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A psychometric evaluation of the Hospital Anxiety and Depression Scale;
HADS, and a longitudinal investigation of exercise, gender and affective functioning

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**Anxiety and depression in cardiac patients: A psychometric evaluation of the Hospital
Anxiety and Depression Scale; HADS, and a longitudinal investigation of exercise,
gender and affective functioning**

Tiffany T. Hunt-Shanks

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TABLE OF CONTENTS

TABLE OF CONTENTS.....	ii
LIST OF TABLES.....	vii
LIST OF FIGURES.....	viii
LEGEND.....	ix
ABSTRACT.....	x
ACKNOWLEDGEMENTS.....	xii
INTRODUCTION.....	1
Cardiovascular Disease, Depression and Anxiety: Prevalence and Definitions.....	1
Depression & Anxiety in Cardiac Patients: Health Outcomes.....	4
The Assessment/Measurement of Anxiety and Depression.....	7
The Factor Structure of the HADS.....	9
The Factor Structure of the HADS with Cardiac Populations.....	11
Exercise Benefits for Cardiac Patients.....	14
The Impact of Exercise on Anxiety and Depression in Cardiac Patients.....	16
Gender Differences in the Affective Functioning and Exercise Behaviour and Adherence of Cardiac Patients.....	19
Overview of Studies.....	21
Objectives.....	26
References.....	28

STUDY 1: A psychometric evaluation of the Hospital Anxiety and Depression Scale in cardiac patients: Addressing factor structure and gender invariance. Submitted to British Journal of Health Psychology.....	45
CHAPTER 1: INTRODUCTION.....	45
CHAPTER 2: METHODS.....	50
Participants.....	50
Procedures.....	51
CHAPTER 3: MEASURES.....	51
Demographic Characteristics.....	51
Anxiety and Depression.....	52
CHAPTER 4: RESULTS.....	52
Characteristics of the participants and HADS Subscales.....	52
Main Analyses.....	52
Purpose 1.....	53
Purpose 2.....	55
CHAPTER 5: DISCUSSION.....	56
REFERENCES.....	64
TABLES.....	73
Table 1: Characteristics of Factor Models to be tested.....	73
Table 2: Hospital Anxiety and Depression Scale (HADS) items.....	74
Table 3: Characteristics of Participants.....	75

Table 4: Mean Scores and Standard Deviations (S.D.) of Scores on the HADS	
Sub-scales.....	76
Table 5: Goodness of Fit Statistics with Male and Female Cardiac Patients.....	77
Table 6: Factor Loading, Error Variance, Construct Reliability and Variance	
Extracted for the Hospital Anxiety and Depression Scale Constructs	
for Male Cardiac Patients.....	78
Table 7: Factor Loading, Error Variance, Construct Reliability and Variance	
Extracted for the Hospital Anxiety and Depression Scale Constructs	
for Female Cardiac Patients.....	79
STUDY 2: Gender differences in cardiac patients: A longitudinal investigation of	
exercise, autonomic anxiety, negative affect and depression. Submitted to	
Psychology, Health & Medicine.....	80
CHAPTER 6: INTRODUCTION.....	80
CHAPTER 7: METHODS.....	84
Participants.....	84
Procedures.....	84
CHAPTER 8: MEASURES.....	85
Demographic Characteristics.....	85
Affective Functioning.....	86
Exercise.....	86
CHAPTER 9: ANALYSIS AND RESULTS.....	87
Preliminary Analyses.....	87

Characteristics of the Participants.....	87
Change Scores.....	87
Confounding Variables.....	87
Examination of Variables Across Time by Gender.....	88
Moderation.....	90
Mediation.....	91
CHAPTER 10: DISCUSSION.....	92
REFERENCES.....	99
TABLES.....	107
Table 1: Characteristics of Participants.....	107
Table 2: Mean Scores and Standard Deviations (S.D.) of the Affective and Exercise Scales.....	108
Table 3: Percentage of Participants with “Possible” and “Probable” Cases of Anxiety and Depression.....	109
FIGURES.....	110
Figure 1: Study Flow.....	110
CONCLUSION.....	111
General Discussion.....	111
Exploring Gender Differences.....	117
Measurement/Assessment Issues.....	123
Practical Applications.....	125
Summary.....	127

REFERENCES.....	130
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LIST OF TABLES

STUDY 1: TABLES

Table 1: Characteristics of Factor Models to be tested.....	68
Table 2: Hospital Anxiety and Depression Scale (HADS) items.....	69
Table 3: Characteristics of Participants.....	70
Table 4: Mean Scores and Standard Deviations (S.D.) of Scores on the HADS Sub-scales.....	71
Table 5: Goodness of Fit Statistics with Male and Female Cardiac Patients.....	72
Table 6: Factor Loadings and Construct Reliabilities for the Hospital Anxiety and Depression Scale Constructs for Male Cardiac Patients.....	73
Table 7: Factor Loadings and Construct Reliabilities for the Hospital Anxiety and Depression Scale Constructs for Female Cardiac Patients.....	74

STUDY 2: TABLES

Table 1: Characteristics of Participants.....	103
Table 2: Mean Scores and Standard Deviations (S.D.) of the Affective and Exercise Scales.....	104
Table 3: Percentage of Participants with “Possible” and “Probable” Cases of Anxiety and Depression.....	105
Table 4: Standardized betas for exercise prediction of autonomic anxiety, Negative affect and depression by sex at baseline.....	106

LIST OF FIGURES

STUDY 2: FIGURE

Figure 1: Study Flow.....	110
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Legend

CABG = Coronary artery bypass graft surgery

CR = Cardiac rehabilitation

MACES = Major adverse coronary events

AMI = Acute myocardial infarction

PCI = Percutaneous coronary intervention

Abstract

Gender differences are apparent in both the affective functioning and exercise behaviour of cardiac patients. Specifically, female cardiac patients demonstrate more anxiety and depression, and reduced exercise compared to males. Accordingly, gender appropriate screening measures and interventions are needed. In studying a diverse sample of cardiac patients over two years, the objectives of the first investigation were to 1) examine the factor structure of the HADS, and 2) test measurement invariance between genders. The aims of the second study were to 1) examine the prevalence of autonomic anxiety, negative affect and depression, and 2) determine whether gender moderated the exercise/affective relationships, and 3) evaluate whether exercise mediated the gender/affective relationships. 801 cardiac inpatients completed questionnaires including the HADS at baseline, 6 months, 12 months and 24 months post-discharge. Confirmatory factor analysis consistently supported a three-factor structure of the HADS, with the best fitting model comprised of negative affect, autonomic anxiety and depression. Structural equation modeling showed that the HADS was invariant by gender among cardiac patients. Repeated measures analysis of covariance (ANCOVA) revealed that female cardiac patients had greater autonomic anxiety, negative affect and depression and reduced exercise compared to male cardiac patients at all time points. Although exercise was significantly related to affective outcomes at various time points for both men and women, gender did not moderate any of the exercise/affective relationships, and exercise did not mediate any of the gender/affective relationships. In summary, the HADS can be appropriately used with both male and female cardiac patients to assess three domains of

psychological distress. Future investigations should consider the predictive validity and relevance of the HADS subscales with respect to diagnostic distinctions and clinical outcomes among cardiac patients and other clinical populations. In addition, further research is needed to clarify the complex relationships between gender and the affective functioning of cardiac patients.

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Introduction

Cardiovascular Disease, Depression and Anxiety: Prevalence and Definitions

Cardiovascular disease (CVD) is a serious public health issue. CVD is the leading cause of death among Canadians and costs the economy over 18 billion dollars annually. Based on data from 2004, CVD was responsible for 31% of all deaths among men and 33% of all deaths among women (Heart & Stroke Foundation, 2008). Prevalence data from Canadian self-report surveys indicate that heart disease or stroke was reported in 6.9% of individuals aged 50-64, 17.6% of individuals aged 65-79 and 28% of individuals aged 80 or above (Heart & Stroke Foundation, 2008). In describing CVD, the Heart and Stroke Foundation of Canada (2008) note that CVD encompasses diseases and injuries of the cardiovascular system (e.g., heart, blood vessels). Within the cardiac literature, some commonly studied groups of patients include those who have experienced myocardial infarction (MI), coronary artery bypass graft surgery (CABG) and percutaneous coronary intervention (PCI) (See Roberts, Bonnici, Mackinnon, & Worcester, 2001; Higgins, Hayes & McKenna, 2001; Frasure Smith, Lespérance, Juneau, Talajic & Bourassa, 1999).

Although research with cardiac patients has traditionally focused on physical health outcomes, consideration for the role of negative emotions in CVD is both necessary and essential for a comprehensive understanding of variables that impact clinical outcomes in cardiac patients (Sirois & Burg, 2003). Accordingly, the presence of both symptoms of depression and anxiety, as well as clinical disorders (e.g., Major Depressive Disorder, Generalized Anxiety Disorder) have been increasingly evaluated in research with cardiac patients (Frasure-Smith & Lespérance, 2008). In characterizing

depression, the Diagnostic and Statistical Manual of Mental Disorders (4th ed. Rev, *DSM-IV-TR*, American Psychiatric Association, 2000) outlines that a major depressive episode is typically represented by depressed mood over two weeks that impairs social, occupational and/or daily functioning. A diagnosis of a Major Depressive Episode (MDE) requires that five or more of the following symptoms be evidenced: depressed mood experienced most of the day, more days than not, reduced interest or pleasure in activities, significant weight loss or gain, sleep difficulties, psychomotor difficulties, fatigue and/or energy loss, feelings of guilt and/or worthlessness, reduced ability to concentrate or make decisions, and suicidal ideation, gestures or attempts (APA, 2000). A Major Depressive Disorder (MDD) is characterized by one or more MDE's not better accounted for by other medical or comorbid mental conditions (APA, 2000).

Various investigations have considered the prevalence and incidence rates of depressive symptoms and/or disorders in cardiac patients. For instance, in one of the largest, wide reaching investigations of cardiac populations, the INTERHEART study looked at 11,119 post-myocardial infarction (MI) patients and 13,648 age and sex matched controls from 52 countries (Rosengren et al., 2004). The results revealed that depression was more prevalent in cases than controls, with post-MI patients evidencing rates of depression at 24% and matched controls evidencing rates of depression at 17.6% [OR 1.55 (1.42-1.69)] (Rosengren et al., 2004). Similarly, depression incidence rates reported in the literature are approximately 25% in CHD patients (Januzzi, Stern, Pasternak & DeSanctis, 2000). With respect to Canadian data, the Ontario Cardiac Rehabilitation Pilot Project (Cardiac Care Network of Ontario, 2002) reported a

depression prevalence rate at 17.9% for individuals prior to cardiac rehabilitation (CR) program entry. This falls within the typical point prevalence depression rates for coronary heart disease (CHD) patients that are reported to range from 15-25% (Arthur, 2005). However, it is important to note that significant gender differences in the prevalence of both depressive symptoms and disorders have been identified, with more women meeting criteria for MDD compared to men (See Frasure Smith & Lespérance, 2008) and more women reporting depressive symptoms compared to men (Cardiac Care Network of Ontario, 2002; Frasure-Smith, Lespérance & Talajic, 1995; Frasure-Smith et al., 1999; Grace et al., 2002a; Grace et al., 2002b). This is consistent with trends found in the general population (APA, 2000).

In addition to depressive symptoms and disorders, anxiety symptoms and disorders are also receiving increased research attention with cardiac patients (Frasure-Smith & Lespérance, 2008). In summarizing some of the key features of anxiety disorders recognized in the DSM-IV, Zinbarg and Barlow (1996) note that anxiety disorders subsume the following: "...somatic manifestations of panic, the perception of derealization, intrusive thoughts, sensitivity to evaluation, compulsive rituals, re-experiencing of traumatic events, worry and agoraphobic avoidance" (pp. 181). Although the grouping of disorders under the label "Anxiety Disorders" implies shared features, there is also recognition that both unique features and distinct categories are present (i.e., Obsessive Compulsive Disorder, Panic Disorder, etc.) (Zinbarg & Barlow, 1996).

With respect to anxiety in post MI patients, prevalence rates have been reported to range from 18.5% -26% (Mayou et al., 2000; Moser & Dracup, 1996). Canadian data

from the Ontario Cardiac Rehabilitation Project (Cardiac Care Network of Ontario, 2002) indicate that elevated anxiety symptoms were evidenced in 16.1% of the sample, with women having higher anxiety scores than men. However, higher rates of anxiety symptoms have been reported with different cardiac populations. For instance, in a recent Canadian investigation, 41.4% of patients with coronary artery disease (CAD) had elevated anxiety scores (Frasure-Smith & Lespérance, 2008). In addition, it is noted that the prevalence of Panic Disorder can be as high as 60% in cardiology clinics (APA, 2000). Furthermore, female cardiac patients tend to have higher rates of anxiety symptoms compared to males (Cardiac Care Network of Ontario, 2002; Frasure Smith & Lespérance, 2008). Interestingly, this finding has been demonstrated cross-culturally with cardiac patients (Moser et al., 2003) and it is consistent with trends in the general population (APA, 2000).

