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The prevalence and impact of depression and anxiety in cardiac rehabilitation: A longitudinal cohort study

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Abstract

Background: Co-morbid depression and anxiety symptoms are frequently under-recognised and under-treated in heart disease and this negatively impacts self-management.

Aims: The purpose of this study was to determine the prevalence, correlates and predictors of depression and anxiety in cardiac rehabilitation programmes, the impact of cardiac rehabilitation on moderate depression, anxiety and stress symptoms, and the relationship between moderate depression, anxiety and stress symptoms and cardiac rehabilitation adherence.

Methods: This was a retrospective cohort study of 5908 patients entering cardiac rehabilitation programmes from 2006–2017, across two Sydney metropolitan teaching hospitals. Variables included demographics, diagnoses, cardiovascular risk factors, medication use, participation rates, health status (Medical Outcomes Study Short Form-36) and psychological health (Depression Anxiety Stress Scales) subscale scores.

Results: Moderate depression, anxiety or stress symptoms were prevalent in 18%, 28% and 13% of adults entering cardiac rehabilitation programmes, respectively. Adults with moderate depression (24% vs 13%), anxiety (32% vs 23%) or stress (18% vs 10%) symptoms were significantly less likely to adhere to cardiac rehabilitation compared with those with normal-mild symptoms ($p < 0.001$). Anxiety (odds ratio 4.395, 95% confidence interval 3.363–5.744, $p < 0.001$) and stress (odds ratio 4.527, 95% confidence interval 3.315–6.181, $p < 0.001$) were the strongest predictors of depression. Depression (odds ratio 3.167, 95% confidence interval 2.411–4.161) and stress (odds ratio 5.577, 95% confidence interval 4.006–7.765, $p < 0.001$) increased the risk of anxiety on entry by more than three times, above socio-demographic factors, cardiovascular risk factors, diagnoses and quality of life.

Conclusion: Monitoring depression and anxiety symptoms on entry and during cardiac rehabilitation can assist to improve adherence and may identify the need for additional psychological health support. Exploring the relevance and use of adjunct psychological support strategies within cardiac rehabilitation programmes is warranted.

Introduction

Heart disease remains the leading cause of death internationally, accounting for 17.9 million deaths (31%) globally,[1] and US$863 billion in global healthcare expenditure.[2] Depression and anxiety cost the global economy US$1 trillion per year, and accounts for as high as 10% of the global disease burden,[3,4] and increases heart disease healthcare costs.[5] Co-morbid depression and anxiety increases the risk of poorer prognosis and mortality after a cardiac event,[6] with depression

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increasing the risk more than two-fold,[7,8] and reduces compliance with medications and recommended treatments.[9]

Depression and anxiety are under-recognised and under-treated in heart disease patients, particularly in women.[10] Misdiagnosis commonly occurs during hospitalisation due to the protective function of denial,[11] and accounts for the persistence of symptoms after discharge and on entry into cardiac rehabilitation (CR) programmes. Milder forms of depression occur in up to 30% of patients after an acute cardiac event.[12] Whilst depressive symptoms are considered transient in nature[6], they can also worsen over time.[13] Diagnosed moderate depression and anxiety symptoms occurs in 11%[14,15] and 15%[16] of heart disease patients, placing them at an even greater risk of further cardiovascular events, poorer quality of life,[17] functional decline or disability,[18] and reducing productivity.[19]

Reduced adherence to recommendations for risk factor management protocols including hypertension, smoking, dyslipidaemia, diabetes, sedentary lifestyle and weight management[20,21] after a cardiac event is common due to the complex interplay of physical, social, environmental and psychological components of heath, which are often not afforded the same priority as the treatment of physical symptoms.[22] Psychological health is also likely to mediate the bi-directional interaction between psychosocial risk factors and heart disease.[22,23] Optimising depression and anxiety in heart disease patients, therefore, presents an opportunity to improve the impact of psychosocial risk factors on poorer cardiovascular outcomes.[22] Some efforts have been made to integrate psychological health within secondary prevention to improve psychological health management.[4,24,25] However, this has not led to widespread changes in the delivery of psychological health support in heart disease care. Assessment of the mental health status of all heart disease patients also varies greatly across clinical settings.[26]

