ACCEPTED VERSION

Depression and Anxiety Among Coronary Heart Disease Patients: Can Affect Dimensions and Theory Inform Diagnostic Disorder-Based Screening?

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Objectives: To examine the association between low positive affect, somatic anxiety and general distress with affective disorders, anxious misery, and visceral fear among coronary heart disease patients. **Participants:** Patients awaiting a coronary revascularization procedure (N = 158; 20.9% female; median age = 65, interquartile range 58–73) underwent structured interview with the Mini-International Neuropsychiatric Interview. Patients completed a brief version of the Mood and Anxiety Symptom Questionnaire (i.e., Anxiety Depression Distress Inventory-27) and a measure of Type D personality. **Results:** Somatic anxiety scores yielded an area under the curve (AUC) = .784 and 75.0% sensitivity and 68.5% specificity in relation to panic disorder. Low positive affect yielded AUC = .811 and 70.4% sensitivity and 77.1% specificity for major depression. General distress yielded AUC = .795 and 75.0% sensitivity and 72.5% specificity for generalized anxiety disorder. No affective dimension was optimally associated with the anxious misery or visceral fear cluster. Trait negative affect was not a suitable screener for any disorder. **Conclusions:** The Anxiety Depression Distress Inventory-27 dimensions of low positive affect and somatic anxiety provided optimal detection of depression and panic disorder, respectively, as hypothesized, supporting discriminant validity. © 2012 Wiley Periodicals, Inc. J. Clin. Psychol. 00:1–14, 2012.

Keywords: depression; panic disorder; generalized anxiety disorder; coronary heart disease; receiver operating characteristics

The close interrelation between depression and anxiety is exemplified by high concurrent and lifetime comorbidity (Clark & Watson, 1991; Prenoveau et al., 2010; Watson, 2009), shared diagnostic symptom criteria (Brown, Chorpita, & Barlow, 1998; Ninan & Berger, 2001), common cognitive therapy and pharmacological responsiveness (Andrews et al., 2009; Prenoveau et al., 2010), and shared genetic heritability (Andrews et al., 2009; Prenoveau et al., 2010; Watson, 2009). Theories describing how best to distinguish between depression and anxiety have commonly implicated a relatively nonspecific temperamental disposition toward general distress, negative emotionality, or personality trait (e.g., neuroticism), herein referred to collectively as negative affectivity (NA; Brown & Barlow, 2009; Clark & Watson, 1991; Prenoveau et al., 2010; Watson, 2009). In fact, one recent review concerning impending revisions to the Diagnostic and Statistical Manual of Mental Disorders-Fifth Edition (DSM-V) and International Classification of Diseases has unequivocally concluded that NA is the defining feature of depression and anxiety disorders (Andrews et al., 2009), distinguishing these from neurodevelopmental disorders, psychoses, externalizing disorders, and neurocognitive disorders. Though the higher order NA factor is common to all emotional disorders, evidence based on large epidemiological comorbidity surveys (Krueger, 1999; Watson, 2009) and longitudinal structural analysis

(Prenoveau et al., 2010) has suggested that certain disorders and symptoms tend to cluster together. These emotional clusters have been described as anxious-misery (i.e., major depression, dysthymia, generalized anxiety disorder, posttraumatic stress disorder) and visceral fear (i.e., panic disorder, social phobia, agoraphobia, specific phobia; Krueger, 1999).

To differentiate between the affective disorders within the anxious-misery and visceral fear clusters, some theorists suggest evaluating unique dimensional symptoms or, in other words, the phenotypic variance that makes each disorder relatively unique (Clark & Watson, 1991; Prenoveau et al., 2010; Watson, 2009). Compelling evidence has implicated that low positive affect (i.e., the absence of positive affect symptoms such as optimism and happiness) is a dimensional marker for unipolar depression, while somatic hyperarousal (i.e., visceral-fear response of shakiness, difficulty swallowing) is a marker for panic disorder (Clark & Watson, 1991; Prenoveau et al., 2010; Watson, 2009). Given the importance of early and accurate identification of clinical and subclinical anxiety and depression, it is therefore requisite to explore the etiology and symptomatic expression of these negative emotions to evaluate current taxonomic systems, describe symptom phenomenology, validate self-report inventories, and inform routine screening procedures.

Conspicuously, such clinical observations that inform psychiatric and psychological nomenclature to distinguish between depression and anxiety have not readily translated to health research paradigms. In coronary heart disease (CHD) samples, for example, depression and anxiety disorders and/or symptoms are typically reported in isolation, even when datasets contain multiple distress measures (Suls & Bunde, 2005). This practice neglects symptom interrelation and comorbidity and implies an unjustified level of specificity (T. W. Smith & Cundiff, 2011), which may have dramatic implications for screening and determining prognostic associations with CHD morbidity. Interestingly, routine screening for depression, but not anxiety, was recently advocated for all CHD patients by the American Heart Association as a pathway to clinical care (Lichtman et al., 2008). The approximate prevalence of depression among CHD populations is 15%-20%, suggesting nearly one in five patients might be suitable candidates for intervention (Lichtman et al., 2008). Moreover, CHD and unipolar depression are among the top 10 causes of disease burden globally (Lopez, Mathers, Ezzati, Jamison, & Murray, 2006), while the prognostic and aetiological association between depression and CHD has been established in some meta-analyses (van Melle et al., 2004). Thus, the clinical importance of accurately identifying persons with comorbid depression and CHD cannot be underestimated.