Evidently, anxiety and depression are salient issues for cardiac patients. Therefore, it is concerning that depression and anxiety have been linked to significant negative health outcomes including increased mortality risk (Hermann et al., 1998; Barth et al., 2004; Carney et al., 2004; Van Melle et al., 2004) and recurrent cardiac events (Denollet & Brutsaert, 1998; Frasure-Smith et al., 1995; Moser & Dracup, 1996; Strik et al., 2003).

Depression & Anxiety in Cardiac Patients: Health Outcomes

Both American and Canadian researchers have reported negative impacts of depression on the short and long- term health of patients with established CHD (Barefoot

et al., 1996; Frasure-Smith, Lespérance & Talajic, 1993; Frasure-Smith et al., 1995). For instance, Canadian studies have shown that elevated depressive symptoms are a predictor of mortality up to 18-months post MI, with elevated depressive symptoms demonstrated more frequently in women than men (Frasure-Smith et al., 1993, Frasure-Smith et al., 1995). Recently, another Canadian investigation demonstrated that MDD was associated with an increased risk of major adverse cardiac events; MACEs (e.g., cardiac death, myocardial infarction, nonelective revascularization) in both male and female CAD patients over 2 years. Specifically, patients reporting MDD had over twice the risk of MACEs (OR 2.54, 95% CI, 1.27-5.09) than those not reporting MDD (Frasure Smith and Lespérance, 2008).

Studies of American CAD patients have also revealed that depressive symptoms predict cardiac death, with greater odds of death among patients with moderate-severe depressive symptoms (Barefoot et al., 1996). Moreover, within recent years, large-scale, meta-analyses have confirmed that depressive symptoms predict mortality in CHD patients and MI patients. Specifically, Barth et al. (2004) concluded that CHD patients reporting depressive symptoms had twice the risk of mortality (OR 2.24; 1.37-3.60) when compared with those not reporting depressive symptoms. Furthermore, among patients reporting clinical depression, their risk of mortality was significantly greater (OR 2.61; 1.53-4.47) than those not reporting clinical depression (Barth et al., 2004).

Similarly, Van Melle et al. (2004) concluded that depression was significantly related to cardiac mortality (OR 2.59, 95% CI, 1.77-3.77) and all cause mortality (OR 2.38, 95% CI, 1.76-3.22) among MI patients. Interestingly, the results were independent

of depression assessment (i.e., self report, diagnostic interview) suggesting that both clinical depression and depressive symptoms are associated with poor cardiovascular outcomes in post MI patients (Van Melle et al., 2004).

It is acknowledged that compared to depression, less research has been done in relation to anxiety (Lane, Carroll & Lip, 2003). Nonetheless, some studies are emerging that consider the association between anxiety and established CHD. Among CAD patients, elevated anxiety symptoms have been related to poor physical functioning and increased risk of recurrent cardiac events (Sullivan, LaCroix, Baumm, Grothaus & Katon, 1997; Frasure-Smith & Lespérance, 2008). Recent research demonstrated that CAD patients with Generalized Anxiety Disorder had twice the risk of MACEs (OR 2.9, 95% CI, 1.07-4.88) compared patients without the disorder (Frasure-Smith & Lespérance, 2008). Similarly, among post MI patients, elevated anxiety symptoms have been consistently associated with an increased risk of recurrent cardiac events (Denollet & Brutsaert, 1998; Frasure-Smith et al., 1995; Moser & Dracup, 1996; Strik et al., 2003) in addition to decreased exercise and poorer quality of life (Lane et al., 2001; Mayou et al., 2000).

Clearly, both anxiety and depression pose significant health risks to cardiac patients' physical health (Frasure-Smith & Lespérance, 2008; Van Melle et al., 2004). Therefore, it is important to consider how depression and anxiety are evaluated and what screening and assessment tools are employed with cardiac patients.

The Assessment/Measurement of Anxiety and Depression

In assessing depression, it is recognized that both psychological symptoms (e.g., worthlessness, guilt) and somatic symptoms (e.g., fatigue, lethargy) can be present (APA, 2000). Therefore, when evaluating symptoms of depression, both somatic and psychological features can be examined. With regards to anxiety, it can be conceptualized as a transitory state (state anxiety), personality trait (trait anxiety) or as a process (i.e., a sequence of cognitions, emotions and behaviors in response to a stressor) (Spielberger, 1972). Therefore, it can be measured through physiological (e.g., blood pressure, respiration, perspiration) or phenomenological responses (e.g., self-reported state or trait anxiety). Some common methods of assessing anxiety and depression include self-report measures and semi-structured or structured interviews. Typically, self-report measures of anxiety and depression are used to identify the presence or absence of symptoms, whereas structured interviews are used as diagnostic tools (Groth-Marnat, 1999).

Some frequently used self-report measures of depression include the Beck Depression Inventory (BDI) (Beck, Ward, Mendelson, Mock & Erbaugh, 1961), the Centre for Epidemiological Studies Depression Scale (CES-D) (Sawyer Radloff, 1971), and the Hamilton Rating Scale for Depression (Hamilton, 1967). The BDI assesses the presence/absence of beliefs and symptoms (psychological and somatic) that are likely related to depression. Depressive symptoms are summed and categorized into mild, moderate or severe ranges (Groth-Marnat, 1999). Similarly, the Hamilton Rating Scale for Depression assesses the presence/absence of depressive symptoms. Overall depressive symptoms are rated from absent to severe (Hamilton, 1967). The CES-D assesses levels

of depressive symptomatology with higher scores indicating more symptoms. Persons with high-average scores are labeled “at risk of depression” or in need of treatment (Sawyer Radloff, 1971).

A commonly used self-report measure of anxiety is the State Trait Anxiety Inventory (STAI) (See Spielberger et al., 1970). State anxiety describes anxiety triggered by a situation, whereas trait anxiety reflects anxiety inherent within one’s personality (Spielberger, 1972). The STAI has 20 items that assess state anxiety and 20 items that assess trait anxiety. Anxiety symptoms are categorized into ranges (below average-above average) compared with normative data from the general population (Spielberger et al., 1970).

Examples of clinical interviews commonly used in the assessment of affective disorders include the structured clinical interview for the DSM-III (SCID: Spitzer, Williams & Gibbon, 1987), the Schedule for Affective Disorders and Schizophrenia (SADS: Endicott & Spitzer, 1978), and the Diagnostic Interview Schedule (DIS: Robins, Helzer, Croughan & Ratcliff, 1981).

Recent guidelines set forth by the American Heart Association (2008) indicate that patients with coronary heart disease should be routinely screened for depression across various settings, including cardiac rehabilitation programs, hospitals, doctors’ offices and clinics (Lichtman et al., 2008). Within research settings, it is noted that due to personnel or resource limitations, the administration of structured clinical interviews is not always feasible. Therefore, standardized self-report measures are often used in order to identify elevated depression and/or anxiety symptoms among cardiac patients who

may require referral to a mental health professional for further assessment (Young, 2001). One self-report measure that has been used commonly in the assessment of depression and anxiety symptoms is the Hospital Anxiety and Depression Scale (Zigmond & Snaith, 1983)

The Factor Structure of the HADS

Overall, reviews of the HADS generally conclude that it is a reliable, valid screening instrument for anxiety and depression in both diseased and non-diseased populations (Bjelland, Dahl, Tangen, Haug & Necklemann, 2002; Herrmann, 1997). However, there has been some concern regarding the underlying factor structure of the HADS. In particular, in recognizing that physical illness can impact mood, Zigmond and Snaith (1983) noted that the HADS items are intended to capture the psychic versus physical or somatic components of distress. However, Martin et al. (2003) have argued that the underlying factor structure of the HADS may be influenced by physical components of health and/or disease status. Specifically, distinct factor structures seem to emerge according to health presentation. For instance, a one-factor structure was identified in cancer patients (Razavi, Delvaux, Farvacques & Robaye, 1990), whereas three-factor structures have been identified in post MI patients (Martin et al., 2003) and persons suffering Major Depression (Friedman, Samuelian, Lancrenon, Even & Chiarelli, 2001). Furthermore, four-factor structures have been identified among patients with end-stage renal disease (Martin & Thompson, 1999) and five-factor structures have emerged with pregnant women (Karimova & Martin, 2003). Such discrepancies are noteworthy as they call into question the construct validity of the HADS (Martin et al., 2003).

Furthermore, although the majority of research supports a two-factor structure, there is increasing evidence that questions this assumption. For instance, when the factor structure of the HADS was reviewed by Bjelland et al. (2002), it was found that eleven studies ($N=14,588$) supported a two-factor structure, five studies ($N= 3459$) supported a three-factor structure, and two studies ($N= 235$) supported a four-factor structure.

The evidence for a three-factor structure in the HADS may in part be attributed to the work of Clark and Watson (1991) who outlined a tripartite model of anxiety and depression. According to this model, anxiety and depression possess both unique and shared features. Specifically, a unique feature of depression is the evidence of anhedonia (lack of interest or pleasure in life), whereas unique features of anxiety include hyperarousal and physiological tension. Common features of both anxiety and depression syndromes include characteristics of general affective distress, or negative affect (Clark & Watson, 1991). Therefore, it was argued that there is a tripartite structure of anxiety and depression that consists of anhedonia (specific to depression), physiological hyperarousal (specific to anxiety) and general distress (shared) (Clark & Watson, 1991). Although Clark and Watson's (1991) tripartite model suggests a single factor model, with the three correlated factors of autonomic anxiety, anhedonic depression and negative affectivity, other researchers (Clark, Steer & Beck 1994) have found that when evaluating the tripartite model, two first order factors (anxiety and depression) and one single higher order factor (negative affectivity) emerge. Essentially, it is argued that a hierarchical tripartite model exists whereby general distress causes autonomic anxiety and anhedonic depression (Clark et al., 1994).

Dunbar, Ford, Hunt and Der (2000) argued that it is possible to group the HADS items into the three conceptual categories outlined in the tripartite model (Clark & Watson, 1991) when using the HADS with the general population. In addition, other researchers have found that a three-factor structure emerges when employing the HADS with outpatients treated for major depression (Friedman et al., 2001). Furthermore, Martin et al. (2003) have argued that among post-MI patients, the underlying factor structure of the HADS is three-dimensional. This latter finding is of particular interest given that considerable variability in the factor structure of the HADS has been identified with cardiac patients including unidimensional (e.g., Johnston, Pollard and Hennessey, 2000), two-factor (e.g., Roberts et al., 2001) and three-factor structures (e.g., Martin et al., 2008; Martin et al., 2003).

The Factor Structure of the HADS with Cardiac Populations

There have been a handful of studies that have looked at the factor structure of the HADS in cardiac patients. For instance, Johnston et al. (2000) conducted a confirmatory factor analysis of the HADS in a longitudinal study of 108 MI patients. The results indicated that a two-factor structure was evident at the 2-month follow up. However, across the 1-year time frame, separation of anxiety and depression did not always occur. Therefore, it was argued that the HADS may be more appropriately used as a unidimensional measure of psychological distress with MI patients.

In another investigation, Roberts et al. (2001) looked at the factor structure of the HADS in a sample of 167 female cardiac patients (52% coronary artery bypass grafts

/CABGS; 48% acute myocardial infarction/AMI). A confirmatory factor analysis produced a two-factor solution of anxiety and depression. However, other researchers have identified a three- factor structure when using the HADS with post MI patients. In particular, Martin and Thompson (2000) found that all of the HADS-D items loaded onto one factor, suggesting a depressed affect factor, whereas two factors emerged with respect to the HADS-A. Specifically, items 3, 9, and 13 (“I get a sort of frightened feeling as if something awful is about to happen;” “I get a sort of frightened feeling like ‘butterflies’ in the stomach;” and “I get sudden feelings of panic”) loaded onto one factor. It was argued that these items seem to capture the fear and/or panic responses related to physiological arousal from anxiety. Accordingly, it was argued that perhaps this factor reflects components of “state anxiety” (i.e., anxiety triggered by the situation: Spielberger, 1972). Items 1, 5 and 11 (“I feel tense or ‘wound up’;” “Worrying thoughts go through my mind;” and “I feel restless as if I have to be on the move”) loaded onto another factor that seemed to be more representative of enduring and cognitive components of anxiety. Therefore, it was argued that this factor represented components of “trait anxiety” (i.e., anxiety inherent within one’s character: Spielberger, 1972) (Martin & Thompson, 2000).

Subsequent research with post MI patients has continued to support a 3-factor structure of the HADS. Specifically, Martin et al. (2003) performed a confirmatory factor analysis of the HADS with a sample of 335 post MI patients participating in a manualized CR program. Seven models were evaluated including Razavi et al.’s (1990) single factor model, the two-factor models of Zigmond and Snaith (1983) and Moorey et

al. (1991), the single order and hierarchical versions of Clark and Watson's (1991) tripartite model as studied by Dunbar et al. (2000), and the three-factor structure found by Friedman et al. (2001). The results revealed that the three-factor models of Dunbar et al., (2000) and Friedman et al. (2001) provided better fits and explanations of the data than all other models. Dunbar's (2000) hierarchical tripartite model provided the best fit at 1 week and 6 months, whereas Friedman et al.'s (2001) three-factor model provided the best fit at 6 weeks. Based on this, it was concluded that among post-MI patients, the underlying factor structure of the HADS is three-dimensional (Martin et al., 2003).