Whilst structured clinical interview is the only well-validated measure for the diagnosis of depression and anxiety, cut-off scores of validated screening instruments used in practice to define clinically significant depression, in many, but not all cases, also correspond to standard criteria for a diagnosis of depression and vice versa.[27] As such, understanding the prevalence of moderate psychological health symptoms, factors that increase vulnerability to poor psychological outcomes[28] and predictors of depression and anxiety symptoms will provide the evidence required for health organisations, clinicians and policy makers to better understand the impact of poor psychological health on CR service provision. It will also allow decision-makers to plan for better coordination of services in order to optimise uptake and adherence to CR services, which is aligned with an integrated approach to care.

Aims

The aims of this study were to identify (a) the prevalence and correlates of moderate depression anxiety and stress symptoms in adults with heart disease who participated in CR programmes; (b) predictors of moderate depression and anxiety symptoms on entry into CR programmes; (c) the impact of CR programmes on moderate depression, anxiety and stress; and (d) the impact of moderate depression, anxiety and stress on adherence to CR programmes.

Methods

Study design, setting and participants

This was a retrospective cohort study of Australian adults with heart disease who participated in CR programmes in two hospitals in metropolitan Sydney, Australia, between 2006–2017. Ethical approval for use of the dataset was obtained from Western Sydney Local Health District Human Research Ethics Committee (AU RED LNR/17/WMEAD/24) and ratified by the University of Technology Sydney Human Research Committee (ETH 17-1604).

Sample

Participants were adults aged 18 years and older who had a recent admission to hospital with a cardiac condition, had a cardiac diagnosis including acute coronary syndrome or heart failure, or were referred to CR for risk factor modification.

Data collection

Variables. **Demographic characteristics** included gender, age, year of entry into CR, occupation, and family history of heart disease in members under 55 years of age. Marital status was defined as married, engaged or defacto; divorced or separated; widowed; or single (see Table 1).

Health status included Short Form-36 (SF-36) Quality of Life measures (version 1). Subscales included general health, physical functioning, role-physical, bodily pain, vitality, social functioning, role-emotional, mental health and health transition. Both the overall SF-36 scores and subscale scores on entry and at completion of CR were used in the analyses. Higher scores reflected greater mental and physical self-rated health.[29] The SF-36 has been validated in coronary heart disease[30] and CR populations.[31]

Table 1. Socio-demographic factors associated with depression, anxiety and stress on entry into cardiac rehabilitation (CR) programmes (2006–2017).

Variable	Normal to mild depression n (%)	Moderate to extremely severe depression n (%)	p Value	Normal to mild anxiety n (%)	Moderate to extremely severe anxiety n (%)	p Value	Normal to mild stress n (%)	Moderate to extremely severe stress n (%)	p Value
Overall	3917 (82)	867 (18)		3447 (72)	1333 (28)		4143 (87)	637 (13)	
Socio-demographic factors	N (%)	N (%)		N (%)	N (%)		N (%)	N (%)	
Sex			0.002			<0.001			0.010
Male	3085 (79)	642 (74)		2754 (80)	969 (73)		3252 (79)	471 (74)	
Female	832 (21)	225 (26)		693 (20)	364 (27)		891 (21)	166 (26)	
Marital status			<0.001			<0.001			<0.001
Married, engaged or de-facto	2978 (76)	565 (65)		2621 (76)	918 (69)		3087 (75)	452 (71)	
Divorced/separated	368 (9)	150 (17)		325 (10)	193 (15)		419 (10)	99 (16)	
Widowed	292 (8)	64 (8)		248 (7)	108 (8)		324 (8)	32 (5)	
Single	273 (7)	86 (10)		247 (7)	112 (8)		305 (7)	54 (8)	
Occupation			<0.001			<0.001			<0.001
Employed	1947 (50)	328 (38)		1715 (50)	558 (42)		2015 (49)	258 (41)	
Unemployed/benefits	268 (7)	155 (18)		268 (7)	194 (15)		304 (7)	118 (19)	
Retired	1464 (37)	295 (34)		1314 (38)	444 (33)		1564 (38)	194 (31)	
School/home duties	143 (4)	44 (5)		107 (3)	80 (6)		154 (4)	33 (5)	
Not known	78 (2)	38 (5)		66 (2)	50 (4)		88 (2)	28 (4)	
Family history of heart disease	1409 (36)	367 (43)	0.001	1224 (36)	551 (42)	0.001	1509 (37)	266 (42)	0.029
	Mean (SD)	Mean (SD)		Mean (SD)	Mean (SD)		Mean (SD)	Mean (SD)	
Age	61.1 (12.0)	59.2 (12.3)	<0.001	61.3 (11.9)	59.4 (12.6)	<0.001	61.0 (12.1)	58.9 (12.0)	<0.001
Heart disease diagnoses	N (%)	N (%)		N (%)	N (%)		N (%)	N (%)	
Diagnoses			<0.001			<0.001			<0.001
Acute myocardial infarction	1144 (29)	238 (28)		1039 (30)	342 (26)		1213 (29)	168 (26)	
Cardiothoracic surgery	1272 (33)	211 (24)		1127 (33)	355 (27)		1324 (32)	158 (25)	
Percutaneous coronary angiogram/stent	855 (22)	176 (20)		752 (22)	277 (21)		901 (22)	128 (20)	
Chest pain/angina	163 (4)	69 (8)		133 (4)	99 (7)		174 (4)	58 (9)	
Other	482 (12)	173 (20)		395 (11)	260 (19)		530 (13)	125 (20)	