Practically, however, substantial interrelation between depression and anxiety complicates identification of depression when employing self-reported dimensions (e.g., correlation with anxiety) and diagnostic categories (e.g., comorbidity and symptom overlap with certain disorders such as generalized anxiety disorder). This is exemplified by comparable screening sensitivity afforded by some depression and anxiety scales among CHD samples in detection of major depression and generalized anxiety disorder (Bambauer, Locke, Aupont, Mullan, & McLaughlin, 2005; Frasure-Smith & Lesperance, 2008; Poole & Morgan, 2006). Given the absence of empirical investigation of validated clinical theory in CHD, it is possible that affective dimensions may aid screening efforts by distinguishing between anxiety and depression disorders (Craske et al., 2009; Watson, 2009) and informing targeted therapeutic intervention as to the primary disorder(s) among CHD patients. A second advantage of validating dimensional symptoms with respect to affective disorders is clarification of prognostic associations between *unique* affective constructs and CHD risk factors (Kubzansky & Kawachi, 2000). Importantly, as Kubzansky and Kawachi (2000) once described "evidence that "pure" anxiety (as independent of depression), or the reverse, plays a role in CHD has yet to be demonstrated" (p. 332).

To the best of our knowledge, we are not aware of a previous study among CHD populations to evaluate how the affective disorders and broader emotional clusters are associated with dimensional symptoms, as has been established elsewhere (Bredemeier et al., 2010; Prenoveau et al., 2010). The current study attempts to address such a limitation among a sample of CHD patients, focusing particularly on depression, panic, and general anxiety disorders. To inform brief screening procedures for CHD patients, a dimensional self-report measure of low positive affect, somatic anxiety, and general distress was examined (Anxiety Depression Distress

Inventory [ADDI]-27, see the Methods section). Scores on the ADDI-27 scales were employed to detect the presence or absence of affective disorders and clusters with logistic regression and receiver operator characteristics (ROCs), i.e., the true and false positive detection rates. Based on previous theoretical models, it was hypothesized that the low positive affect scale would be positively associated with major depression and the anxious-misery cluster. Conversely, it was hypothesized that somatic anxiety would not be positively associated with major depression and the anxious-misery cluster. Furthermore, it was also hypothesized that the somatic anxiety scale would be positively associated with panic disorder and the visceral-fear cluster. In contrast, it was hypothesized that low positive affect would not be positively associated with panic disorder and the visceral-fear cluster. Given longstanding debates concerning generalized anxiety disorder, it was hypothesized that the presence of this disorder would not be optimally detected by any specific affect dimension.

Methods

Participants

Eligible patients were aged > 18 years scheduled for nonemergency coronary revascularization surgery (i.e., elective and urgent surgery) to provide symptom relief of CHD symptoms (e.g., angina, shortness of breath). From 252 approached patients, 94 were excluded for the following reasons: language, reading, writing or vision difficulty (n = 3), participating in another research trial (n = 10), declined (n = 23), health reasons (n = 2), developmental disorder (n = 2), dementia (n = 1), living in a rural Aboriginal community and no contact details (n = 11), late addition to surgery list (n = 2), inter-hospital transfer or on ward for less than 24 h (n = 16), surgery postponed indefinitely (n = 1), time constraints or admitted on weekend (n = 13), withdrew consent after recruitment (n = 1), and a confused state (n = 1) ascertained by the Short Portable Mental Status Questionnaire (Eissa, Andrew, & Baker, 2003). After psychological examination (described further below), patients were excluded if the following were present: current psychosis and/or taking anti-psychotic medications (n = 3), current or past alcohol and/or substance abuse (n = 5).

Procedure

Recruitment took place at the cardiac preadmission clinic of two institutions, Flinders Medical Centre and Flinders Private Hospital South Australia, Australia, between February 2007 and March 2009. Patients were recruited at the hospital preadmission clinic in the week before surgery or on the hospital ward if an urgent patient, inter-hospital transfer, or rural patient. Patients were assessed a median 3 days preoperatively (interquartile range 1–3 days). Before precardiac surgery workup, patients were invited to participate in the study. Recruited patients then completed self-report distress questionnaires and returned them to the research trial coordinator. The research trial coordinator scored self-report distress measures blinded to the diagnostic interview results. This study received ethics approval from the respective institutions.

Preoperative CHD and medical information were collected prospectively by resident medical officers; surgical and postoperative parameters were collected by surgical staff and entered into an electronic database. Standardized definitions of the Australian Society of Cardiothoracic Surgeons were employed in this study. Database management was maintained via regular meetings with the database manager and staff to maintain consistent data collection and accuracy. After written and informed consent, patients underwent structured diagnostic interview (described further below) to determine affective and other psychiatric disorders.