More recently, a cross-cultural examination of the HADS revealed that the Friedman et al (2001) model provided the best fit for a sample of German cardiac patients, whereas a Dunbar et al (2001) model provided the best fit for cardiac patients from Hong Kong and the United Kingdom (Martin et al., 2008). A three-factor structure of the HADS has also been supported with distinct groups of cardiac patients including Acute Coronary Syndrome (ACS) patients (Martin et al., 2004) as well as mixed groups of cardiac patients (e.g., coronary artery bypass graft; CABG, MI, unstable angina pectoris, and percutaneous transluminal coronary angioplasty) (Barth & Martin, 2005).

In summary, given that the HADS is being used quite commonly in cardiac patients (Roberts et al., 2001) and may be one of the preferred anxiety and depression screeners with this population (Hermann et al, 1998), it is essential to clearly elucidate its factor structure, relevance and utility as a screening instrument. Furthermore, in addition to establishing a valid screening tool for anxiety and depression with male and female cardiac patients, it is important to consider appropriate interventions. One intervention

that is showing promise in alleviating both depression and anxiety symptoms within cardiac populations is exercise.

Exercise Benefits for Cardiac Patients

There is increasing evidence to support the positive role of exercise for cardiac patients. In fact, several psychological and physiological benefits have been documented including reduced depression (Lett et al., 2005; Milani et al., 1996; Stern et al., 1983), reduced anxiety (Barr Taylor et al., 1986; Blanchard et al., 2002a; Lavie & Milani, 1995; Yoshida et al., 2001), improved quality of life; QOL (Dugmore et al., 1999; Marchionni et al., 2003; McConnell, Mandak, Sykes, Fesniak & Dasgupta, 2003), increased functional capacity (Belardinelli, Demetrios, Cianci & Pucaro 1999; Belardinelli et al., 2001; Schuler et al., 1992), increased exercise capacity (Haskell et al., 1994; Heldal, Sire & Dale, 2000; Lisspers et al., 1999; Marchionni et al., 2003; McConnell et al., 2003; Schuler et al., 1992, Yu, Sheung-Wai, Ho & Lau, 2003), improved endothelial functioning (Hambrecht et al., 2000), and improved cholesterol levels (Higgins et al., 2001; Taylor et al., 2004). Other notable benefits of exercise for CHD patients include reduced hospital admissions and/or doctor visits (Belardinelli et al., 1999; Belardinelli et al., 2001; Haskell et al., 1994; Marchionni et al., 2003) and earlier return to work (Dugmore et al., 1991; Higgins et al., 2001).

Of particular importance is the consistent and recurrent finding that exercise reduces the mortality rate in cardiac patients. In an early review of randomized trials in post MI patients, O'Connor et al. (1989) found that cardiac rehabilitation programs

incorporating an exercise component lead to a 20% reduction in mortality. More recently, Taylor et al. (2004) conducted a systematic review and meta-analysis of randomized controlled trials comparing usual care and exercise-based rehabilitation in patients with CHD. The review included exercise-only interventions and those that included exercise as one component of a more comprehensive rehabilitation program (i.e., exercise, psychological and education components). Based on 48 intervention trials (N = 8940), compared to usual care alone, exercise-based rehabilitation was related to significantly greater reductions in cardiac [OR= 0.74 (0.61-0.96)] and all cause mortality [OR= 0.80 (0.68-0.93)] (Taylor et al., 2004).

The mortality benefits of exercise for CAD patients (N = 7683) were also recognized in a recent Cochrane review that compared randomized controlled trials of exercise alone versus exercise within multicomponent/comprehensive CR programs (Jolliffe et al., 2005). Specifically, exercise-only interventions produced a 27% reduction in all cause mortality, with a slightly smaller reduction reported for the more comprehensive programs (Jolliffe et al., 2005).

In summary, numerous physical and psychological benefits of exercise have been identified for cardiac populations (Belardinelli et al., 1999; Belardinelli et al., 2001; Haskell et al., 1994; Marchionni et al., 2003; Jolliffe et al., 2005; Thompson et al., 2003; Lett et al., 2005; Milani et al., 1996; Stern et al., 1983; Barr Taylor et al., 1986; Blanchard et al., 2002a; Blanchard et al., 2002b; Lavie & Milani, 1995; Yoshida et al., 2001). Accordingly, exercise is both prescribed and recommended for cardiac patients

and appropriate guidelines have been put forth (See Smith et al., 2006). What follows is a review of the role of exercise on anxiety and depression in cardiac patients.

The Impact of Exercise on Anxiety and Depression in Cardiac Patients

In both past and recent literature reviews, researchers have acknowledged the positive impact of exercise on anxiety and depression in cardiac patients. For instance, Kugler et al., (1994) conducted a meta-analytical review of pre-post investigations examining the impact of exercise programs on anxiety and depression in coronary patients. Small-medium positive effect sizes were reported for anxiety ($d_{\text{mean}} = .3137$) and depression ($d_{\text{mean}} = .4569$) and it was concluded that exercise programs offer psychological benefits and should be considered as an adjunct treatment to therapy (Kugler et al., 1994). In a more recent review of non-pharmacological treatments for depression in CHD patients, exercise was highlighted as an important intervention for consideration as it has the potential to both reduce depressive symptoms and cardiovascular risk factors (Lett et al., 2005). For instance, in an uncontrolled investigation, Milani et al. (1996) looked at depressive symptoms in 338 patients after a major cardiac event. Elevated depressive symptoms were present in 20% of patients. All patients were assigned to 12 weeks of educational and exercise sessions. Upon program completion, there was a significant reduction in patients' depressive symptom prevalence with an overall reduction of 45%. In addition, reductions of 28% and 58% in patients evidencing moderate and severe depression scores were reported respectively (Milani et al., 1996).

A few controlled studies examining the impact of exercise on depressive and/or anxious symptoms in post MI patients have been conducted. For example, Barr-Taylor et al. (1986) examined the impact of different exercise conditions on depressive and anxious symptoms in post MI men. A sample of 210 patients were randomized to one of four conditions: 1) 3 week treadmill and home exercise training, 2) treadmill and medically supervised exercise training, 3) treadmill, no formal exercise training, and 4) control. The results revealed that 13% of the sample evidenced moderate to severe depressive symptoms. At 6-month follow-up, depressive symptoms were significantly improved in the gym training groups compared to the no-training group. Furthermore, the gym-training groups showed significantly reduced state and trait anxiety scores compared to controls.

Some investigations have highlighted that combined conditions of exercise and therapy can afford optimal mood benefits. For instance, Oldridge et al. (1991) studied 201 depressed or anxious post MI male patients and randomized them to either an exercise and cognitive behavioural therapy condition or standard care. At the end of 8 weeks, it was found that compared to controls, the treatment condition showed both significantly improved exercise tolerance and reduced anxiety symptoms. However, no significant differences emerged between groups in relation to depression (Oldridge et al., 1991).

Although therapy and antidepressants have been highlighted as standard methods in the treatment of depression, the mortality benefits of these interventions have not been supported (Lett et al., 2005). In particular, in one of the few randomized controlled trials

examining an empirically validated treatment for depression, the Enhancing Recovery in Coronary Heart Disease Patients (ENRICHD) trial contrasted cognitive behavioral therapy (and antidepressants where indicated) against usual care for CHD patients (ENRICHD, 2003). Although the intervention produced greater improvements in depressive scores than usual care, it was interesting to note that no significant differences emerged between groups in relation to mortality (ENRICHD, 2003). This finding is of importance as counseling alone may not afford the physical benefits associated with exercise. Accordingly, it has been argued that a combination of cognitive behavioral therapy and exercise might be the most appropriate intervention as both reductions in depression and improvements in physical health and mortality would be afforded (Lett et al., 2005).

At present, the American Heart Association recognizes cognitive behavioral therapy, exercise and antidepressant drugs as viable treatment options for depression in cardiac patients (Lichtman et al., 2008). Typically, combined approaches of exercise and counseling are found in CR programs. Moreover, investigations of CR programs frequently infer that such programs afford both physical and psychological benefits to both male and female cardiac patients such as improved depression and/or anxiety and quality of life (Blanchard et al., 2002a; Engeltson et al., 1999; Oldridge et al., 1991; Milani et al., 1996; Yoshida et al., 1999; Yoshida et al., 2001) and improved exercise and/or exercise tolerance levels (Oldridge et al., 1991; Yoshida et al., 1999; Yoshida et al., 2001). Therefore, it is concerning that gender discrepancies persist in both the affective

functioning and exercise participation of cardiac patients- factors that will be discussed in the next section.

Gender Differences in the Affective Functioning and Exercise Behaviour and Adherence of Cardiac Patients

Studies and reviews of cardiac patients have consistently highlighted that women experience greater anxiety and/or depression symptoms than men (Grace et al., 2002a; Grace et al., 2002b). In addition, gender discrepancies in exercise participation have been identified as a significant concern, with women participating significantly less than their male counterparts (Halm, Penque, Doll & Beahrs, 1999; Schuster & Waldron, 1991). Canadian researchers have noted that gender differences in the affective functioning and/or exercise behaviour of cardiac patients are salient issues, both for CR participants and non-participants (Grace et al., 2005; Reid et al., 2006). For instance, in a recent longitudinal investigation, it was found that women who attended CR were significantly more depressed than men and that depressed patients participated in significantly less CR exercise components compared to non-depressed patients (Grace et al., 2005). In another recent longitudinal investigation, it was found that women non-CR participants had significantly lower exercise rates compared to their male counterparts (Reid et al., 2006). Findings from both American and Canadian data also suggest that 70-80% of eligible participants do not participate in CR programs (Morbidity and Mortality Weekly Report: MMMR, 2001; Armstrong et al., 1994), and dropout rates have been reported to range anywhere from approximately 10% (e.g., Schuster & Waldron, 1991) up to 36% (Balady

et al., 1996). Furthermore, men have significantly higher CR program completion and attendance compared to women (Halm et al., 1999; Schuster & Waldron, 1991).

Researchers have highlighted several potential barriers to CR participation including, resources, motivational factors, program location and access, and a lack of physician referrals, particularly for women and elderly persons (Giannuzzi et al., 2003). Poor referral rates have been noted by Canadian investigators. For example, Grace et al (2002b) found that among 906 coronary patients, only 28.3% were referred to CR programs by physicians. Moreover, compared to women, men were 1.187 times more likely to be referred (95% CI. 1.056-1.334) (Grace et al., 2002b). In addition to poor referral rates, it is noted that female cardiac patients often experience multiple stressors (e.g., marital stress, work stress) that contribute significant threats to their cardiovascular and mental health (Orth-Gomér & Leineweber, 2005). Accordingly, it is plausible that the presence of multiple stressors would potentially perpetuate women's anxiety and/or depression as well as impede exercise and/or CR participation. In addition, it is possible that in part, the gender discrepancy in cardiac patients' symptom prevalence is attributable to differences in men and women's coping styles in response to their anxiety and/or depression. For example, according to Nolen-Hoeksema's (1991) response styles theory, women are more likely than men to engage in ruminative coping responses (i.e., passive and repetitive focus on symptoms, meanings and consequences of distress), whereas men are more likely than women to engage in distracting coping responses (e.g., exercise, socializing). Consequently, women may experience increased depressive

symptomatology and prolonged depression, whereas men may experience reduced depressive symptomatology and duration (Noelen-Hoeksema, 1991).

When using exercise as an example of a coping response to depression, it is possible that this behavior mediates the relationship between gender and depressive symptoms. Specifically, it is possible that exercise is the variable directly responsible for reducing depressive symptoms and duration. Consequently, the gender differences in depression may be explained by the fact that men are exercising and women are not exercising.

Evidently, there are multiple factors that may contribute to the gender discrepancies in cardiac patients affective functioning and exercise behaviour. Unfortunately, with reduced exercise behaviour, female cardiac patients may not be acquiring the same mortality and psychological benefits from exercise as their male counterparts. Therefore, further exploration of factors that are contributing to the pronounced gender differences in cardiac patients' affective functioning and exercise behaviour appear warranted.

Overview of Studies

Given that anxiety and depression are often prevalent in cardiac patients, the need for both appropriate screening tools and interventions has been highlighted (Lichtman et al., 2008; Januzzi et al., 2000). Fortunately, the Hospital Anxiety and Depression Scale (HADS: Zigmond & Snaith, 1983) has been recognized as an appropriate screening measure of anxiety and depression in cardiac patients (Martin & Thompson, 2000; Martin

et al., 2003; Roberts et al., 2001). Also, there is a significant body of literature that has identified exercise as an effective intervention for anxiety and depressive symptoms in cardiac populations (Barr Taylor et al., 1986; Blanchard et al., 2002a; Lett et al., 2005; Milani et al., 1996; Stern et al., 1983).