Risk factors included smoking status, sedentary lifestyle prior to the cardiac event, depression, diabetes or hypertension.

Heart disease diagnosis included acute myocardial infarction (MI), cardiothoracic surgery, percutaneous coronary angiogram and/or stent insertion, chest pain or angina or other diagnoses.

Current medications were categorised into key cardiac medication groups including self-reported blood pressure control or use of digoxin, beta-blocker agents, angiotensin-converting enzyme (ACE) inhibitors, anti-arrhythmic agents, calcium antagonists, or nitrates.

Physiological assessment included body mass index (BMI), exercise capacity, defined by metabolic exercise testing (MET) levels or six-minute walk test (6MWT) results on entry, systolic blood pressure (SBP), diastolic blood pressure (DBP) and resting heart rate (HR) on entry into CR programmes.

Psychological assessment consisted of the Depression, Anxiety and Stress as measured by the Depression Anxiety Stress Scale (DASS-21).[32] The DASS-21 is a set of three self-report scales designed to measure the negative emotional states of depression, anxiety and stress. The depression subscale assesses dysphoria, hopelessness, devaluation of life, self-deprecation, lack of interest/involvement, anhedonia and inertia. The anxiety subscale assesses autonomic arousal, skeletal muscle effects, situational anxiety and subjective experience of anxious affect. The stress subscale is sensitive to levels of chronic non-specific arousal. It assesses difficulty relaxing, nervous arousal, and being easily upset/agitated, irritable/over-reactive and impatient.[32] All scales of the DASS-21 have been shown to have high internal consistency and to yield meaningful discriminations in a variety of settings,[32,33] and have been widely used in CR.[34] The term 'moderate depression' was used to define moderate to extremely severe depressive symptoms, indicated by a DASS-21 subscale score of ≥ 14. 'Moderate anxiety' was used to describe to moderate to extremely severe anxiety symptoms, defined by a DASS-21 subscale score of ≥ 10. 'Moderate stress' was used to describe moderate to extremely severe stress symptoms, defined by a DASS-21 subscale score of ≥ 19.

Participation rates in CR programmes included days to pre-assessment at CR and drop out. Adults who dropped out of CR programmes due to reasons other than non-motivation or lack of attendance/contact were excluded from this analysis, given that these adults may simply have been referred to another programme or re-hospitalised.

Statistical analysis

De-identified data was cleaned, then exported into SPSS Statistical Package Version 23 for analysis. Independent *t*-tests and Mann Whitney U tests were used to analyse continuous data and chi-squared tests and Fishers exact tests were used for categorical outcomes in univariate non-parametric analyses. Scores derived from psychometric measures for depression, anxiety and stress, and quality of life, were all measured on continuous scales on entry and at completion of CR programmes. Statistical significance was set at $p < 0.05$. To determine predictors of moderate depression or anxiety, factors with $p < 0.1$ were entered into stepwise backward logistical regression models using likelihood ratio tests. Receiver operating curves determined that the sensitivity/specificity of the depression and anxiety models was area under the curve (AUC) = 0.923 and AUC = 0.860 respectively, indicating that we were not able to reject the hypothesis that the fit of the models was good, and the likelihood of a type I or type II error was low.