Self-Reported Distress

Patients completed the Mood and Anxiety Symptom Questionnaire (MASQ) that comprises a list of statements, and respondents indicate for each item how much they have felt or experienced

these feelings or thoughts in the past week using a Likert type scale ranging from 1 (*not at all*) to 5 (*extremely*). For our purposes here, as Clark and Watson specify (1991), items reflecting positive affect are negatively keyed and reverse scored. Therefore, increasing scores reflect less positive affect and more distress. Consistent with empirical evidence (Clark & Watson, 1991), the MASQ was developed to measure the unique symptom dimensions of depression (i.e., low positive affect/anhedonia), anxiety (i.e., somatic anxiety, anxious hyperarousal) as well as nonspecific distress (i.e., NA). The MASQ was reported as a reliable and valid measure with excellent internal consistency in other non-CHD samples (Bredemeier et al., 2010; Keogh & Reidy, 2000; Reidy & Keogh, 1997; Watson, Clark et al., 1995; Watson, Weber et al., 1995).

Some inconsistencies with the factor structure of the 90-item MASQ have led to several revisions to reduce the item content and improve distinction between depression and anxiety. One advantage of a shortened MASQ is brevity for screening purposes in cardiac or primary care settings. Osman and colleagues (2011) recently performed rigorous psychometric evaluation of the MASQ to derive a 27-item scale. The ADDI-27 is the briefest version of the MASQ items to date with sound psychometric properties. For parsimony, herein we refer to the Anxiety Depression Distress Inventory-27, and the three scales as general distress, low positive affect, and somatic anxiety. Consistent with Osman et al. (2011), nine items each were allocated to a somatic anxiety scale (originally 17 items) characteristic of anxiety and panic disorder (Watson, Clark, et al., 1995; Watson, Weber et al., 1995). The low positive affect scale (originally 22 items) is characteristic of unipolar depression (Watson, Clark, et al., 1995; Watson, Weber et al., 1995). The general distress scale (originally 15 items) is nonspecific and moderately associated with depression, panic disorder and generalized anxiety disorder, though differentially associated to phobic anxiety (Watson, 2009).

Patients also concurrently completed a relevant personality trait measure consistent with other research (Denollet, 2005). The Type D (Distressed) Scale-14 (DS14) consists of two scales, seven items each, that measure NA and social inhibition respectively. Previous research has corroborated favorable psychometric properties and prognostic association with CHD outcomes (Denollet, 2005). However, recent taxometric evidence suggests that the DS14 reflects a dimensional and not categorical construct (Ferguson et al., 2009). Therefore, here only the NA subscale scores, tapping into dysphoria, worry, and irritability, were investigated with ROCs based on the hypotheses concerning affective disorders and NA and previous empirical models (Watson, 2009).

Psychiatric Status

The Mini-International Neuropsychiatric Interview version 5.0.0 (MINI) served as the standardized criterion for current affective disorders (yes/no) administered by an intern psychologist (first author, 2,000 hours clinical psychology therapy experience, employed 0.4 full-time equivalent in the hospital setting). The MINI assesses a range of mood, anxiety, and other disorders (Sheehan et al., 1997; Sheehan et al., 1998). Kappa coefficients ($\kappa = .86 - .96$) suggest favorable agreement with the structured clinical interview for Diagnostic and Statistical Manual of Mental Disorders, Third Edition, Revised (DSM-III-R) patients (Sheehan et al., 1997), and also the composite international diseases interview ($\kappa = .43 - .73$; Sheehan et al., 1998). Adopting DSM-IV criteria (American Psychiatric Association, 2000), only depression, panic, and generalized anxiety disorder were analyzed as individual disorders with respect to the ADDI-27 scores considering the established importance to cardiac research (Chen, Tsai, Lee, & Lin, 2009; Frasure-Smith & Lesperance, 2008) and also the low base rates ($<5\%$ of total and <10 cases) of other affective disorders in the sample (described in the results section). To compensate, we also grouped disorders together to form two affective clusters (Watson, 2009). A participant was included in the binary (yes/no) anxious-misery cluster if they met criteria for one or more of the following disorders: major depression, dysthymia, generalized anxiety disorder, and posttraumatic stress disorder. A participant was included in the binary (yes/no) visceral-fear cluster if they met criteria for one or more of the following disorders: panic disorder, agoraphobia, social phobia, and specific phobia.

Therefore, considering comorbidity, membership in the anxious-misery and visceral-fear group was not mutually exclusive and merely reflects the hypothesized disorder clusters (Watson, 2009). Patients meeting current other MINI criteria were excluded for the following reasons: current psychosis and/ or taking anti-psychotic medications (n = 3), current or past alcohol and/ or substance abuse (n = 5).

