Nagib R, Määdge M, Salehi-Gilani S, et al. Clinical outcome and quality of life after reoperative CABG: off-pump versus on-pump—observational pilot study. *J Cardiothorac Surg*. 2013;8(1):1–10.
- Namazi P, Hosseini SS, Mohammadi NJ. Health-related quality of life after valve replacement surgery. *J Client-Centered Nurs Care*. 2015;1(2):91–6.



23. Dueñas M, Ramirez C, Arana R, Failde JJ. Gender differences and determinants of health related quality of life in coronary patients: a follow-up study. *BMC Cardiovasc Disord.* 2011;11(1):1–11.
24. Lavdaniti M, Tsiligiri M, Palitzika D, Chrysomallis M, Marigo MD, Drosos GJ. Assessment of health status using SF-36 six months after coronary artery bypass grafting: a questionnaire survey. *Health Sci J.* 2015;9(1):1.
25. Irfan SN, Rahaman MM, Noman A, Mithun SJ. Health related quality of life among coronary artery bypass graft patient attended at combined military hospital, Dhaka. *Anwer Khan Mod Med Coll J.* 2013;4(2):10–7.
26. Barrie K, Cornick A, Debreuil S, Lee E, Hiebert B, Manji R, et al. Patients with a prolonged intensive care unit length of stay have decreased health-related quality of life after cardiac surgery. In: *Seminars in thoracic and cardiovascular surgery: 2019*; Elsevier; 2019. p. 21–31.
27. AbuRuz ME, Alaloul F, Al-Dweik G. Depressive symptoms are associated with in-hospital complications following acute myocardial infarction. *Appl Nurs Res.* 2018;39:65–70.
28. AbuRuz ME. Perceived control moderates the relationship between anxiety and in-hospital complications after ST segment elevation myocardial infarction. *J Multidiscip Healthc.* 2018;11:359–65.
29. AbuRuz ME, Masa'Deh R. Gender differences in anxiety and complications early after acute myocardial infarction. *J Cardiovasc Nurs.* 2017;32(6):538–43.
30. Tully PJ, Baker RA, Turnbull D, Winefield H. The role of depression and anxiety symptoms in hospital readmissions after cardiac surgery. *J Behav Med.* 2008;31(4):281–90.
31. Tully PJ, Baker RA, Knight JL. Anxiety and depression as risk factors for mortality after coronary artery bypass surgery. *J Psychosom Res.* 2008;64(3):285–90.
32. Oxlad M, Stubberfield J, Stuklis R, Edwards J, Wade TD. Psychological risk factors for increased post-operative length of hospital stay following coronary artery bypass graft surgery. *J Behav Med.* 2006;29(2):179–90.
33. Doering LV, Moser DK, Lemankiewicz W, Luper C, Khan S. Depression, healing, and recovery from coronary artery bypass surgery. *Am J Crit Care.* 2005;14(4):316–24.
34. Issa Hweidi BG, Al-Obeisat S, Al-Smadi A. Prevalence of depression and its associated factors in patients post-coronary artery bypass graft surgery. *J Res Nurs.* 2018;23(1):76–88.
35. Freedland KE, Skala JA, Carney RM, Rubin EH, Lustman PJ, Davila-Roman VG, et al. Treatment of depression after coronary artery bypass surgery: a randomized controlled trial. *Arch Gen Psychiatry.* 2009;66(4):387–96.
36. Chaudhury S, Saini R, Bakhla AK, Singh J. Depression and anxiety following coronary artery bypass graft: current Indian scenario. *Cardiol Res Pract.* 2016;2016:2345184.
37. Humphreys JM, Denson LA, Baker RA, Tully PJJ. The importance of depression and alcohol use in coronary artery bypass graft surgery patients: risk factors for delirium and poorer quality of life. *J Geriatr Cardiol: JGC.* 2016;13(1):51.
38. Kendel F, Gelbrich G, Wirtz M, Lehmkühl E, Knoll N, Hetzer R, et al. Predictive relationship between depression and physical functioning after coronary surgery. *Arch Intern Med.* 2010;170(19):1717–21.
39. Lee GAJ. Determinants of quality of life five years after coronary artery bypass graft surgery. *Heart Lung.* 2009;38(2):91–9.
40. Moser DK, Riegel B, McKinley S, Doering LV, Meischke H, Heo S, et al. The control attitudes scale-revised: psychometric evaluation in three groups of cardiac patients. *Nurs Res.* 2009;58(1):42.
41. Gallagher R, McKinley S. Anxiety, depression and perceived control in patients having coronary artery bypass grafts. *J Adv Nurs.* 2009;65(11):2386–96.
42. Foxwell R, Morley C, Frizelle D. Illness perceptions, mood and quality of life: a systematic review of coronary heart disease patients. *J Psychosom Res.* 2013;75(3):211–22.
43. Juergens MC, Seekatz B, Moosdorf RG, Petrie KJ, Rief W. Illness beliefs before cardiac surgery predict disability, quality of life, and depression 3 months later. *J Psychosom Res.* 2010;68(6):553–60.
44. Lovibond S, Lovibond P. *Manual for the depression anxiety stress scales.* Sydney: Psychology Foundation; 1995. In: ISBN 7334-1423-0; 1995
45. Sinclair SJ, Siefert CJ, Slavin-Mulford JM, Stein MB, Renna M, Blais MA. Psychometric evaluation and normative data for the depression, anxiety, and stress scales-21 (DASS-21) in a nonclinical sample of U.S. adults. *Eval Health Prof.* 2012;35(3):259–79.
46. Mohammad K, Gamble J, Creedy DJM. Prevalence and factors associated with the development of antenatal and postnatal depression among Jordanian women. *Midwifery.* 2011;27(6):e238–45.