Despite these encouraging findings, some limitations are present. In particular, the factor structure of the HADS has come into question, with recent investigations demonstrating that three-factor, as opposed to two-factor structures emerge with cardiac patients (Martin et al., 2008, Barth & Martin, 2005). However, the stability of the HADS factor structure has been examined for very limited time periods (e.g., within one week and/or up to 6-month follow-up) with distinct cardiac populations (e.g., ACS or MI patients) (See Martin et al., 2003; Martin et al., 2004). Although more recent studies have included mixed groups of cardiac patients (See Barth & Martin, 2005; Martin et al., 2008), the factorial stability of the HADS was only examined at one time point (e.g., within one week). Therefore, it is not clear whether different structures emerge using a representative sample of cardiac patients (i.e., CABG, MI and percutaneous coronary intervention; i.e., PCI patients) over an extended time frame (e.g., > 6 months). In addition, it is only recently that investigators have started to address the issues of measurement equivalence, alternately referred to as “measurement invariance” (Vandenberg & Lance, 2000) when employing the HADS with cardiac patients. Measurement invariance is an important issue to address as there may be cultural, gender or other individual differences that prevent cardiac patients from approaching and/or responding to the HADS in a similar manner. Recently, Martin et al (2008) found that the

HADS is variant, or non-equivalent in terms of measurement characteristics (e.g., factor covariances, measurement weights and residuals) with cardiac patients from different countries. Although this is an interesting finding, further research is needed to determine what specific factors, if any, are creating discrepancies in cardiac patients responses to the HADS. For example, the issue of gender invariance has yet to be examined. This is surprising given that women show greater anxiety and depression levels compared to men (Cardiac Care Network of Ontario, 2002; Frasure-Smith et al., 1999; King, 2001).

Additionally, reviews of the HADS have found that women tend to score higher on HADS anxiety items than men (Hermann, 1997). Consequently, assessment of gender differences in HADS anxiety responding would seem particularly important given that it is the HADS anxiety scale that becomes divided within the tripartite factor models, which have demonstrated relevance with cardiac populations (Martin et al., 2003; Martin et al., 2008).

Furthermore, although researchers have looked at affective changes in cardiac patients for both men and women, efforts to explain the changes have been rather limited, particularly in relation to exercise behavior (Blanchard et al., 2002a). To date, gender-based exercise discrepancies and their respective impacts on anxiety and depression have at times either not been considered (e.g., Milani et al., 1996) and have not been feasible due to the very few number of women (e.g. Yoshida et al., 1999; Yoshida et al, 2001), or the outright exclusion of female cardiac patients (e.g., Barr Taylor et al., 1986; Oldridge et al., 1991). In addition, investigations have often focused solely on MI patients (Barr-Taylor et al., 1986; Oldridge et al., 1991; Stern, 1983; Yoshida et al., 2001). However,

exercise has been linked to reduced anxiety and depression in CABG patients (O'Rourke, Lewin, Whitecross & Pacey, 1990) and improved psychological functioning in PCI patients (Higgins et al., 2001). Furthermore, sample sizes have tended to be small (e.g., 106-210 patients) (Barr-Taylor et al., 1986; Oldridge et al., 1991; Stern et al., 1983) and short follow-up periods (i.e., 10 weeks-6 months) have frequently been reported in investigations that have examined anxiety and/or depressive symptoms in relation to exercise behavior (i.e., Blanchard 2002a; Engebretson et al., 1999; Yoshida et al., 1999). Therefore, it is unclear as to how exercise impacts male and female cardiac patients' affective experiences over an extended period of time (e.g., > 1 year).

It is also worth noting that previous researchers (e.g. Grace et al., 2005) have typically focused on absolute (i.e., measured at a given point in time) levels of exercise and affective variables across time (e.g., baseline depression was used to predict exercise participation at 1 year). Although this approach is important, given that both cardiac patients' exercise behaviour (Balady et al., 1996; Halm et al., 1999; Schuster & Waldron, 1991) and affective symptoms (Frasure-Smith et al., 1999) can vary considerably across time, particularly among women, it is important to examine whether a change in exercise behaviour is significantly related to the change in anxiety and/or depression over an extended period of time (i.e., > 1 year) for both male and female cardiac patients. Importantly, this has yet to be investigated.

Given the strong evidence of gender differences in the affective and exercise outcomes of cardiac patients (See Grace et al., 2005, Reid et al., 2006), it is appropriate to consider gender as a moderator of the exercise/affective relationship. Although this

approach is important, and speaks to the strength of the relationship between the variables, it does not address whether differences in exercise levels explain the differences in affect from a gendered perspective. To do so, one must determine whether exercise mediates the gender/changes in affect relationship (Baron & Kenny, 1986). For example, a moderation analysis may show that exercise has a large effect on autonomic anxiety for women, but not for men, whereas the opposite may be true for negative affect, even though both genders have similar scores for both variables. In this case, a gender appropriate intervention would be tailored to target autonomic anxiety in women and negative affect in men to increase exercise levels in both groups. However, a mediation analysis may show that women may engage in significantly less exercise than men because they have significantly higher autonomic anxiety. In this case, an intervention may be designed to decrease the anxiety in women with the intent of reducing the gender disparity in exercise.

Evidently, further examination of gender-based exercise discrepancies and their respective impacts on male and female cardiac patients' affective functioning could potentially inform interventions. However, within cardiac populations, studies have yet to determine whether exercise has similar effects on men and women's anxiety and depression (i.e., does gender moderate the exercise/affective relationships?). Similarly, it is unclear whether cardiac patients' exercise behavior explains the gender difference in men and women's anxiety and depression (i.e., does exercise mediate the gender/affective relationships?).

Currently, among cardiac patients, there is an apparent need to 1) address measurement concerns related to the factor structure of the HADS, and 2) further explore of the roles of exercise and gender in relation to anxiety and depression. Accordingly, two studies were outlined.

Objectives

The first investigation was intended to 1) examine the factor structure of the HADS in a diverse sample of cardiac patients across two years, and 2) test measurement invariance between genders. Based on previous research with cardiac patients (Martin et al., 2008; Martin et al., 2003), it was hypothesized that compared to unidimensional and two-factor structures, a three-factor structure of the HADS would emerge and provide the best model fit to the data at baseline, 6, 12 and 24-months. Given that gender invariance has not been examined previously in research with the HADS among cardiac patients, null hypotheses were assumed. Therefore, it was hypothesized that no gender differences would emerge with respect to the factor structure of the HADS at baseline, 6, 12 and 24-months.

The second study was designed to examine the symptoms of autonomic anxiety, negative affect and depression of cardiac patients across two years. Based on previous research (Cardiac Care Network of Ontario, 2002; Frasure-Smith et al., 1995; Frasure-Smith et al., 1999; Grace et al., 2002a; Grace et al., 2002b), it was hypothesized that compared to male patients, female patients would report significantly more autonomic anxiety, negative affect and depression at baseline, 6, 12 and 24-months.

Another purpose was to examine whether a) gender moderated the exercise/affective relationship in cardiac patients across two years using absolute values and b) whether changes in exercise were moderated by the gender/changes in affectivity relationship (i.e., changes in psychological distress for men and women) in cardiac patients over two years. Based on previous research (Cardiac Care Network of Ontario, 2002; Frasure-Smith et al., 1995; Frasure-Smith et al., 1999; Grace et al., 2002a; Grace et al., 2002b, Grace et al., 2005; Reid et al., 2006), it was hypothesized that the exercise/affective relationship would be significantly stronger for men than women when using both absolute and change scores at all time intervals.

The final objective was to examine whether a) exercise mediated the gender/affective relationship in cardiac patients across two years, and b) whether changes in exercise mediated the gender/ changes in affectivity relationship (i.e., changes in anxiety and depression for men and women) in cardiac patients across two years. When using the absolute values, it was hypothesized that compared to female patients, male patients would report significantly more exercise, which in turn, would lead to reduced autonomic anxiety, negative affect and depression at all time points. When using change values, it was hypothesized that compared to male patients, female patients would have a significantly greater change in their exercise behavior (i.e., more exercise), which would be associated with a significantly greater change in affective functioning (i.e., reductions in autonomic anxiety, negative affect, and depression) between 6, 12 and 24-months.

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Study 1:

A psychometric evaluation of the Hospital Anxiety and Depression Scale
in cardiac patients: Addressing factor structure and gender invariance.

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Introduction

Cardiovascular disease (CVD) is a serious public health issue. It is the primary cause of death in most western countries (Gianuzzi et al., 2003) and costs the Canadian economy approximately 18.5 billion dollars per year (Health Canada, 2005a). Not only is CVD associated with increased mortality risk, but it is also linked with other disability and illness (Public Health Agency of Canada, 2006) including mental health problems.

Anxiety and depression symptoms are salient issues for both male and female cardiac patients (Cardiac Care Network of Ontario, 2002). However, increased affective disturbance is more often present in women. In fact, several investigations have found that female cardiac patients tend to have both higher depression and anxiety scores than male cardiac patients (Cardiac Care Network of Ontario, 2002; Frasure-Smith et al., 1995; Frasure-Smith et al., 1999; Grace et al., 2002a; Grace et al., 2002b). Such findings are concerning given that elevated anxiety symptoms have been associated with an increased risk of recurrent cardiac events (Denollet & Brutsaert, 1998; Frasure-Smith et al., 1995; Moser & Dracup, 1996; Strik et al., 2003), while elevated depression scores have been associated with increased mortality risk among patients with coronary heart disease (Barth, Schumacher & Hermann-Lingen, 2004; Carney et al., 2004; Van Melle et al., 2004).

Given that anxiety and depression are often prevalent in cardiac patients, the need for both appropriate screening tools and interventions has been highlighted (Januzzi et al., 2000). One screening tool that has been increasingly used with cardiac patients is the Hospital Anxiety and Depression Scale (HADS: Zigmond & Snaith, 1983). Reviews of the HADS typically indicate that it is a reliable and valid screening instrument for anxiety and depression in both diseased and non-diseased populations (Bjelland et al., 2002; Hermann, 1997). However, there has been some debate regarding the underlying factor structure of the HADS. Specifically, although a two-factor structure (e.g., anxiety and depression) is supported among most populations (Bjelland et al., 2002; Hermann 1997), it has been argued that a three-factor structure is more appropriate with cardiac populations (Martin et al., 2003; Martin, Thompson & Chan, 2004; Barth & Martin, 2005; Martin, Thompson & Barth, 2008), persons with major depression (Friedman et al., 2001) and even the general population (Dunbar et al., 2000).

The evidence for a three-factor structure in the HADS may in part be attributed to the work of Clark and Watson (1991) who outlined a tripartite model of anxiety and depression. According to this model, anxiety and depression possess both unique and shared features. Specifically, a unique feature of depression is the evidence of anhedonia (lack of interest or pleasure in life), whereas unique features of anxiety include hyperarousal and physiological tension. Building on this idea, some researchers (Friedman et al., 2001) have proposed a three-factor solution to the HADS characterized by psychic anxiety (e.g., worrying thoughts/feelings), psychomotor agitation (e.g., physical tension) and depression (Friedman et al., 2001). However, within the tripartite

model, it is noted that common features of both anxiety and depression syndromes include characteristics of general affective distress, or negative affect (Clark & Watson, 1991). Therefore, it is argued that there is a tripartite structure of anxiety and depression that consists of anhedonia (specific to depression), physiological hyperarousal (specific to anxiety) and general distress (shared) (Clark & Watson, 1991). Although Clark and Watson's (1991) tripartite model suggests a single factor model, with the three correlated factors of autonomic anxiety (i.e., physiological hyperarousal), anhedonic depression and negative affectivity, other researchers (Clark et al., 1994) have found that when evaluating the tripartite model, two first order factors (anxiety and depression) and one single higher order factor (negative affectivity) emerge. Essentially, it is argued that a hierarchical tripartite model exists whereby general distress causes autonomic anxiety, and anhedonic depression (Clark et al., 1994).

To date, considerable variability in the factor structure of the HADS has been identified with cardiac patients including unidimensional (e.g., Johnston et al., 2000), two-factor (e.g., Roberts et al., 2001) and three factor structures (e.g., Martin et al., 2003; Martin et al., 2004; Barth & Martin, 2005; Martin et al., 2008). However, there is accumulating evidence to support a three-factor structure of the HADS among cardiac patients. Specifically, Martin et al. (2003) performed a confirmatory factor analysis of the HADS with a sample of 335 myocardial infarction (MI) patients participating in a manualized cardiac rehabilitation (CR) program. Seven models (See Table 1) were evaluated including Razavi et al.'s (1990) single factor model, the two-factor models of Zigmond and Snaith (1983) and Moorey et al. (1991), the single order and hierarchical

versions of Clark and Watson's (1991) tripartite model as studied by Dunbar et al. (2000), and the three-factor structure found by Friedman et al. (2001). Selection criteria for the models included both a clearly reported factor extraction procedure and a precise factor structure with clinical relevance (Martin et al., 2003). The results revealed that the three-factor models of Dunbar et al. (2000) and Friedman et al. (2001) provided better fits and explanations of the data than all other models across six months.

More recently, a cross-cultural examination of the HADS revealed that the Friedman et al (2001) model provided the best fit for a sample of German cardiac patients, whereas a Dunbar et al (2000) model provided the best fit for cardiac patients from Hong Kong and the United Kingdom (Martin et al., 2008). A three-factor structure of the HADS has also been supported with distinct groups of cardiac patients including MI patients (Martin et al., 2003), Acute Coronary Syndrome (ACS) patients (Martin et al., 2004) as well as mixed groups of cardiac patients (e.g., coronary artery bypass graft; CABG, MI, unstable angina pectoris, and percutaneous transluminal coronary angioplasty) (Barth & Martin, 2005).