Statistical Analysis

Analyses were two-tailed and an alpha value $p < .05$ was considered statistically significant (SPSS Inc 18.0, Chicago, IL) and no adjustment was made for multiple comparisons (see Rothman, 1990). The MINI affective disorder diagnosis (yes/no) served as the external criterion for affective disorders. Because of statistical power limitations, more than 10 cases were required for a given disorder or cluster to proceed with ROCs and regression analyses. The area under curve (AUC) from ROCs evaluated the accuracy of the ADDI-27 scale scores and Type D NA scale scores to identify a particular psychiatric disorder or affective cluster. Instances where AUC = 0.5 the screening measure does no better than chance and AUC = 1.0 corresponds to perfect accuracy. Swets' (1988) suggested interpretation of AUC values as small (0.5 – ≤0.7), moderate (0.7 – ≤0.9) and high (0.9 – ≤1). Optimal cut points are reported for AUC $p < .05$ and were determined by maximizing sensitivity (i.e., identification of true positives) and specificity (i.e., identification of true negatives) with the Youden statistic (Y = sensitivity + specificity − 100). The positive predictive value and negative predictive values are also reported. Positive predictive values are the proportion of patients with positive test results who are correctly identified. Conversely the negative predictive values are the proportion of patients with negative test results who are correctly identified. Specificity >75% is desirable for screening purposes, thereby minimizing false positives.

Consistent with previous affect dimension research (Buckby, Yung, Cosgrave, & Killackey, 2007) a series of logistic regressions were performed for the association with affective disorders and disorder clusters according to dimensions, general distress, and trait NA. A categorical cutpoint was adopted from the ROC analyses, taking the score at which Youden index was maximized. We did not proceed with a regression analysis in instances where a dimensional scale was not associated with a cluster or disorder. The tolerance, variance inflation factor, and eigen values were assessed to determine multicollinearity; a tolerance value of ≥0.2 and/ or variance inflation factor ≤4 was regarded as acceptable.

Results

Descriptives

The 94 patients excluded from the study were not discrepant from participants on comorbid CHD conditions as previously reported (Tully, Baker, Winefield, & Turnbull, 2010; Tully et al., 2011) but were more likely to identify as Aboriginal, χ^2 (1) = 5.85, $p = .02$. A total N = 158 patients were recruited (20.9% female; 11.4% concomitant valve surgery; 3.8% Aboriginal; 27.8% urgent surgery; median age = 65; interquartile range 58–73). Highly prevalent comorbidity was evident for hypercholesterolemia and hypertension (74.7% and 64.6%, respectively), while heart failure was prevalent among 25.3% of patients.

The proportion of patients receiving an affective diagnosis was as follows: major depression (n = 27, 17.1%), generalized anxiety disorder (n = 16, 10.1%), panic disorder (n = 12, 7.6%), dysthymia (n = 9, 5.7%), agoraphobia (n = 6, 3.8%), social phobia (n = 4, 2.5%), specific phobia (n = 2, 1.3%), and posttraumatic stress disorder (n = 1, 0.6%). With respect to comorbidity, 67.1% of patients were free from any affect disorder, 31 (19.6%) met criteria for one disorder, 17 (10.8%) met criteria for two disorders, and four (2.5%) met criteria for three disorders. Descriptive and reliability statistics for the continuous self-report distress measures in the total group were as follows: general distress, mean [M] = 15.16 (standard deviation [SD] = 4.87,

α = .84, inter-term correlation = .37); low positive affect, M = 14.04 (SD = 2.84, α = .75 inter-term correlation = .40); somatic anxiety, M = 21.68 (SD = 4.26, α = .79, inter-term correlation = .31); and DS14 NA, M = 7.83 (SD = 5.43, α = .86, inter-term correlation = .46).

Descriptive and reliability statistics for the continuous self-report distress among persons meeting current anxious misery disorder criteria were as follows: general distress, M = 18.77 (SD = 5.82, α = .92, inter-term correlation = .40); low positive affect, M = 38.16 (SD = 6.99, α = .85, inter-term correlation = .33); somatic anxiety, M = 31.34 (SD = 6.00, α = .85, inter-term correlation = .31); and DS14 NA, M = 11.31 (SD = 6.36, α = .86, inter-term correlation = .55).

Descriptive and reliability statistics for the continuous self-report distress among persons meeting current visceral fear disorder criteria were as follows: general distress, M = 13.72 (SD = 5.66, α = .90, inter-term correlation = .40); low positive affect, M = 17.86 (SD = 4.89, α = .81 inter-term correlation = .33); somatic anxiety, M = 25.09 (SD = 6.06, α = .79, inter-term correlation = .31); and DS14 NA, M = 10.38 (SD = 5.47, α = .82, inter-term correlation = .39).

Receiver Operating Characteristics

Anxious-misery cluster. There were n = 39 (24.7% of total) persons meeting at least one diagnosis from the anxious-misery cluster (N.B. the total number of depression, dysthymia, generalized anxiety disorder and posttraumatic stress disorder cases exceeds 39 due to comorbidity between these disorders). The AUC was greatest for low positive affect scale scores, followed by general distress, trait NA, and somatic anxiety. Employing a cutpoint of 21 from the general distress scale, sensitivity was 81.4% with 42.6% specificity. The sensitivity of other measures were <70%, suggesting suboptimal screening utility in detection of anxious-misery disorders. The receiver operating characteristics are presented in Table 1.