Results

This study sample was drawn from a cohort of 5908 patients from two hospitals in one local health district in Sydney, Australia, and a total of 4784 participants completed the DASS-21 questionnaire on entry into CR programmes. Symptoms of moderate to extremely severe depression were prevalent in approximately 18% ($n = 867$) of adults who entered CR programmes. A higher proportion of participants (28%, $n = 1333$) reported having moderate to extremely severe anxiety, and approximately 13% of adults ($n = 637$) reported having symptoms of moderate to extremely severe stress on entry into CR programmes (see Table 1).

Factors associated with depression, anxiety and stress symptoms on entry into CR programmes are described in Tables 1–3. A significantly greater proportion of adults with at least moderate depression, anxiety or stress symptoms were male (79%), married, engaged or in a de-facto relationship (74%), or employed (48%) with a mean age of 60 years (standard deviation (SD) ± 12). Heart disease risk factors were increasingly prevalent in adults with these symptoms including sedentary lifestyle (58%), hypertension (62%) and hypercholesterolaemia (11%), lower exercise capacity testing scores (METS: mean = 8 (SD ± 12); 6MWT: mean = 331 metres (SD ± 114)), and borderline obesity (BMI: mean = 29 (SD ± 13)).

Change in depression anxiety and stress symptoms at completion of CR

Depression. Nine percent of adults with moderate depression on entry had only normal to mild depressive symptoms on completion. However, 5% of adults with moderate depression on entry who completed CR

Table 2. Cardiovascular risk factors and medication use associated with depression, anxiety and stress on entry into cardiac rehabilitation (CR) programmes (2006–2017).

Variable / Risk factors	Normal to mild depression n (%)	Moderate to extremely severe depression n (%)	p Value	Normal to mild anxiety n (%)	Moderate to extremely severe anxiety n (%)	p Value	Normal to mild stress n (%)	Moderate to extremely severe stress n (%)	p Value
Smoking									
Current smoker	826 (21)	251 (29)	<0.001	747 (22)	330 (25)	0.068	902 (22)	175 (28)	0.001
Ex-smoker	1221 (31)	252 (29)		1070 (31)	401 (30)		1266 (30)	205 (32)	
Sedentary lifestyle	2198 (56)	576 (66)	<0.001	1924 (56)	848 (64)	<0.001	2382 (58)	390 (61)	<0.001
Self-reported depression	573 (15)	362 (42)	<0.001	513 (15)	420 (32)	<0.001	671 (16)	262 (42)	<0.001
Diabetes	1181 (30)	315 (36)	<0.001	1016 (30)	477 (36)	<0.001	1272 (31)	221 (35)	0.042
Hypercholesterolaemia	3496 (89)	777 (90)	0.509	3094 (91)	1176 (89)	0.106	3692 (90)	578 (91)	0.454
Hypertension	2403 (61)	563 (65)	0.049	2130 (62)	832 (62)	0.681	2555 (62)	407 (64)	0.302
Days to pre-assessment (mean (SD))	29 (25)	32 (26)	0.109	29 (24)	31 (30)	0.256	29 (25)	32 (26)	0.086
Physiological Assessment	Mean (SD)	Mean (SD)		Mean (SD)	Mean (SD)		Mean (SD)	Mean (SD)	
Body mass index	29 (5)	30 (6)	<0.001	29 (5)	29 (6)	0.045	29 (6)	30 (6)	0.001
Pre-assessment MET level	8 (3)	7 (2)	<0.001	8 (3)	7 (3)	<0.001	8 (3)	7 (3)	0.001
Six minute walk test pre-assessment (m)	336 (114)	316 (111)	0.040	344 (115)	308 (107)	<0.001	336 (113)	306 (111)	0.011
Resting SBP (mm Hg)	149 (27)	144 (26)	0.434	117 (17)	116 (18)	0.050	117 (18)	117 (17)	0.793
Resting DBP (mm Hg)	69 (10)	70 (10)	0.333	69 (10)	69 (10)	0.531	69 (10)	70 (10)	0.172
Resting HR (mm Hg)	72 (13)	75 (13)	<0.001	72 (13)	75 (14)	<0.001	73 (13)	75 (14)	0.001
Medications	N (%)	N (%)		N (%)	N (%)		N (%)	N (%)	
BP control	2436 (92)	571 (92)	0.949	2157 (92)	846 (92)	0.978	2590 (93)	413 (91)	0.978
Digoxin use	122 (3)	45 (5)	0.003	97 (3)	70 (5)	<0.001	138 (3)	29 (5)	0.119
Beta-blocker use	2849 (73)	631 (73)	0.991	2529 (74)	949 (71)	0.130	3020 (73)	458 (72)	0.555
ACE inhibitor use	2304 (59)	501 (60)	0.551	2055 (60)	746 (56)	0.020	2428 (59)	373 (59)	0.927
Anti-arrhythmic use	296 (8)	56 (7)	0.269	245 (7)	107 (8)	0.272	309 (8)	43 (7)	0.531
Calcium antagonist use	457 (12)	122 (14)	0.047	396 (12)	182 (14)	0.037	479 (12)	99 (16)	0.004
Nitrates use	275 (7)	103 (12)	<0.001	228 (7)	150 (11)	<0.001	296 (7)	82 (13)	<0.001
Cholesterol control	3482 (91)	763 (90)	0.656	3089 (91)	1153 (89)	0.007	3681 (91)	561 (90)	0.117