Despite these interesting findings, and researchers' efforts to examine the factor structure of the HADS with cardiac populations, some noteworthy limitations are present. In particular, the stability of the HADS factor structure has been examined for very limited time periods (e.g., within one week and/or up to 6-month follow-up) with distinct cardiac populations (e.g., ACS or MI patients) (See Martin et al., 2003; Martin et al., 2004). Although more recent studies have included mixed groups of cardiac patients (See Barth & Martin, 2005; Martin et al., 2008), the factorial stability of the HADS was only

examined at one time point (e.g., within one week). Therefore, it is not clear whether different structures emerge using a representative sample of cardiac patients (i.e., (i.e., CABG, MI and percutaneous coronary intervention; i.e., PCI patients) over an extended time frame (e.g., > 6 months). In addition, it is only recently that investigators have started to address the issues of measurement equivalence, alternately referred to as “measurement invariance” (Vandenberg & Lance, 2000) when employing the HADS with cardiac patients. Measurement invariance is an important issue to address as there may be cultural, gender or other individual differences that prevent cardiac patients from approaching and/or responding to the HADS in a similar manner. Recently, Martin et al (2008) found that the HADS is variant, or non-equivalent in terms of measurement characteristics (e.g., factor covariances, measurement weights and residuals) with cardiac patients from different countries. Although this is an interesting finding, further research is needed to determine what specific factors, if any, are creating discrepancies in cardiac patients responses to the HADS. For example, the issue of gender invariance has yet to be examined. This is surprising given that women show greater anxiety and depression levels compared to men (Cardiac Care Network of Ontario, 2002; Frasure-Smith et al., 1999; King, 2001). Additionally, reviews of the HADS have found that women tend to score higher on HADS anxiety items than men (Hermann, 1997). Consequently, assessment of gender differences in HADS anxiety responding would seem particularly important given that it is the HADS anxiety scale that becomes divided within the tripartite factor models, which have demonstrated relevance with cardiac populations (Martin et al., 2003; Martin et al., 2008).

Accordingly, the present investigation was intended to 1) examine the factor structure of the HADS in a diverse sample of cardiac patients across two years, and 2) test measurement invariance between genders. Based on previous research with cardiac patients (Martin & Thompson, 2000; Martin et al., 2003), it was hypothesized that compared to unidimensional and two-factor structures, a three-factor structure of the HADS would emerge and provide the best model fit to the data at baseline, 6, 12 and 24-months. Given that gender invariance has not been examined previously in research with the HADS among cardiac patients, null hypotheses were assumed. Therefore, it was hypothesized that no gender differences would emerge with respect to the factor structure of the HADS at baseline, 6, 12 and 24-months.

Methods

Participants

Participants were drawn from the Tracking Exercise After Cardiac Hospitalization (TEACH) trial (Reid et al., 2006), which was a prospective study designed to examine exercise patterns and predictors in coronary patients. Between May 2002 and December 2003, 1433 patients were approached and 826 (57.6%) agreed to participate. Participants were comprised of 308 PCI, 302 AMI and 216 CABG patients. During the course of the study, 25 patients (3.0%) died and 68 patients (8.4%) were re-hospitalized with a new cardiac event (AMI, PCI or CABG), but were retained in the analyses. The final sample consisted of 801 cardiac patients (604 male / 197 female).

Procedures

Patients were recruited to participate from three cardiac centers in Ottawa (two sites) and Kingston (one site), Canada. Ethical approval was obtained from the Research Ethics Committee at each site. Participants were between the ages of 20 and 85 years, and had been hospitalized for acute myocardial infarction (AMI), PCI, or CABG.

Participants were recruited in-hospital by a study coordinator at each site and all participants provided written informed consent. Patients completed a baseline psychosocial questionnaire that included demographic and affective scales. After hospital discharge, the psychosocial questionnaire was mailed two weeks in advance of the three time points (6, 12 and 24- months) that included a stamped envelope to return the questionnaire within one week of receiving it.

Measures

Demographic characteristics

Demographic characteristics included self-reported gender, age, ethnicity, employment status, marital status, and education. Age was categorized as 65 years or less or over 65 years, as frequently reported in exercise training with cardiac patients (Fletcher et al., 2001). Education was categorized as 13 years or less, equivalent to secondary school graduation or less in Ontario, or more than 13 years, indicating some post-secondary education. The reason for hospitalization was obtained from the hospital chart and categorized as AMI, PCI or CABG. When participants fell into two or more categories (e.g., PCI following AMI), they were classified according to the

event/procedure with the greatest impact on physical activity levels post-hospitalization (CABG > AMI > PCI), determined from a preliminary analysis (See Reid et al., 2006).

Anxiety and depression

Anxiety and depression were measured via the HADS (Zigmond & Snaith, 1983). The HADS contains 7 anxiety items and 7 depression items (See Table 2), each of which are rated on 4-point scales with different verbal anchors depending on the particular item. The 7 respective items are summed to form each subscale and both subscales can be summed to form the HADS-Total score. The HADS has been frequently employed with cardiac populations (Martin & Thompson, 2000; Martin et al., 2003; Roberts et al., 2001).

Results

Characteristics of the Participants and HADS Subscales

Characteristics of the participants are shown in Table 3. Participants consisted of 604 men ($\bar{X}$ age = 60.95, SD = 9.97) and 197 women ($\bar{X}$ age = 62.57, SD = 10.15). Mean scores and standard deviations of participants' ratings on the HADS subscales are shown in Table 4. All HADS subscales had Cronbach's alpha's > .70 (range = .70 -.90) with the exception of the Friedman et al (2001) psychomotor agitation subscale at all time points for women (range = .62 - .69) and at baseline and 24-months for men (α = .62 and .68 respectively).

Main Analyses

The assumptions for univariate and multivariate normality were assessed and met. Structural equation models (SEM) were estimated with maximum likelihood procedures

using LISREL 8.8 (Jöreskog & Sörbom, 2006). For latent variable identification, the loading for each concept's first indicator was pre-set to 1.0 in the model to create a metric scale. Multiple goodness of fit tests were used to evaluate the models including the chi-square goodness of fit test (χ^2), the comparative fit index (CFI), the normed fit index (NFI), and the root mean squared error of approximation (RMSEA). The χ^2 can be used for both model comparison and the evaluation of model fit (Bentler & Bonett, 1980). However, it is cautioned that the χ^2 can be quite sensitive to sample size and small data departures from normality (Werts et al., 1985). In terms of good fitting models, it is suggested that the χ^2 value should be low relative to the degrees of freedom (Werts et al., 1985), the CFI value should be > 0.94 (Hu & Bentler, 1999), and the NFI value should be $> .90$ (Tabachnick & Fidell, 2001). It is also noted that the RMSEA values of $< .06$ reflect a good fitting model (Hu & Bentler, 1999) and that values up to $.08$ are acceptable (Vandenberg & Lance, 2000), whereas RMSEA values $> .10$ suggest a poor fitting model (Browne & Cudeck, 1993). It is recommended that several fit indices be consulted to determine the adequacy of model fit (Tabachnick & Fidell, 2001).

Purpose One

A confirmatory factor analysis was performed to support or refute the finding that a three-factor structure of the HADS would emerge and provide the best model fit at baseline, six, 12 and 24-months among cardiac patients. Seven models of the HADS outlined in past research were assessed including the single factor model found by Razavi et al. (1990), the two-factor model originally described by Zigmond and Snaith (1983), the two-factor model detailed by Moorey et al. (1991), two versions of Clark and

Watson's (1991) three-factor model as studied by Dunbar et al (2002) and two versions of Friedman et al.'s (2001) three-factor model (See Table 1).

The factor models and fit indices are displayed in Table 5. Examination of the χ^2 , CFI, NFI and RMSEA across all time intervals reveals that the top three performing models were Dunbar et al.'s (2000) three-factor, correlated, hierarchical model, Dunbar et al.'s (2000) three-factor, uncorrelated, hierarchical model and Friedman et al.'s (2001) three-factor, correlated model.

The factor loadings, construct reliabilities and variances extracted for the top three performing models were examined. In evaluating model performance, it is suggested that factor loadings exceed a minimum .50 cut-point (Ford et al., 1986) construct reliabilities be $\geq .70$ and variance extracted be $> .50$ (Garson, 2007). Based on these criteria, the best performing model for male and female cardiac patients was the Dunbar et al. (2000) hierarchical, correlated model. With regard to variance extracted, the results revealed that the autonomic anxiety subscale was $> .50$ across time, with one exception for the women at 12 months. The negative affect and depression subscales fell slightly short of the cutoff with the exception of the depression subscale for women at 24-months. The factor loadings and construct reliabilities for men and women are displayed in Tables 6-7. For brevity purposes, only the results of the top performing model are included. However, it should be noted that a factor analysis of the HADS scores averaged across the four time points provided further support for a three-factor solution, with the best model fits offered by the Dunbar et al (2001) models, followed by the Friedman et al (2001) correlated model.

In summary, the results suggest that the three-factor solutions to the HADS (e.g., Dunbar et al. 2001 models, Friedman et al 2001, correlated model) emerged consistently to provide the best model fits at baseline, 6, 12 and 24-months among cardiac patients. When various psychometric factors are considered (e.g., fit indices, factor loadings, construct reliabilities and variance extracted) the best performing model across time for male and female cardiac patients appeared to be the Dunbar et al. (2000) hierarchical, correlated model. The present results provide further support for both the presence and persistence of a three-factor structure of the HADS among cardiac patients.

Purpose Two

The second set of analyses examined whether or not the measurement and structural level of the HADS was invariant by gender in the baseline, six-month, twelve-month, and twenty-four-month samples. To do so, the procedure outlined by Byrne, Shavelson, and Muthen (1989) was utilized. The first step tested an unconstrained model to obtain the baseline measurements and error variances for comparison purposes. The second model constrained the factor loadings to be invariant between the male and female cardiac patients. The third model constrained the factor loadings and/or factor covariances to be invariant. The fourth model constrained the factor loadings, factor covariances and/or factor variances and the fifth model constrained these parameters in addition to the error variances. At each stage, models were considered to be invariant based upon a non-significant change in the χ^2 and lack of change in the CFI. Cheung and Rensvold (2002) suggest a change $> .01$ in the CFI is recommended to reject the invariant null hypothesis. Therefore, if the change in χ^2 was significant within the samples, the

models were still considered invariant if the change in the CFI did not exceed .01. The results revealed that across all models and all time points, there was no CFI change $> .01$. In summary, the results suggest that the seven tested HADS models are invariant by gender in the baseline, six-month, 12-month and 24-month samples.

Discussion

The purpose of the present study was to 1) examine the factor structure of the HADS in a diverse sample of cardiac patients across two years, which is 18 months longer than the typical time period, and 2) test measurement invariance in the HADS between genders, which has never been done. With regard to the first purpose, the results revealed that across all time points, the three-factor models of Dunbar et al. (2000) and the Friedman et al. (2001) correlated model were the best performing models of all the models tested. The results are consistent with the hypotheses and previous research of Martin et al. (2008; 2004; 2003) and Barth and Martin (2005) who also found that a three-factor structure of the HADS emerged among cardiac patients. Although the Dunbar et al. (2000), hierarchical, uncorrelated model performed the best at baseline, similar to the findings of Martin et al. (2003), the best fitting model at six-months was offered by the Dunbar et al. (2000) hierarchical, correlated model. Additionally, the present investigation demonstrated that the Dunbar et al., (2000) hierarchical, correlated model was also the best fitting model at 12-months, and arguably at 24-months where although it had a higher χ^2 than the opposing Dunbar et al (2000) model (641.2 vs. 557.9), and a problem with the factor loading of item 12 at 24-months (See Table 7), it had a better RMSEA value (e.g., .09 vs. .10). Consistent with the findings of Martin et al

(2008), low factor loadings were observed for items 7 “I can sit at ease and feel relaxed” and 11 “I feel restless, as if I have to be on the move”. Martin et al (2008) argued that the latter item is difficult to justify as a negative affect item according to Clark and Watson’s (1991) original conceptualization of this construct. In fact, it could be argued that both items 7 and 11 better characterize components of psychomotor agitation or restlessness as opposed to negative affect.

In addition to fit indices, the models were also evaluated with respect to factor loadings, construct reliabilities and variance extracted. Among the top three performing models, there seemed to be some problems with Friedman et al. (2001) correlated model with regard to the factor loadings of items 7 and 12 where the standardized coefficients fell outside of acceptable range (e.g., > 1.00). Furthermore, initial analyses highlighted some concerns in terms of the internal reliability of the psychomotor agitation subscale (e.g., α ’s = $< .70$), particularly with women. This latter finding is consistent that of Martin et al. (2003) who found that the internal reliability of the psychomotor agitation subscale was $< .70$ at 1-week and 6-week time intervals. However, whereas Martin et al (2003) found that the subscale had sufficient internal reliability at 6 months, the present results suggest that the subscale remains unstable across a 24-month period with women, but has acceptable internal reliability at 6 and 12 months with men. Future studies might consider revision of this subscale in order to improve its reliability with both genders.