Major depression. There were n = 27 major depression cases detected (17.1% of total). The ROC analysis showed an AUC = .811 for the low positive affect scale scores with favorable sensitivity and specificity (70.4% and 77.1%, respectively) at a cutpoint of 17. The sensitivity and specificity of other scales were suboptimal for screening purposes. Somatic anxiety scores were no better than chance to predict individual major depression cases as hypothesized. Figure 1 displays the ROC curve for low positive affect indetection of major depression.

Generalized anxiety disorder. There were n = 16 Generalized anxiety disorder cases detected (10.1% of total). General distress scale scores yielded the highest AUC, while a cutpoint of 18 achieved favorable sensitivity and specificity (75.0% and 72.5%, respectively). Low positive affect scores performed no better than chance to detect generalized anxiety disorder. Figure 2 displays the ROC curve for general distress in detection of generalized anxiety disorder.

Visceral-fear cluster. There were n = 21 (13.3% of total) persons meeting at least one diagnosis from the visceral-fear cluster (N.B. the total number of panic disorder, agoraphobia, social phobia and specific phobia cases exceeds 21 due to comorbidity between these disorders). Somatic anxiety scale scores achieved the highest AUC though the sensitivity and specificity was suboptimal for screening purposes. General distress and low positive affect performed no better than chance in detection of the visceral fear cluster.

Panic disorder. There were n = 12 (7.6% of total) cases of panic disorder detected. The AUC was highest for somatic anxiety scale scores followed by trait NA and general distress. Low positive affect performed no better than chance as hypothesized. Somatic anxiety showed favorable sensitivity and specificity (75.0% and 68.5% respectively) in detection of panic disorder. The general distress scale also yielded favorable sensitivity and specificity (83.3% and 63.0% respectively). Figure 3 displays the ROC curve for somatic anxiety in detection of panic disorder.

Table 1

Receiver Operating Characteristics of MASQ Dimensional Subscales and Affective Disorders/Clusters (N = 158)

Disorders grouped by affective cluster	AUC (*SE*)	95% CI	Optimal cutoff	Sensitivity (True+)	Specificity (True−)	Youden	PPV	NPV
Anxious-misery (n = 39) [a]								
Low positive affect [c]	.765 (.044)	.679–.851	16	58.1	79.1	37.3	47.7	85.2
General distress	.745 (.050)	.646–.843	21	81.4	42.6	39.2	31.7	87.5
Anxious arousal	.711 (.050)	.611–.812	16	43.6	90.8	34.3	60.8	83.1
Trait negative affect	.715 (.049)	.618–.812	11	53.5	89.1	40.4	61.7	85.4
Major depression (n = 27)								
Low positive affect [c]	.811 (.048)	.716–.906	17	70.4	77.1	47.5	38.9	92.7
General distress	.732 (.060)	.615–.849	21	51.9	93.9	45.7	63.7	90.4
Somatic anxiety	.543 (.065)	.416–.670	-	-	-	-	-	-
Trait negative affect	.713 (.057)	.601–.825	12	52.9	87.8	39.6	47.2	90.0
Generalized anxiety disorder (n = 16)								
General distress	.795 (.068)	.661–.929	18	75.0	72.5	47.5	23.5	96.3
Low positive affect [c]	.538 (.077)	.387–.690	-	-	-	-	-	-
Somatic anxiety	.667 (.074)	.522–.812	23	68.8	69.0	37.8	20.0	95.2
Trait negative affect	.677 (.077)	.527–.827	11	56.3	83.1	39.3	27.3	94.4
Visceral-fear (n = 21) [b]								
Somatic anxiety	.780 (.043)	.696–.864	22	65.1	73.9	39.0	27.7	93.3
General distress	.595 (.074)	.449–.740	-	-	-	-	-	-
Low positive affect [c]	.532 (.085)	.366–.699	-	-	-	-	-	-
Trait negative affect	.666 (.063)	.542–.789	11	47.6	83.2	30.8	30.2	91.2
Panic disorder (n = 12)								
Somatic anxiety	.784 (.079)	.587–.908	23	75.0	68.5	43.5	16.4	97.1
General distress	.763 (.083)	.607–.920	17	83.3	63.0	46.3	15.6	97.9
Low positive affect [c]	.529 (.105)	.322–.735	-	-	-	-	-	-
Trait negative affect	.781 (.065)	.654–.908	11	66.7	82.9	49.5	24.3	96.8

Note. AUC = area under curve; CI = confidence interval; NPV = negative predictive value; PPV = positive predictive value; SE = standard error

Current psychiatric disorders were derived by structured clinical interview with the MINI (Sheehan et al., 1997, 1998); low positive affect, somatic anxiety, and general distress were measured with Osman et al's (2011) version of the MASQ (Watson et al., 1995; Watson et al., 1995); trait NA was measured by the DS14 (Denollet, 2005).

[a] Anxious-misery group comprises major depression, dysthymia, generalized anxiety disorder, and posttraumatic stress disorder.

[b] Visceral-fear group comprises agoraphobia, panic disorder, specific phobia, and social phobia.

[c] Positive affect items were reverse scored for the purposes of receiver operator characteristic analysis so that higher scores on all measures were indicative of more distress.