ACE: angiotensin-converting enzyme; BP: blood pressure; DBP: diastolic blood pressure; MET: metabolic exercise testing; SBP: systolic blood pressure.

Table 3. Health status and psychological risk factors associated with depression, anxiety and stress symptoms on entry to cardiac rehabilitation (CR) programmes (2006–2017).

Variable Health status (SF-36 subscale scores)	Normal to mild depression Mean (SD)	Moderate to extremely severe depression Mean (SD)	p Value	Normal to mild anxiety Mean (SD)	Moderate to extremely severe anxiety Mean (SD)	p Value	Normal to mild stress Mean (SD)	Moderate to extremely severe stress Mean (SD)	p Value
General health	65.99 (18.86)	43.84 (19.93)	<0.001	66.99 (18.80)	49.43 (20.47)	<0.001	64.66 (19.73)	44.66 (19.75)	<0.001
Physical functioning	60.59 (23.44)	46.99 (23.60)	<0.001	62.37 (22.92)	47.38 (23.45)	<0.001	59.87 (23.67)	46.89 (23.34)	<0.001
Role-physical	35.13 (40.00)	17.60 (31.40)	<0.001	37.56 (40.62)	17.63 (30.89)	<0.001	34.11 (39.77)	17.92 (31.68)	<0.001
Bodily pain	68.94 (24.28)	51.57 (24.79)	<0.001	70.42 (24.14)	54.11 (24.21)	<0.001	68.22 (24.47)	50.05 (24.79)	<0.001
Vitality	59.14 (20.34)	34.34 (18.89)	<0.001	60.20 (20.59)	40.72 (19.93)	<0.001	57.64 (21.14)	35.34 (19.37)	<0.001
Social functioning	71.07 (43.68)	44.21 (24.79)	<0.001	72.57 (26.37)	50.21 (26.05)	<0.001	69.57 (27.06)	44.42 (25.44)	<0.001
Role-emotional	61.22 (43.68)	23.61 (36.85)	<0.001	63.54 (43.13)	31.32 (40.86)	<0.001	58.74 (44.31)	26.36 (38.19)	<0.001
Mental health	77.20 (15.87)	49.62 (18.41)	<0.001	77.89 (16.24)	58.05 (19.64)	<0.001	75.96 (16.76)	47.74 (18.59)	<0.001
Health transition	26.69 (21.34)	38.73 (21.22)	<0.001	26.51 (21.31)	34.70 (21.97)	<0.001	27.45 (21.34)	38.01 (22.77)	<0.001
SF-36 pre-assessment total	113.40 (15.06)	90.71 (13.97)	<0.001	114.64 (4.98)	95.85 (15.01)	<0.001	112.16 (15.77)	90.67 (14.69)	<0.001
Psychological assessment (DASS-21)	N (%)	N (%)		N (%)	N (%)		N (%)	N (%)	
Depression									
Normal to mild	–	–	–	3423 (94)	670 (50)	<0.001	3752 (91)	161 (25)	<0.001
Moderate to extremely severe	–	–	–	204 (6)	663 (50)	–	391 (9)	476 (75)	–
Anxiety									
Normal to mild	3423 (83)	204 (24)	<0.001	–	–	–	3340 (81)	107 (17)	<0.001
Moderate to extremely severe	670 (17)	663 (76)	–	–	–	–	803 (19)	530 (83)	–
Stress									
Normal to mild	3752 (96)	391 (45)	<0.001	3340 (97)	803 (60)	<0.001	–	–	–
Moderate to extremely severe	161 (4)	476 (55)		107 (3)	530 (40)		–	–	–