With regard to the correlated and uncorrelated hierarchical versions of the Dunbar et al (2000) models, both performed very similarly in terms of the factor loadings, construct reliabilities and variance extracted. This is not surprising given that models are

essentially identical with the exception of that one model permits anxiety and depression to correlate, whereas the other restricts this correlation. Conceptually, an argument could be made in favor of the correlated version of the Dunbar et al (2000) model as it is noted that depression and anxiety disorders are often comorbid and that symptoms frequently overlap (Gorman, 1996/1997). Moreover, a correlated model that shows the relationship between autonomic anxiety and anhedonic depression is potentially useful for distinguishing between comorbid anxiety and depression (e.g. high levels of autonomic anxiety and anhedonia) versus mixed anxiety and depression (e.g., low levels of autonomic anxiety and anhedonia) (Clark et al., 1994; Joiner & Blalock, 1995). Clinically, from both a screening and assessment standpoint, it is important to distinguish between different symptom presentations of anxiety, depression, mixed anxiety and depression, and comorbid anxiety and depression, and the tripartite model is useful for making these distinctions (Joiner & Blalock, 1995; Teachman et al., 2007). Moreover, in the context of applying the HADS with cardiac patients, the tripartite model could potentially serve as a relevant screening tool to both identify and distinguish between various symptom presentations. In addition, rather than using separate symptom screening measures for autonomic anxiety, anhedonic depression and negative affect with cardiac patients, the HADS affords a combined approach that facilitates assessment of the tripartite structures.

Interestingly, the best performing subscale within the Dunbar et al. (2000) models was frequently the autonomic anxiety subscale. This is noteworthy given that it comprises only three items (e.g., 3, 9, 13; “I get a sort of frightened feeling as if

something awful is about to happen;” “I get a sort of frightened feeling like ‘butterflies’ in the stomach;” and “I get sudden feelings of panic”). Consistent with the findings of Martin and Thompson (2000), the results suggest that when using the HADS with cardiac patients, there is a distinct facet that captures the fear and/or panic responses related to physiological hyperarousal from anxiety. Previous research shows that the autonomic anxiety construct is relevant and valid with various adult populations (e.g., psychotherapy outpatients, undergraduates, air force cadets) (Joiner Jr. et al., 1999). Moreover, the autonomic anxiety construct has demonstrated clinical relevance in that it differentiates Panic Disordered patients from patients with Generalized Anxiety Disorder (GAD) and depression (Joiner Jr. et al., 1999). Given that anxiety has been identified as an important, yet understudied variable among cardiac patients (Lane et al., 2003) future investigations should consider the predictive validity and relevance of the HADS autonomic anxiety subscale with respect to diagnostic distinctions (e.g., panic disorder vs. GAD) and clinical outcomes (e.g., rates of mortality, morbidity etc.).

Overall, examination of the psychometric integrity of the top performing scales showed that the Dunbar et al (2000) models outperformed that of Friedman et al. (2001), and that generally, the Dunbar et al (2000) hierarchical, correlated model provided the most statistically sound version of the HADS with cardiac patients across 24-months. To date, research with the tripartite model indicates that the structure of negative affect, autonomic anxiety and anhedonic depression is similar amongst adults. Indeed, the tripartite model has demonstrated relative invariance among diverse adult samples including clinical and non-clinical samples and persons aged 18- 93 (Teachman et al.,

2007; Joiner Jr. et al., 1999). Moreover, the results of the present investigation support the relevance of the tripartite model with both male and female cardiac patients when employing the HADS.

Regarding the second purpose, results showed that the seven tested HADS models were invariant by gender across baseline, six-month, 12-month and 24-month samples; thereby supporting the null hypothesis. Interestingly, invariance between genders persisted regardless of the factor structure tested (e.g., uni-dimensional, two-dimensional, three-factor) suggesting that both male and female cardiac patients approach and respond to the HADS items in a similar manner. This is an encouraging finding as the HADS appear to afford a gender-impartial assessment of anxiety and depression symptoms with this population. However, the fact remains that female cardiac patients have higher rates of anxiety and depression compared to male cardiac patients (Cardiac Care Network of Ontario, 2002; Frasure-Smith et al., 1999; King, 2001). Therefore, although this discrepancy does not appear to be attributable to measurement variance when using the HADS scale, it is important to consider why the gender differential in anxiety and depression persists. Although a comprehensive review is beyond the scope of this paper, it is useful to recognize gender as a multidimensional construct when evaluating gender differences in health. Indeed, it is widely acknowledged that multiple factors impact men and women's physical and mental health besides biological sex (Davidson et al., 2006; Doyal, 2001). Accordingly, there are various approaches to studying gender differences in health including biological, psychological, social and cultural levels (Davidson et al., 2006). At the biological level of health, gender differences are often evaluated with

regard to reproductive components, and various genetic, metabolic and hormonal factors (Doyal, 2001). At the psychological level of health, gender differences have frequently been examined in relation to personality, social support and coping skills. Finally, at the social and cultural levels, gender differences have been studied in relation to health attitudes, values and behaviors (Davidson et al., 2006).

Evidently, there are multiple ways in which to study the gender discrepancy in anxiety and depression among cardiac patients. Within the psychosocial fields, there is growing research on gender-based mood differences in relation to cardiac patients social support (See Lett et al., 2005), and illness beliefs (see King 2002), in addition to increased awareness for female cardiac patients multiple roles and stressors related to work, marriage and family (See Orth-Gomér et al., 2000, Orth-Gomér & Leineweber, 2005). Moreover, recent research has highlighted the importance of identifying and modifying psychosocial and behavioral risk factors of cardiovascular disease in both men and women (Orth-Gomér, 2007).

Although it is important to evaluate the diverse factors that may contribute to the gender-based affective differentials in cardiac patients, it is also important to have an element of specificity. In particular, when examining the gender discrepancy in affective symptoms among cardiac patients, it is important to consider whether the gender differences are unique to depression and/or anxiety or if they are attributable to covarying factors relevant to both gender and depression and/or anxiety (e.g., symptoms, disorders, personality) (Joiner & Blalock, 1995). In recognizing the complexity of depression and its overlap with other affective components, the tripartite model is showing increased

relevance and utility for identifying common and unique elements of anxiety and depression (Teachman et al., 2007; Joiner & Blalock, 1995). Furthermore, the results of the present investigation suggest that the tripartite model is a relevant and valid model when employing the HADS with cardiac patients.

Despite the strengths of the current study (i.e., the use of a diverse sample of cardiac patients, a two-year time period, first investigation of gender invariance of the HADS), there are limitations that need to be considered. First, objective psychological diagnoses and clinical outcomes were not evaluated, but would be worth exploring in future research to assess the predictive validity of HADS negative affect, autonomic anxiety and depression subscales. In addition, although gender invariance was shown across seven models of the HADS, replication of the current findings are warranted. Also, although the sample size was sufficient to conduct overall analyses and it was diverse in the sense that it consisted of male and female patients with various cardiac conditions (i.e., CABG, AMI, PCI), future investigations should consider increased sample diversity (e.g., inclusion of ethnic minorities) and larger samples to facilitate subgroup analyses.

In conclusion, the present study demonstrated that a three-factor structure of the HADS emerged consistently and provided the best model fit across a two-year time frame among a diverse sample of cardiac patients. Furthermore, within this sample, the HADS was invariant by gender. This suggests that the HADS could be appropriately used as a screening instrument in both male and female cardiac patients and could be used in intervention research. Future investigations should examine the predictive validity and

relevance of the HADS tripartite structures with respect to diagnostic distinctions and clinical outcomes among cardiac patients and other clinical populations.

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Tables

Table 1.

Characteristics of Factor Models to be tested

Model	# of Factors	Factor Labels and Item Numbers	Factor Relationships
Zigmond and Snaith (1983)	2	anxiety: 1, 3, 5, 7, 9, 11, 13 depression: 2, 4, 6, 8, 10, 12, 14	uncorrelated
Moorey et al. (1991)	2	anxiety: 1, 3, 5, 9, 11, 13 depression: 2, 4, 6, 7, 8, 10, 12, 14	correlated
Razavi et al. (1990)	1	general distress: 1-14	correlated
Dunbar et al. (2000)	3	autonomic anxiety: 3, 9, 13 negative affectivity: 1, 5, 7, 11 anhedonic depression: 2, 4, 6, 8, 10, 12, 14	correlated tripartite/hierarchy 1
Dunbar et al. (2000)	3	autonomic anxiety: 3, 9, 13 negative affectivity: 1, 5, 7, 11 anhedonic depression: 2, 4, 6, 8, 10, 12, 14	uncorrelated tripartite/hierarchy 2
Friedman et al (2001)	3	psychic anxiety: 3, 5, 9, 13 psychomotor agitation: 1, 7, 11 depression: 2, 4, 6, 8, 10, 12, 14	correlated
Friedman et al (2001)	3	psychic anxiety: 3, 5, 9, 13 psychomotor agitation: 1, 7, 11 depression: 2, 4, 6, 8, 10, 12, 14	uncorrelated

Item numbers represent Zigmond and Snaith's (1984) original conceptualization of the anxiety and depression subscales for the HADS (See Table 2).

Table 2.

Hospital Anxiety and Depression Scale (HADS) items

Anxiety Items	Depression Items
1. I feel tense or 'wound up':	2. I still enjoy the things I used to enjoy:
3. I get sort of a frightened feeling as if something awful is about to happen:	4. I can laugh and see the funny side of things:
5. Worrying thoughts go through my mind:	6. I feel cheerful:
7. I can sit at ease and feel relaxed:	8. I feel as if I am slowed down:
9. I get a sort of frightened feeling like 'butterflies' in the stomach:	10. I have lost interest in my appearance:
11. I feel restless as if I have to be on the move:	12. I look forward to with enjoyment to things:
13. I get sudden feelings of panic:	14. I can enjoy a good book or radio or TV programme:

Table 3.

Characteristics of Participants

Characteristic	Men (n = 604) %	Women (n = 197) %
Age		
> 65	35.8	44.2
≤ 65	64.2	55.8
Race		
White	93.5	98
Other	6.5	2
Marital Status		
Married	79.5	58.4
Other	20.5	41.6
Education		
> 13 years	38.1	25.4
≤ 13 years	68.9	74.6
Employment Status		
Employed	43.9	31
Not employed	56.1	69
Reason for Hospitalization		
AMI	35.6	38.1
PCI	37.7	37.1
CABG	26.7	24.9

Note. AMI, acute myocardial infarction, PCI, percutaneous coronary intervention; CABG, coronary artery bypass graft surgery.

Table 4.

Mean scores and standard deviations (S.D.) of scores on the HADS sub-scales

HADS Variable	Baseline		6 months		12 months		24 months	
	M	F	M	F	M	F	M	F
Total score	11.94 (6.60)	14.18 (7.33)	9.82 (6.25)	12.37 (7.28)	9.90 (6.22)	11.71 (7.03)	9.78 (6.22)	12.01 (6.56)
Anxiety subscale	7.29 (4.08)	8.73 (4.47)	5.97 (3.72)	7.64 (4.37)	5.88 (3.59)	7.20 (4.12)	5.81 (3.56)	7.26 (4.05)
Depression subscale	4.64 (3.29)	5.45 (3.73)	3.85 (3.11)	4.73 (3.55)	4.02 (3.22)	4.51 (3.46)	3.97 (3.26)	4.76 (3.21)
Psychic anxiety	3.76 (2.58)	4.94 (3.00)	3.07 (2.37)	4.38 (2.89)	2.96 (2.30)	4.04 (2.75)	2.96 (2.33)	3.97 (2.64)
Psychomotor agitation	3.53 (1.88)	3.79 (1.86)	2.90 (1.69)	3.26 (1.75)	2.92 (1.66)	3.16 (1.70)	2.85 (1.56)	3.28 (1.78)
Autonomic anxiety	2.43 (1.90)	3.22 (2.31)	1.95 (1.74)	2.93 (2.19)	3.33 (0.83)	3.58 (0.96)	2.85 (1.56)	3.28 (1.78)
Negative affect	4.87 (2.55)	5.81 (2.57)	4.02 (2.30)	4.71 (2.44)	3.99 (2.26)	4.56 (2.37)	3.93 (2.19)	4.66 (2.45)

Table 5

Goodness of fit statistics with male and female cardiac patients

Model	df	Baseline					6 months					12 months					24 months				
		χ^2	CFI	NFI	RMSEA	χ^2	CFI	NFI	RMSEA	χ^2	CFI	NFI	RMSEA	χ^2	CFI	NFI	RMSEA	χ^2	CFI	NFI	RMSEA
1	158	1601.7	.88	.86	.15	1141.6	.91	.90	.13	1281.3	.90	.89	.13	1152.9	.91	.90	.13				
2	160	1802.4	.84	.83	.16	1586.6	.88	.87	.15	1548.3	.88	.87	.15	1569.5	.88	.87	.15				
3	154	1135.7	.93	.93	.13	757.7	.96	.95	.10	717.4	.96	.95	.10	655.5	.96	.95	.09				
4	156	2130.1	.87	.86	.18	1893.9	.91	.90	.17	1700.4	.91	.90	.16	1683.8	.91	.89	.16				
5	156	1455.8	.91	.90	.14	894.0	.95	.94	.11	1026.8	.94	.93	.12	892.5	.95	.94	.11				
6	152	1084.1	.93	.92	.12	622.3	.97	.96	.08	716.8	.96	.95	.10	641.2	.97	.95	.09				
7	154	1082.3	.93	.92	.12	624.1	.97	.96	.09	726.2	.96	.95	.10	557.9	.97	.95	.10				

Note. χ^2 = chi-square; CFI = comparative fit index; NFI = normed fit index, RMSEA = root mean square error of approximation. The best model fits are indicated in bold.