Association Between Disorders and Affect Dimensions

Regression model overfitting (Babyak, 2004) and multicollinearity concerns did not permit analysis of multiple affect scales simultaneously. The logistic regression results to determine the association between affective disorders and clusters according to the ROC derived scale score cutpoints are presented in Table 2. The anxious misery cluster was significantly associated with low positive affect, general distress, and trait NA but not somatic anxiety scale scores. Both major depression and generalized anxiety disorder were significantly associated with general distress and trait NA scale scores. The visceral fear cluster was significantly associated with somatic anxiety and trait NA scale scores. Panic disorder was significantly associated with somatic anxiety, general distress and trait NA scale scores.
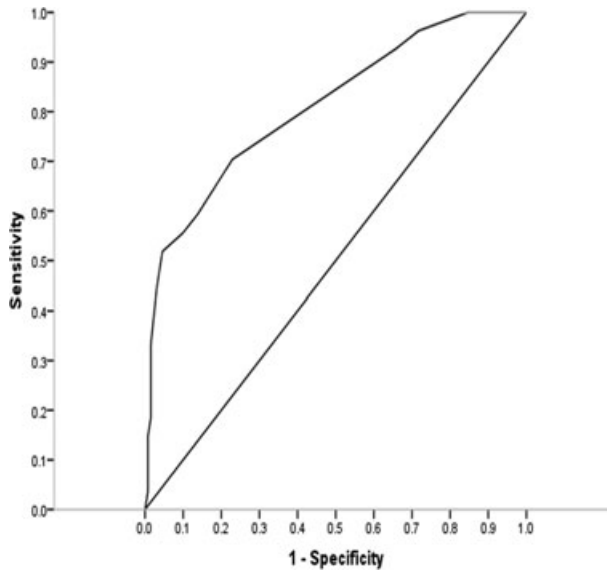
Figure 1. Graph of receiver operating characteristic curves for detection of major depressive disorder by Anxiety Depression Distress Inventory-27 low positive affect scale scores showing sensitivity and 1 – specificity. Area under the curve = .811 (95% CI .716 – .906).
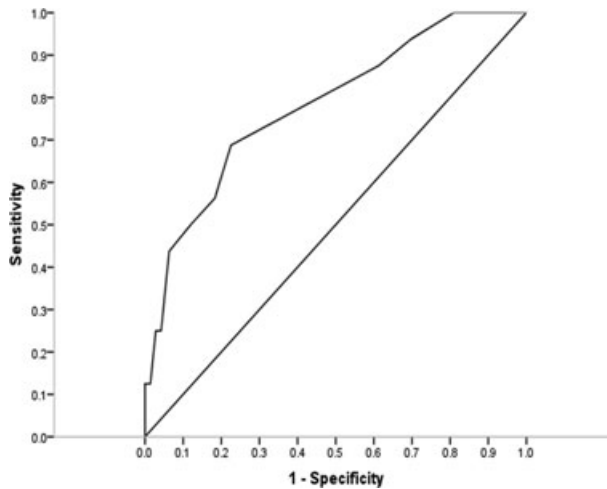

Figure 2. Graph of receiver operating characteristic curves for detection of generalized anxiety disorder by Anxiety Depression Distress Inventory-27 general distress scale scores showing sensitivity and 1 – specificity. Area under the curve = .795 (95% CI .661 – .929).

Discussion

This was perhaps the first investigation of affect dimensions in relation to major depression, panic disorder, generalized anxiety disorder, and the anxious-misery and visceral-fear clusters among CHD patients. The current findings have theoretical and methodological implications for clinical screening among CHD populations. The ROC analysis supported a dimensional association between low positive affect and somatic anxiety scale scores with depression and panic disorder, respectively. These findings can be taken to partly support the hierarchical theory and a dimensional approach to discriminating between anxiety and depression (Clark & Watson, 1991; Mineka, Watson, & Clark, 1998) among CHD patients. Importantly, the low
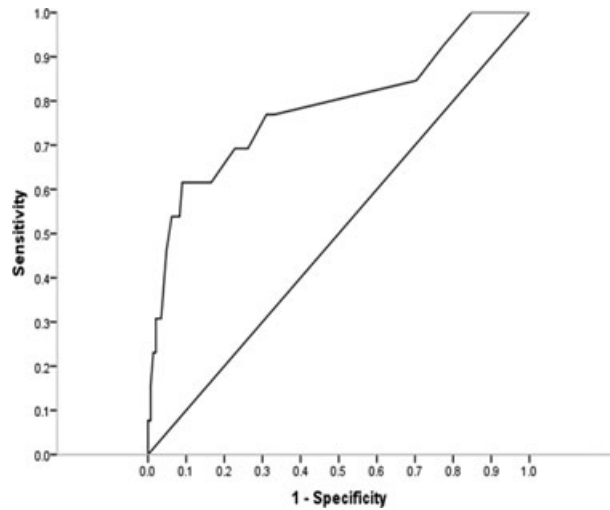
Figure 3. Graph of receiver operating characteristic curves for detection of panic disorder by Anxiety Depression Distress Inventory-27 somatic anxiety scale scores showing sensitivity and 1 – specificity. Area under the curve = .784 (95% CI .587 – .908).