SF-36: Short Form-36.

Table 4. Association between depression, anxiety and stress symptoms and dropout from cardiac rehabilitation programmes.

| DASS-21 subscale | Dropout | | | | p Value |
| | Yes | | No | | |
	n	%	n	%	
Overall	714	100	2564	100	
Depression					
Normal to mild	540	76	2220	87	<0.001
Moderate to extremely severe	174	**24**	344	**13**	
Anxiety					
Normal to mild	482	68	1965	77	<0.001
Moderate to extremely severe	231	**32**	599	**23**	
Stress					
Normal to mild	587	82	2303	90	<0.001
Moderate to extremely severe	126	**18**	261	**10**	

DASS: Depression Anxiety Stress Scales.

programmes remained moderately depressed ($p < 0.001$). Similarly, 15% of adults with moderate anxiety on entry had only normal to mild anxiety symptoms on completion, whilst 8% of these adults remained moderately anxious ($p < 0.001$). Eight percent of adults with moderate stress on entry had only normal to mild stress on completion compared with 3% of adults who remained moderately stressed ($p < 0.001$). The mean reductions in DASS-21 depression, anxiety and stress subscale scores on completion were all 1.93 points ($p < 0.001$).

Depression, anxiety and stress symptoms and dropout from CR programmes

Adults with symptoms of moderate depression (24% vs 13%), anxiety (32% vs 23%) or stress (18% vs 10%) symptoms on entry into CR programmes were significantly more likely to drop out compared with adults with only normal to mild symptoms (all $p < 0.001$) (see Table 4).

Predictors of depression on entry into CR programmes

Independent predictors of moderate depression on entry into CR programmes are described in Table 5. Moderate anxiety increased the risk of moderate depression reflected in higher DASS-21 scores by 4.395 times ($p < 0001$). Similarly, prevalence of moderate stress symptoms increased the risk of moderate depression by 4.527 times ($p < 0.001$). Better role-emotional functioning and mental health (SF-36 subdomain scores) reduced the risk of moderate depression on entry by 0.994 and 0.944 times respectively

($p < 0.001$). Higher health transition scores slightly increased the risk of moderate depression on entry into CR programmes by 1.018 times ($p < 0.001$).

Predictors of anxiety on entry into CR programmes

Moderate depression and stress were the strongest predictors of moderate anxiety, increasing the risk of by 3.167 times ($p < 0.001$) and 5.577 ($p < 0.001$) times respectively. Increasing age ($p = 0.009$) and quality of life ($p < 0.001$) also slightly reduced the risk of moderate anxiety (see Table 6). A diagnosis of chest pain increased the risk of anxiety by 1.945 times ($p = 0.006$). Other diagnoses, such a heart transplantation or left ventricular assisted device insertion, for example, increased the risk of anxiety by 1.553 times ($p = 0.006$) whilst a percutaneous coronary intervention increased the risk by 1.358 times ($p = 0.043$).