1 = Zigmond & Snaith

2 = Friedman et al. (uncorrelated)

3 = Friedman et al. (correlated)

4 = Razavi et al.

5 = Moorey et al.

6 = Dunbar et al. (hierarchy 1, correlated)

7 = Dunbar et al. (hierarchy 2, uncorrelated)

Table 7.

Factor loadings and construct reliabilities for the Hospital Anxiety and Depression Scale constructs for female cardiac patients

Baseline		Women				24-months			
Item	Factor Loading (error variance)	Construct Reliability	Variance Extracted	Factor Loading (error variance)	Construct Reliability	Variance Extracted	Factor Loading (error variance)	Construct Reliability	Variance Extracted
Negative Affect									
1	.80 (.37)			.73 (.47)			.70 (.51)		
5	.83 (.38)			.72 (.43)			.68 (.45)		
7	.39(.51)			.44(.66)			.40(.65)		
11	.42(.80)	.74	.45	.45(.71)	.70	.39	.47(.85)	.67	.35
Autonomic Anxiety									
3	.90 (.22)			.84 (.24)			.81 (.35)		
9	.73 (.73)			.73 (.67)			.63 (.70)		
13	.79 (.50)	.80	.57	.79 (.46)	.80	.58	.76 (.52)	.76	.51
Depression									
2	.74 (.44)			.79 (.35)			.79 (.40)		
4	.62 (.60)			.60 (.68)			.71 (.59)		
6	.66 (.50)			.65 (.61)			.92 (.64)		
8	.48(.74)			.53 (.77)			.76 (.70)		
10	.37(.98)			.58 (.90)			.82 (.73)		
12	.65 (.62)	.75	.28	.82 (.31)	.82	.40	1.07(.28)		
14	.28(.75)			.43(.61)	.82	.40	.46(.70)	.88	.53

Note. Dunbar et al., h1 correlated model, Construct reliability = $[\text{sum}(\text{factor loadings})]^2 / [(\text{sum}(\text{factor loadings}))^2 + \text{sum}(\text{error variance})]$. Bolded values include factor loadings > .5, construct reliabilities > .70, and variance extracted > .50.

Study 2:

Gender differences in cardiac patients: A longitudinal investigation of exercise, autonomic anxiety, negative affect and depression.

Submitted to *Psychology, Health & Medicine*

Introduction

Cardiovascular Disease (CVD) is associated with significant economic, physical and emotional burden. CVD persists as the leading cause of death among men and women, and it is estimated that approximately 20 million people will die from CVDs by 2015 (World Health Organization, 2007). Not only is CVD associated with increased mortality risk, but it is also associated with other disability and illness (Public Health Agency of Canada, 2006) including mental health problems.

Among cardiac patients, anxiety and depression are often prevalent concerns for both men and women (Cardiac Care Network of Ontario, 2002). However, female cardiac patients frequently experience greater symptoms of anxiety and depression compared to males (Cardiac Care Network of Ontario, 2002; Frasure-Smith, Lespérance, Juneau, Talajic & Bourassa, 1999; Grace et al., 2002a; Grace et al., 2002b). This finding is rather alarming given that elevated anxiety and depression symptoms have been associated with an increased risk of recurrent cardiac events and/or mortality among cardiac patients (Strik et al., 2003; Frasure-Smith & Lespérance, 2008; Barth, Schumacher & Hermann-Lingen, 2004; Carney et al., 2004; Van Melle et al., 2004).

Fortunately, there is increasing evidence to support the positive role of exercise for cardiac patients. Several studies of exercise interventions for cardiac patients have

produced positive impacts on anxiety and/or depression symptoms for both men and women (Barr-Taylor et al., 1986; Kugler et al., 1994; Milani et al., 1996; Oldridge et al., 1991, Yoshida et al., 1999; Yoshida et al., 2001). Unfortunately, gender discrepancies in the exercise behavior and adherence of cardiac patients have been well documented (Halm, Penque, Doll & Beahrs, 1999; Schuster & Waldron, 1991; Grace et al., 2005, Reid et al., 2006). Specifically, women exercise significantly less than men (Halm et al., 1999; Schuster & Waldron, 1991) and this finding extends to both cardiac rehabilitation (CR) participants and non-participants (Grace et al., 2005; Reid et al., 2006).

Despite significant gender differences in cardiac patients' anxiety, depression and exercise behavior, studies have yet to determine whether exercise has similar effects on men and women's anxiety and depression (i.e., does gender moderate the exercise/affective relationships?), or whether exercise behavior explains the gender difference in men and women's anxiety and depression (i.e., does exercise mediate the gender/affective relationships?).

To date, gender-based exercise discrepancies and their respective impacts on anxiety and depression have at times, either not been considered (e.g., Milani et al., 1996), or were not feasible due to the very few number of women (e.g. Yoshida et al., 1999; Yoshida et al, 2001), or the outright exclusion of female cardiac patients (e.g., Barr Taylor et al., 1986; Oldridge et al., 1991). In addition, investigations have often focused solely on myocardial infarction (MI) patients (Barr-Taylor et al., 1986; Oldridge et al., 1991; Stern, 1983; Yoshida et al., 2001) compared to other patient populations (e.g., coronary artery bypass graft surgery; i.e., CABG, and percutaneous coronary

intervention; i.e., PCI patients). Furthermore, sample sizes have tended to be small (e.g., 106-210 patients) (Barr-Taylor et al., 1986; Oldridge et al., 1991; Stern et al., 1983) and short follow-up periods (i.e., 10 weeks-6 months) have frequently been reported (i.e., Blanchard 2002a; Engebretson et al., 1999; Yoshida et al., 1999). Therefore, it is unclear as to how exercise impacts male and female cardiac patients' affective experiences over an extended period of time (e.g., > 1 year).

It is also worth noting that previous researchers (e.g. Grace et al., 2005) have typically focused on absolute (i.e., measured at a given point in time) levels of exercise and affective variables across time (e.g., baseline depression was used to predict exercise participation at 1 year). Although this approach is valuable, given that both cardiac patients' exercise behaviour (Balady et al., 1996; Halm et al., 1999; Schuster & Waldron, 1991) and affective symptoms (Frasure-Smith et al., 1999) can vary considerably across time, particularly among women, it is necessary to examine whether a change in exercise behaviour is significantly related to the change in anxiety and/or depression over an extended period of time (i.e., > 1 year) for both male and female cardiac patients. Importantly, this has yet to be investigated.

Although there appears to be distinct patterns that female cardiac patients both exercise less (Reid et al., 2006; Halm et al., 1999; Schuster & Waldron, 1991) and experience greater anxiety and depression than their male counterparts (Cardiac Care Network of Ontario, 2002; Frasure-Smith et al., 1999; Grace et al., 2002a; Grace et al., 2002b), the potential mediating effect of exercise in the gender/affective relationship has received little attention. Furthermore, the few investigations that have considered these

relationships in cardiac patients (e.g., Blanchard et al, 2002a; 2002b) have been limited by small samples and very short follow-up periods (i.e., ≤ 18 weeks). Therefore, in order to build on past research and address some of the aforementioned limitations, the current study employed a longitudinal design with three objectives.

The first purpose of this study was to examine the symptoms of autonomic anxiety, negative affect and depression of cardiac patients across two years. Based on previous research (Cardiac Care Network of Ontario, 2002; Frasure-Smith et al., 1999; Grace et al., 2002a; Grace et al., 2002b), it was hypothesized that compared to male patients, female patients would report significantly more autonomic anxiety, negative affect and depression at baseline, 6, 12 and 24 months.

The second purpose of this investigation was to examine whether a) gender moderated the exercise/affective relationship using absolute values and whether b) changes in exercise were moderated by the gender/changes in affectivity relationship (i.e., changes in psychological distress for men and women) in cardiac patients over two years. Based on previous research (Cardiac Care Network of Ontario, 2002; Frasure-Smith et al., 1999; Grace et al., 2002a; Grace et al., 2002b, Grace et al., 2005; Reid et al., 2006), it was hypothesized that the exercise/affective relationship would be significantly stronger for men than women when using both absolute and change scores at all time intervals.

The third purpose of this investigation was to examine whether a) exercise mediated the gender/affective relationship, and whether b) changes in exercise mediated the gender/ changes in affectivity relationship (i.e., changes in anxiety and depression for

men and women) in cardiac patients across two years. When using the absolute values, it was hypothesized that compared to female patients, male patients would report significantly more exercise, which in turn, would lead to reduced autonomic anxiety, negative affect and depression at all time points. When using change values, it was hypothesized that compared to male patients, female patients would have a significantly greater change in their exercise behavior (i.e., more exercise), which would be associated with a significantly greater change in affective functioning (i.e., reductions in autonomic anxiety, negative affect, and depression) between 6, 12 and 24 months.

Methods

Participants

Participants were drawn from the Tracking Exercise After Cardiac Hospitalization (TEACH) trial (Reid et al., 2006), which was a prospective study designed to examine exercise patterns and predictors in cardiac patients. Between May 2002 and December 2003, 1433 patients were approached and 826 (57.6%) agreed to participate. Participants were comprised of 308 PCI, 302 AMI and 216 CABG patients. During the course of the study, 25 patients (3.0%) died and 68 patients (8.4%) were re-hospitalized with a new cardiac event (AMI, PCI or CABG), but were retained in the analyses. The final sample consisted of 801 cardiac patients (604 male / 197 female). Inclusion and exclusion data is displayed in Figure 1.

Procedures

Patients were recruited to participate from three cardiac centers in Ottawa (two sites) and Kingston (one site), Canada. Ethical approval was obtained from the Research

Ethics Committee at each site. Participants were between the ages of 20 and 85 years, and had been hospitalized for AMI, PCI, or CABG. Persons with contraindications to exercise were excluded (See Reid et al., 2006). Participants were recruited in-hospital by a study coordinator at each site and all participants provided written informed consent. Patients completed a baseline psychosocial questionnaire that included demographic, affective, and exercise scales. Six, 12 and 24 months following hospital discharge, participants were mailed questionnaires to measure psychosocial constructs and exercise behaviour.

Measures

Demographic characteristics

Demographic characteristics are displayed in Table 1. When participants fell into two or more categories for hospitalization (e.g., PCI following AMI), they were classified according to the event/procedure with the greatest impact on exercise levels post-hospitalization (CABG > AMI > PCI), determined from a preliminary analysis (See Reid et al., 2006). Seven comorbidities that potentially influence patients' ability to be physically active (i.e., history of AMI, congestive heart failure, peripheral vascular disease, stroke, arthritis, diabetes, and lung disease) were identified by site clinicians and physiotherapists. Patients indicated "yes" or "no" as to whether they had ever been diagnosed with any of the aforementioned comorbid health conditions. Responses were summed to form a comorbidity index.

Affective Functioning

Anxiety and depression were measured via the Hospital and Anxiety Depression Scale (HADS) (Zigmond & Snaith, 1983). The HADS contains 7 anxiety items (e.g., I feel tense or wound up) and 7 depression items (e.g., I still enjoy the things I used to), each of which are rated on 4-point scales with different term verbal anchors depending on the particular item. Recent psychometric evaluations suggest that a three-factor structure comprised of negative affect, autonomic anxiety and depression is supported when using the HADS with cardiac patients (Martin, Thompson & Barth, 2008; Hunt-Shanks et al., 2008). Therefore, the current investigation evaluated affective functioning using the three subscales of the HADS including negative affect (e.g., “Worrying thoughts go through my mind”) autonomic anxiety (e.g., “I get a sort of frightened feeling as if something awful is about to happen”) and depression (e.g., “I look forward with enjoyment to things”). Given that cut-points for the newly formed scales have not been established, the traditional cut-points for “possible” and “probable” cases of depression and anxiety (i.e., scores of 8-10, and > 11 respectively) were applied (Zigmond & Snaith, 1983).

Exercise

Exercise was assessed by the leisure score index (LSI) of the Godin Leisure-Time Exercise Questionnaire (Godin & Shephard, 1985). An independent evaluation of this measure found that it compares favourably to nine other self-report measures of exercise (Jacobs et al., 1993). The LSI contains three questions that assessed the frequency of mild, moderate, and strenuous exercise performed for at least 15 minutes during free time in a typical week. Participants were asked to consider a typical week in the previous 6

months. Aggregate scores were created for mild-moderate exercise, and mild, moderate and strenuous exercise. No significant differences emerged between the aggregates. Therefore, the latter aggregate score (i.e., all levels of exercise) was used in the analyses.