Table 2

Logistic Regression Results for Affective Disorders and Clusters According to Dimensional Cutoff Scores

	β	Wald	OR	95% CI lower	95% CI upper	P
Anxious misery (n = 39)[a]						
Low positive affect	2.03	20.09	7.59	3.13	18.41	<.001
Somatic anxiety	1.45	1.89	4.26	.54	33.89	.17
General distress	3.60	29.21	36.73	9.94	135.71	<.001
Trait negative affect	2.15	24.45	8.58	3.66	20.12	<.001
Major depression (n = 27)						
Low positive affect	2.36	19.41	10.57	3.70	30.18	<.001
General distress	2.81	28.00	16.56	5.85	46.84	<.001
Trait negative affect	2.05	19.08	7.74	3.09	19.39	<.001
Generalized anxiety disorder (n = 16)						
Somatic anxiety	1.90	10.94	6.66	2.17	20.50	<.001
General distress	2.28	15.43	9.82	3.14	30.67	<.001
Trait negative affect	1.84	11.18	6.32	2.15	18.63	.001
Visceral fear (n = 21)[b]						
Somatic anxiety	1.14	3.95	3.12	1.02	9.58	.04
Trait negative affect	1.51	9.32	4.51	1.71	11.85	<.01
Panic disorder (n = 12)						
Somatic anxiety	1.34	4.73	3.81	1.14	12.70	.03
General distress	2.16	4.11	8.70	1.07	70.54	.04
Trait negative affect	2.27	12.17	9.68	2.71	34.65	<.001

Note. CI = confidence interval; OR = odds ratio.

Current psychiatric disorders were derived by structured clinical interview with the MINI (Sheehan et al., 1997, 1998); anhedonia, anxious arousal, and general distress were measured with the MASQ (Watson et al., 1995; Watson et al., 1995); trait NA was measured by the DS14 (Denollet, 2005).

[a]Anxious-misery group comprises major depression, generalized anxiety disorder, and posttraumatic stress disorder.

[b]Visceral-fear group comprises agoraphobia, panic disorder, specific phobia, and social phobia/anxiety disorder.

[c]Positive affect items were reverse scored for the purposes of regression analysis so that higher scores on all measures were indicative of more distress.

positive affect and somatic anxiety dimensions displayed favorable ROC screening properties in prediction of depression and panic disorder respectively, thus supporting discriminant validity of the ADD-27. The general distress dimension was also associated with generalized anxiety disorder.

The association between each individually analyzed disorder with trait NA and general distress in regression analyses supports the theorized nonspecificity of these broad distress dimensions. The results also supported that major depression and panic disorder were significantly associated with low positive affect and somatic anxiety, respectively (Mineka et al., 1998; Watson, 2009). However, low positive affect performed no better than chance to detect either panic or generalized anxiety disorder, while, conversely, somatic anxiety was no better than chance in detection of major depression. Together, the balance between disorder nonspecificity, along with unique disorder related dimensions, partly supports a hierarchical conceptualization of affect (Watson, 2009). Grouping disorders into theoretical clusters showed a significant AUC for the general distress dimension with respect to anxious-misery but not visceral fear. In contrast, trait NA was significantly associated with both of the affective clusters. This finding partly supports the assertion that the relationship between the heterogeneous anxiety disorders and NA is relative and not absolute (Mineka et al., 1998). However, somatic anxiety was not unique to visceral fear as an AUC = .711 was found for the anxious-misery cluster. This was perhaps explained by incorporating generalized anxiety disorder cases within the anxious-misery cluster as generalized anxiety disorder appeared to be associated with general distress, trait NA, and somatic anxiety. Indeed, evidence from the DSM-V field trials may inform pending diagnostic taxonomy revisions for generalized anxiety disorder and clinical phenotypes (American Psychiatric Association, 2010).

Interestingly, generalized anxiety disorder was associated with both somatic anxiety and general distress, though only the latter scale appeared to display favorable ROC screening properties. Comparably, the Hospital Anxiety and Depression Scale anxiety subscale has been demonstrated to tap into somatic anxiety symptoms (Martin, Thompson, & Barth, 2008). Though considered to be characteristic of panic (Joiner et al., 1999), favorable sensitivity (90.7%) and specificity (61.4%) for Hospital Anxiety and Depression Scale-anxiety scores ≥8 have been reported with respect to generalized anxiety disorder in cardiac samples (Frasure-Smith & Lesperance, 2008). With respect to depression, a recent systematic review reported median sensitivity 84% (range 39%–100%) and specificity 79% (58%–94%) of various depression measures among 11 cardiac studies (Thombs et al., 2008). The ADDI-27 positive affect scale was within the abovementioned ranges for identifying current depression cases, and supported a recent ROC study with the MASQ (Bredemeier et al., 2010). However the positive affect scale precluded analysis of somatic symptoms that may form an important part of a cardiac patient's depression experience (Fraguas Junior, Ramadan, Pereira, & Wajngarten, 2000).