47. Musa AS, Pevalin DJ, Al Khalaleh MA. Spiritual well-being, depression, and stress among hemodialysis patients in Jordan. *J Holist Nurs.* 2018;36(4):354–65.
48. Moussa MT, Lovibond P, Laube R, Megahead HAJ. Psychometric properties of an arabic version of the depression anxiety stress scales (DASS). *Res Soc Work Pract.* 2017;27(3):375–86.
49. AbuRuz MEJ. Anxiety and depression predicted quality of life among patients with heart failure. *J Multidiscip Healthc.* 2018;11:367.
50. AbuRuz ME, Alaloul F, Saifan A, Masa'Deh R, Abusalem SJ. Quality of life for Saudi patients with heart failure: a cross-sectional correlational study. *Glob J Health Sci.* 2016;8(3):49.
51. Alaloul F, AbuRuz ME, Moser DK, Hall LA, Al-Sadi AJ. Factors associated with quality of life in Arab patients with heart failure. *Scand J Caring Sci.* 2017;31(1):104–11.
52. Coons SJ, Alabdulmohsin SA, Draugalis JR, Hays RDJ. Reliability of an Arabic version of the RAND-36 health survey and its equivalence to the US-English version. *Med Care.* 1998;428–432.
53. Ruo B, Rumsfeld JS, Hlatky MA, Liu H, Browner WS, Whooley MAJ. Depressive symptoms and health-related quality of life: the heart and soul study. *JAMA.* 2003;290(2):215–21.
54. Stafford L, Berk M, Reddy P, Jackson HJJ. Comorbid depression and health-related quality of life in patients with coronary artery disease. *J Psychosom Res.* 2007;62(4):401–10.
55. AbuRuz ME, Momani A, Shajrawi AJ. The association between depressive symptoms and length of hospital stay following coronary artery bypass graft is moderated by perceived control. *Risk Manag Healthc Policy.* 2021;14:1499.
56. Lin Y, Chen J, Wang ZJ. Meta-analysis of factors which influence delirium following cardiac surgery. *J Cardiac Surg.* 2012;27(4):481–92.
57. Tully PJ, Baker RA, Winefield HR, Turnbull DAJ. Depression, anxiety disorders and type D personality as risk factors for delirium after cardiac surgery. *Aust N Z J Psychiatry.* 2010;44(11):1005–11.
58. Kazmierski J, Banys A, Latek J, Bourke J, Jaszewski RJ. Cortisol levels and neuropsychiatric diagnosis as markers of postoperative delirium: a prospective cohort study. *Crit Care.* 2013;17(2):1–10.
59. Freiberg MS, Kraemer KLJ. Health: focus on the heart: alcohol consumption, HIV infection, and cardiovascular disease. *Alcohol Res Health Sci J.* 2010;33(3):237.
60. Abah U, Dunne M, Cook A, Hoole S, Brayne C, Vale L, et al. Does quality of life improve in octogenarians following cardiac surgery? A systematic review. *BMJ Open.* 2015;5(4):e006904.
61. deNeto FJA, Reis LMCB, Veras MR, Queiroz LLC, Nunes KdLN, Miranda Pd, et al. Impact of cardiovascular interventions on the quality of life in the elderly. *Braz J Cardiovasc Surg.* 2015;30(6).
62. Kaur M, Kumar A, Kumari VJII. Quality of life and lifestyle of patients before and after coronary artery bypass grafting (CABG). *Nurs Health Sci.* 2013;2:10–5.
63. Moser DK, Dracup K, Evangelista LS, Zambroski CH, Lennie TA, Chung ML, et al. Comparison of prevalence of symptoms of depression, anxiety, and hostility in elderly patients with heart failure, myocardial infarction, and a coronary artery bypass graft. *Heart Lung.* 2010;39(5):378–85.
64. Vaccarino V, Lin ZQ, Kasl SV, Mattern JA, Roumanis SA, Abramson JL, et al. Gender differences in recovery after coronary artery bypass surgery. *J Am Coll Cardiol.* 2003;41(2):307–14.
65. Doyle F, McGee H, Conroy R, Conradi HJ, Meijer A, Steeds R, et al. Systematic review and individual patient data meta-analysis of sex differences in depression and prognosis in persons with myocardial infarction: a MINDMAPS study. *Psychosom Med.* 2015;77(4):419–28.
66. Lehto S, Koukkunen H, Hintikka J, Viinamäki H, Laakso M, Pyörälä KJ. Depression after coronary heart disease events. *Scand Cardiovasc J.* 2000;34(6):580–3.
67. Freedland KE, Rich MW, Skala JA, Carney RM, Dávila-Román VG, Jaffe ASJ. Prevalence of depression in hospitalized patients with congestive heart failure. *Psychosom Med.* 2003;65(1):119–28.

68. van Melle JP, de Jonge P, Ormel J, Crijns HJ, van Veldhuisen DJ, Honig A, et al. Relationship between left ventricular dysfunction and depression following myocardial infarction: data from the MIND-IT. *Eur Heart J*. 2005;26(24):2650–6.
69. AbuRuz MEJ. Patients with ST segment elevation myocardial infarction: moderating effect of perceived control on the relationship between depression and in-hospital complications. *BMC Cardiovasc Disord*. 2019;19(1):1–7.
70. Heo S, Lennie TA, Pressler SJ, Dunbar SB, Chung ML, Moser DK. Factors associated with perceived control and the relationship to quality of life in patients with heart failure. *Eur J Cardiovasc Nurs*. 2015;14(2):137–44.
71. Banerjee T, Lee KS, Browning SR, Hopenhayn C, Westneat S, Biddle MJ, et al. Limited association between perceived control and health-related quality of life in patients with heart failure. *J Cardiovasc Nurs*. 2014;29(3):227–31.

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