Discussion

Key findings indicate that (a) one in five adults had moderate to extremely severe psychological health symptoms on entry into CR programmes; (b) these adults were significantly less likely to complete CR programmes; (c) one half of adults with moderate depression and anxiety symptoms who completed CR did not show significant improvements in their psychological health symptoms; (d) the impact of moderate anxiety and stress on moderate depression has been underestimated, and the effect is bi-directional. Specifically, having moderate anxiety or stress quadrupled the risk of moderate depression on entry into CR; moderate depression tripled the risk of moderate anxiety; and moderate stress increased the risk of moderate anxiety

Table 5. Predictors of depression on entry into cardiac rehabilitation programmes.

Factor	Odds ratio	Lower	Upper	p Value
Anxiety				
Moderately to extremely severe	4.395	3.363	5.744	<0.001
Stress				
Moderate to extremely severe	4.527	3.315	6.181	<0.001
Role-emotional	0.994	0.990	0.997	<0.001
Mental health	0.944	0.935	0.952	<0.001
Health transition	1.018	1.012	1.025	<0.001

Table 6. Predictors of anxiety on entry into cardiac rehabilitation.

Factor	Odds ratio	Lower	Upper	p Value
Depression				
Moderately to extremely severe	3.167	2.411	4.161	<0.001
Stress				
Moderate to extremely severe	5.577	4.006	7.765	<0.001
Age	0.989	0.981	0.997	0.009
Quality of life (SF-36)	0.943	0.936	0.950	<0.001
Diagnoses				
Acute myocardial infarction	–			<0.001
PCI/ stent	1.358	1.010	1.826	0.043
Chest pain	1.945	1.209	3.129	0.006
Other	1.553	1.131	2.131	0.007

PCI: percutaneous coronary intervention; SF-36: Short Form-36.

by over five times. These findings confirm depression as a strong predictor of anxiety over and above CAD severity, antidepressant use or clinical characteristics.[35] A diagnosis of chest pain increased the risk of anxiety on entry into CR, which is consistent with previous findings in recently diagnosed heart failure patients.[36] However, no link between depression and chest pain was established, confirming difficulties in determining a causal relationship between these two factors.[37]

Increasing age and improved overall quality of life reduced the risk of moderate anxiety, whilst better role functioning due to emotional health and mental health reduced the risk of moderate to extremely severe depression. This confirms the perception of poor mental health as a useful indicator of undiagnosed depression.[38] Better general health now compared with one year ago also increased the risk for moderate depressive symptoms on entry into CR programmes. This could indicate that moderate depressive symptoms are persistent, despite improvements in health as a result of treatment of the cardiovascular condition.[13] Decreased adherence to medication in depressed patients may be attributable to a perception of no additional benefit or 'feeling worse' whilst perceptions of disability, incapacitation and de-masculinisation in men may contribute to reduced adherence to exercise-based programmes.[39,40] These findings indicate that success in heart disease secondary prevention, including adherence to CR programmes may depend on the interaction between the body and the mind, which needs to be better reflected in the assessment and management of depression and anxiety, as well as psychosocial risk factors that impact psychological health and quality of life.[23]

Comprehensive screening, referral and treatment of co-morbid depression and anxiety symptoms after a cardiac event is essential to identify patients at risk of poorer cardiovascular prognosis and mortality.[15,41] American Heart Association and National Heart Foundation of Australia guidelines recommend screening for depression in heart disease patients using the patient health questionnaire (PHQ-2), and PHQ-9 for those meeting diagnostic criteria,[15] whilst international CR guidelines recommend screening all patients for both depression and anxiety symptoms.[42–44] Despite these recommendations,[15] screening and referral procedures for depression are not standard practice during hospitalisation, and omission of screening varies between 29–68% in CR programmes.[41] Screening, referral and management of clinically

significant anxiety, as well as depression, is essential to cardiovascular risk reduction given the current findings and is supported by previous findings of depression in 39% of adults with generalised anxiety disorder,[45] anxiety after an acute cardiac event as predictive of developing depression in the following six months,[17,46] and the higher relapse rates and poorer response rates to antidepressant medication treatment among those with anxious depression.[47] The hospital anxiety and depression scale, for example, has been identified as the most commonly used screening tool for anxiety and depression in 248 CR programmes across South America, USA and Canada,[41] and the most efficient method for screening and utilisation of adjunct psychological strategies in the CR setting.[48] The DASS-21 has additional utility in that it is available in approximately 50 languages and dialects, increasing accessibility for its use in non-English speaking populations, where depression and anxiety rates are known to be high.[49]