With respect to clinical screening utility and at least 70% sensitivity and 60% specificity, favorable ROCs were evident for low positive affect and somatic anxiety in identifying depression and panic respectively among CHD patients. The findings with respect to the association between somatic anxiety dimension and panic disorder are encouraging considering the overlap between somatic manifestations of anxiety and those of heart disease (Craske et al., 2009; Watson, 2009). The poor predictive value of the visceral-fear cluster by somatic anxiety suggests that this dimension is perhaps most reflective of panic disorder (Joiner et al., 1999). These findings support those elsewhere that somatic anxiety is not necessarily a marker of the entire spectrum of disorders that comprise the visceral-fear cluster, and possibly a poor diagnostic screener for simple and social phobia (Boschen & Oei, 2007; Buckby et al., 2007). Research describing an association between low positive affect and somatic anxiety with social phobia (Hughes et al., 2006) highlights the complexity of screening with unique dimensions for individual disorders within the hierarchical cluster structure.

Despite some favorable ROCs results and support for empirical theory, it is possible that the ADDI-27 and MASQ diagnostic classification utility is jeopardized by delineating a general distress scale, separate from that of low positive affect and somatic anxiety. That is, the disorder specific symptoms may, paradoxically, suboptimally detect depression and panic given that the intrinsic latent NA variance of the emotional disorders is omitted. This could explain generally

lower ROCs for the ADDI-27 here by comparison to measures such as the Hospital Anxiety and Depression Scale (Frasure-Smith & Lesperance, 2008) and Beck Depression Inventory (Thombs et al., 2008), where latent NA variance is diffusely loaded within these *depression* and *anxiety* scales (Martin et al., 2008; Shafer, 2006). It has not been reported whether diagnostic classification of affective disorders and clusters is optimized when self-report measures contain a degree of NA variance diffusely loaded within depression and anxiety subscales. That being said, NA-laden depression and anxiety measures such as the Hospital Anxiety and Depression Scale undoubtedly confound the examination of cardiac morbidity outcomes (T.W. Smith & MacKenzie, 2006; Suls & Bunde, 2005). As Kubzansky and Kawachi (2000) wrote, strong prognostic evidence that depression (as distinct from anxiety) is associated with CHD has yet to be demonstrated. Thus, careful portioning out the unique affect/disorder variance from that of general NA may disentangle the role of specific emotional constructs from broader NA and neuroticism traits in prognostic CHD outcomes research (Tully et al., 2011).

Practically, a balance between the ADDI-27 sensitivity, specificity and predictive values should be considered in context of the intended purpose, whether for diagnostic screening, dimensional research, or establishing prognostic associations with CHD. The findings here support that the 27-item shortened version of the MASQ established by Osman and colleagues (2011) could serve as a brief screening measure for depression, general anxiety, and panic among CHD populations. This suggestion is within the abovementioned limitations concerning delineation of a separate general distress scale and the low prevalence and predictive values of the affective disorders. Yet at the same time, findings that the disorders and clusters displayed a differential association with general distress and trait NA may have implications for delivery of clinical therapy. There is potential therapeutic efficacy and cost-effectiveness from delivery of transdiagnostic approaches that target general distress vulnerability factors common to depression and anxiety, rather than depression or anxiety alone. Dozois and colleagues (2009) recently described that common and modifiable vulnerability risk factors for depression and anxiety include negative cognitive content processes, stress and coping, and behavioural inhibition and avoidance.

These data should be interpreted acknowledging several limitations including that no attempt was made to integrate the dimensional approach with similar theoretical models such as behavioral inhibition and behavioral activation (Gray, 1987). The study analyses employed a shortened questionnaire and the 90-item version is comprised of two additional general distress scales tapping more closely into depression and anxiety respectively (Watson, Clark et al., 1995; Watson, Weber et al., 1995). Although analysis of these scales has typically been omitted for parsimony (Osman et al., 2011; Watson, 2009), it is possible that such MASQ scales could contribute to the diagnostic identification of affective disorders.

Furthermore, the validity of the ADDI-27 and MASQ has not been established in CHD populations. Low base rates of the affective disorders are reflected in the width of the AUC 95% confidence interval values, standard errors, and the positive and negative predictive values. Also, there was less than 5% prevalence of some disorders. Results here were dependent on the MINI diagnosis for one psychologist, and, thus, no inter-rater reliability statistics could be determined. Finally, here patients had established heart disease with substantial comorbidity necessitating coronary revascularisation. Thus ROCs for the ADDI-27 is not known among heterogeneous cardiac samples (e.g., postacute cardiac event, heart failure) and conversely populations free from significant cardiac disease. The high presentation rate of persons with panic presenting with noncardiac chest pain (Fleet et al., 1998) may warrant further investigation to establish validity of ADDI-27 somatic anxiety scale to determine broader diagnostic screening benefits.

Conclusion

In conclusion, the ADDI-27 dimensions of low positive affect and somatic anxiety detected the affect concordant disorders of depression and panic, respectively. When the dimensions were applied to detect a theoretically discordant disorder, positive affect and somatic anxiety performed no better than chance supporting the discriminant validity of the ADDI-27. A differential association was evident between the affect dimensions and the anxious-misery and

visceral fear clusters. Further research could validate the diagnostic utility of affective dimensions and clusters and examine these in relation to adverse CHD outcomes.

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