Screening practices alone are insufficient to modify depression outcomes, and further research is required to understand the impact of referral and compliance with treatment of poor psychological health.[41] Poor compliance with external referral for psychological treatment suggests that patients may feel more comfortable receiving adjunct psychological support within CR programmes.[40] However, the availability of comprehensive CR programmes that include strategies for psychological health varies internationally. Calls for the development and testing of an effective referral and treatment approach that goes beyond process-oriented screening practices towards collaborative care is required to better enhance psychological outcomes in the heart disease clientele.[41] Indeed, collaborative care approaches for depression initiated during the hospitalisation process have demonstrated improved depression, cognitive symptoms of depression, mental health-related quality of life and anxiety in heart disease patients.[50]

It is unknown whether treating depression definitively improves heart disease outcomes.[51] The use of antidepressant medication as a first line of treatment has been inconsistent in reducing depression, and largely disappointing in improving prognosis in CR programmes.[52,53] However, randomised controlled trials of psychosocial interventions highlight that whilst treating depression is inconsistent in improving mortality,[24,54,55] it may reduce depressive symptoms and social isolation,[24] and cardiac event recurrence.[25] As such, the National Institute for Clinical Excellence (NICE)[56] and American Heart Association[6] guidelines recommend the integration of psychosocial interventions such as cognitive behavioural therapy (Class I, Level A evidence) or meditation[57] as adjunct or alternative treatments for those unable to tolerate antidepressant drugs or who

prefer a non-pharmacological approach. These interventions could address identified needs to calm thoughts, alleviate physical discomfort[40] and improve cognition, behaviour and affect that are associated with low perceived social support.[24] However, to date there is not broad consensus or support between clinicians involved in heart disease care in the Australian clinical setting on how adjunct strategies might be best integrated into clinical practice to improve depression and anxiety outcomes or whether adjunct strategies should be incorporated within existing heart disease care. Further research is required to best identify how clinicians might proactively implement comprehensive patient and family-centred strategies to best reduce depression and anxiety in heart disease secondary prevention and reduce cardiovascular risk.

Limitations

It is possible that there is overlap between the constructs of depression, anxiety and stress, and that the current results reflect a syndrome of negative affectivity, or a chronic experience of negative emotions, rather than a relationship between two distinct symptoms or conditions.[58] However, the DASS-21 depression, anxiety and stress subscales are considered to align with facets of diagnostic criteria for mood disorders, panic disorder and generalised anxiety disorder respectively.[33,59] The anxiety subscale also correlates with symptoms of other anxiety disorders, apart from generalised anxiety and obsessive compulsive disorders.[33] Adults with high negative affectivity also have the tendency to be attuned to somatic symptoms, possibly misinterpreting these ambiguous sensations as physical illnesses.[58] Both these factors introduce the possibility of a response bias and is a limitation of the current findings. However, whilst the DASS-21 anxiety subscale contains some somatic items that could be experienced for reasons unrelated to emotion, such as breathlessness, the depression subscale does not contain somatic items, reducing the possibility of artificial score inflation.[33] Caution is required when interpreting the results of the anxiety subscale given its inclusion of somatic content, whilst the depression subscale is considered reliable in differentiating patients with and without depression in the presence of co-morbidity.[33]

The true prevalence of moderate to extremely severe depression and anxiety after CR is possibly higher given that depression and anxiety symptom scores were not available for those who did not complete CR programmes. Use of convenience sampling reduces generalisability of the findings to the broader CR population. Analyses on disease severity, complications and differential diagnoses could not be completed due to the limited data available in this administrative dataset.

Use of some self-reported data and heterogeneity of the sample due to the inclusion of some risk factor modification patients without a definitive heart disease diagnosis may reduce the validity of the findings.

Conclusion

Moderate, clinically significant depression and anxiety symptoms persist on entry into CR programmes. Comprehensive, pro-active screening, referral and treatment of moderate depression and anxiety symptoms within CR programmes is required to decrease the severity and impact of depression and anxiety symptoms and to improve adherence to recommendations for heart disease risk factor management, thereby reducing future cardiovascular risk.

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