Analysis and Results

Preliminary Analyses

Characteristics of the Participants

Characteristics of the participants are shown in Table 1. Participants consisted of 604 men ($\bar{X}$ age = 60.95, SD = 9.97) and 197 women ($\bar{X}$ age = 62.57, SD = 10.15). Means and standard deviations (S.D.) for the affective and exercise scales are displayed in Table 2. The percentages of “possible” and “probable” cases of anxiety and depression (Zigmond & Snaith, 1983) are displayed in Table 3.

Change Scores

Residualized change scores (RCS: Cohen & Cohen, 1995) were generated and saved (SPSS REGRESSION) to represent changes in autonomic anxiety, negative affect, depression and exercise from baseline to 6 months, 6 to 12 months, and 12 to 24 months.

Confounding Variables

In order to identify potential confounding variables for the main analyses, a series of zero-order correlations were conducted between the demographic variables and the 1) absolute scores, and 2) residualized change scores for exercise, autonomic anxiety, negative affect and depression at baseline, 6, 12, and 24 months. Twelve demographic variables were significantly correlated to the dependent variables. Using a Bonferonni correction ($\alpha = .01$), two variables remained significant (cardiac event and rehabilitation

status). The latter variables were correlated to the predictors. Rehabilitation status was significantly correlated to negative affect at 12 months ($r = -.07, p = .05$), and depression at 6 months ($r = -.11, p = .01$), 12 months ($r = -.12, p = .01$) and 24 months ($r = -.12, p = .01$) and was therefore controlled in subsequent analyses.

Examination of variables across time by gender

To test for potential gender differences in exercise, autonomic anxiety, negative affect and depression of cardiac patients across time, a 2 (gender) by 4 (time) mixed model, repeated measures analysis of covariance (ANCOVA) was conducted for the overall time periods (i.e., baseline to 24 months) controlling for rehabilitation status and type of cardiac event. For exercise, the results revealed that there was a significant main effect for time, $F(3, 793) = 36.88, p < .001$, and a significant main effect for gender, $F(1, 795) = 24.10, p < .001$. Follow-up ANCOVAs revealed a significant main effect for time from baseline to 6 months $F(1, 796) = 103.07, p < .001$, and 12 to 24 months $F(1, 796) = 21.98, p < .001$ with exercise behaviors increasing and subsequently decreasing respectively (See Table 2). Significant main effects for gender emerged from baseline to 6 months $F(1, 796) = 18.92, p < .001$, 6 to 12 months $F(1, 795) = 14.63, p < .001$, and 12 to 24 months $F(1, 795) = 18.87, p < .001$ with men exercising significantly more than women at each time point (See Table 2). No significant time by gender interactions occurred.

For autonomic anxiety, the results revealed that there was a significant main effect for time, $F(3, 794) = 6.79, p < .001$, and a significant main effect for gender, $F(1, 796) = 37.62, p < .001$. Follow-up ANCOVAs revealed significant main effects for time

from baseline to 6 months $F(1, 796) 4.23, p < .04$ and 6 to 12 months $F(1, 796) 9.99, p < .002$, with autonomic anxiety decreasing over time (See Table 2). Significant main effects for gender emerged from baseline to 6 months $F(1, 796) 37.99, p < .001$, 6 months to 12 months $F(1, 796) = 36.06, p < .001$, and 12 to 24 months $F(1, 796) = 28.66, p < .001$, with women having greater autonomic anxiety than men at all time points respectively (See Table 2). In addition, from 6 months to 12 months, a significant time by gender interaction occurred $F(1, 796) = 4.58, p = .03$, with women experiencing greater decreases in autonomic anxiety compared to men (See Table 2).

For negative affect, the results revealed a significant main effect for time, $F(3, 794) = 4.32, p = .005$, and a significant main effect for gender, $F(1, 796) = 14.73, p < .001$. Follow-up ANCOVAs showed a significant main effect for time from baseline to 6 months $F(1, 796) = 8.39, p = .004$ with negative affect significantly decreasing during this time period (See Table 2). Significant main effects for gender also emerged from baseline to 6 months, $F(1, 796) = 12.99, p < .001$, 6 to 12 months $F(1, 796) = 12.07, p = .001$ and 12 to 24 months $F(1, 796) = 13.51, p < .001$ with women experiencing greater negative affect than men (See Table 2). No significant time by gender interactions emerged.

For depression, the results revealed a significant main effect for time, $F(3, 794) = 5.11, p = .002$, and a significant main effect for gender, $F(1, 796) = 9.61, p = .002$. Follow-up ANCOVAs showed a significant main effect for time from baseline to 6 months, $F(1, 796) = 13.86, p < .001$, with depression decreasing during this time period (See Table 2). Significant main effects for gender emerged from baseline to 6 months F

(1, 796) = 11.58, $p = .001$, 6 to 12 months $F(1, 796) = 6.65$, $p = .01$ and 12 to 24 months $F(1, 796) = 5.97$, $p = .02$, with women experiencing greater depression than men (See Table 2). A significant time by gender interaction also emerged from 6 to 12 months for depression $F(1, 796) = 4.56$, $p = .03$, with men's symptoms increasing and women's symptoms decreasing (See Table 2).

Moderation

To test the potential moderating role of gender on the a) exercise/affective relationship using absolute scores controlling for the covariates, and b) exercise changes/affective changes controlling for the covariates, Baron and Kenny's (1986) procedure was used for a dichotomous moderator (i.e., regressions were conducted separately for males and females and the unstandardized betas were statistically compared). When using absolute scores, results revealed that autonomic anxiety was significantly related to exercise for men at 6 months (Standardized Beta (β) = -.09, $p = .03$), and both men ($\beta = -.13$, $p < .01$) and women ($\beta = -.16$, $p = .02$) at 24 months. In addition, negative affect was significantly related to exercise for men at baseline ($\beta = -.09$, $p = .02$), 6 months ($\beta = -.11$, $p < .01$) and 24 months and ($\beta = -.10$, $p = .01$). Finally, depression was significantly related to exercise at all time points for men (β 's = -.11, -.15, -.14, and -.15 respectively, $p < .01$) and baseline ($\beta = -.15$, $p < .01$) and 24 months ($\beta = -.17$, $p = .02$) for women. However, none of the exercise/affective relationships were significantly moderated by gender.

When using change scores, the results revealed that changes in autonomic anxiety were significantly related to changes in exercise for men from baseline to 6 months ($\beta = -$

.09) and 12 to 24 months ($\beta = -.09$). Changes in negative affect were significantly related to changes in exercise for men from baseline to 6 months ($\beta = -.11$) and 12 to 24 months ($\beta = -.10$), and changes in depression were significantly related to changes in exercise for men from baseline to 6-months ($\beta = -.09$) and 12 to 24 months ($\beta = -.08$). However, none of the exercise changes/affective changes relationships were moderated by gender.

Mediation

To test the potential mediating role of exercise on the gender/affective relationship using absolute scores while controlling for covariates, Baron and Kenny's (1986) four steps of mediation were employed across the time intervals. The following steps were implemented: 1) autonomic anxiety was regressed on gender, 2) exercise was regressed on gender, 3) autonomic anxiety was regressed on exercise, and 4) autonomic anxiety was regressed on gender and exercise. For interpretive purposes, significant relationships had to emerge between the variables in steps 1-3, and in order to establish mediation, the beta between gender and autonomic anxiety in the last equation had to be non-significant and smaller than the correlation in step one (Baron & Kenny, 1986). The same steps were followed to examine the potential mediational role of exercise on the gender/depression and gender/negative affect relationships.

The mediation analyses revealed that exercise did not mediate the gender/autonomic anxiety, gender/negative affect or gender/depression relationship. Furthermore, mediation analyses were not performed using change scores given that no significant time by gender interactions coincided between the exercise and affective variables.

Discussion

This study provides new information about the relationships between gender, exercise, autonomic anxiety, negative affect and depression up to two years after hospitalization in a representative sample of cardiac patients. The rates of elevated anxiety in the sample were consistent with previously reported ranges of 18.5- 26% (See Mayou et al., 2000, Moser & Dracup, 1996), and the finding that women have greater anxiety scores than men (See Cardiac Care Network of Ontario, 2002). Surprisingly, the rates of elevated depressive symptoms were much lower in the current sample than reported in previous investigations (See Grace et al., 2005, Frasure-Smith et al., 1999). It is noted that rates of participation in CR are lower for depressed versus non-depressed cardiac patients (Todara, Shen, Niaura & Tilkemeier, 2005, Grace et al., 2005). Therefore, it is possible that the more severely depressed cardiac patients elected not to participate in the present investigation. Future studies should consider evaluating whether the quality of depression (e.g., elevated depressed symptoms versus clinical depression) as assessed by objective measures (e.g., structured clinical interview) influences participation.

As hypothesized, gender differences emerged in relation to affective functioning with women showing greater autonomic anxiety, negative affect and depression than men across all time periods. This finding is consistent with previous research (Cardiac Care Network of Ontario, 2002; Frasure-Smith et al., 1999; Grace et al., 2002a; Grace et al., 2002b), and notably highlights that the affective gender discrepancy persists over a two-year time frame. Interestingly, between 6 and 12 months, although women's autonomic

anxiety and depressive symptoms were higher than that of the men, they experienced greater decreases in both their autonomic anxiety and depressive symptoms. It is possible that the greater decrease in symptoms is due to the fact that women's initial values were higher. Therefore, regression to the mean could have occurred. Both research with the general and cardiac population highlights that women have elevated anxiety and depression symptoms compared to men (Picinelli & Wilkinson, 2000; Cardiac Care Network of Ontario, 2002). This may in part be due to the fact that women tend to report more psychological symptoms and are more likely to seek medical attention compared to men (Picinelli & Wilkinson, 2000). Therefore, it is possible that the female cardiac patients reported more symptoms and/or engaged in increased help-seeking behaviors or coping strategies (e.g., medication, therapy, social support) between 6 and 12 months. However, given that female cardiac patients' affective distress remained greater than males, it is feasible that the coping strategies (if any) used by the females were less effective than those used by the males. For instance, according to Nolen-Hoeksema's (1991) response styles theory, men and women engage in different responses, or coping styles to depression that can impact both the presence of symptoms and duration of depressive episodes. Specifically, it is argued that women are more likely than men to engage in ruminative coping responses (i.e., passive and repetitive focus on symptoms, meanings and consequences of distress), whereas men are more likely than women to engage in distracting coping responses (e.g., physical activity, socializing). As a result, women may experience increased depressive symptomatology and prolonged depression,

whereas men may experience reduced depressive symptomatology and duration (Noelen-Hoeksema, 1991).

Furthermore, some researchers have argued that given women's tendency to ruminate more than men, they may also be more indecisive with their negative attributions and consequently experience both anxiety and depression symptoms versus depression symptoms alone (Joiner & Blalock, 1995). Given the consistent findings that compared to male patients, female cardiac patients experience increased presence and duration of both anxiety and depressive symptoms (Frasure-Smith et al., 1999; Grace et al., 2002a; Grace et al., 2002b), in addition to reduced exercise (Reid et al., 2006; Grace et al., 2005), future research should investigate the role of ruminative coping styles on affective functioning with this population.

Although gender did not moderate any of the exercise/affective relationships when using absolute values, it is important to note that exercise was significantly, negatively related to autonomic anxiety and depression at various time points for both men and women. Furthermore, exercise was significantly, negatively related to; autonomic anxiety for both genders at 24 months, and depression at baseline and 24 months for both genders. Therefore, from an intervention standpoint, in order to reduce affective distress in both male and female cardiac patients, exercise may be particularly beneficial after their initial hospitalization and 24 months later. In addition, alternative interventions to exercise (e.g., pharmacotherapy, counseling) may merit consideration during the 6 to 12 month time period in order to reduce cardiac patients affective distress.

The results of the moderation analyses using change scores indicated that none of the exercise changes/affective changes relationships were moderated by gender.

Nonetheless, small, significant negative relationships emerged for men between baseline and 6 months and 12 to 24 months for the exercise changes/autonomic anxiety changes, exercise changes/negative affect changes and exercise changes/depression changes.

Again, these findings suggest that the timing of interventions may be important for male cardiac patients as changes in exercise are related to small, negative changes in affective distress after their initial hospitalization up to 6 months, then again between 1 year and 2 years post hospitalization.

The results of the mediation analyses indicated that exercise did not mediate any of the gender/affective relationships. Therefore, although gender differences in the exercise behaviour and affective distress of cardiac patients were demonstrated, exercise did not account for these differences. The current findings are consistent with an earlier investigation of cardiac patients where exercise did not emerge as a mediator of a self-management intervention and reduction in depressive symptoms (Scholz, Knoll, Sniehotta & Schwarzer, 2006). However, the present results are inconsistent with a recent study in which physical activity mediated the relationship between depressive symptoms and subsequent cardiac events for cardiac patients (Whooley et al., 2008). It is possible that the current lack of mediation could be the result of unmeasured factors. For instance, both pharmacotherapy and psychotherapy have demonstrated effectiveness for treating affective disturbance in cardiac patients (ENRICHD, 2003). Therefore, future

investigations should consider the potential roles of both medication and counseling in affective changes with this population.

It is also important to recognize that there are potentially multiple, complex factors that contribute to the gender discrepancies in the affective functioning of cardiac patients. For example, it is acknowledged that low social support is a risk factor for both the development and worsening of depressive symptoms among cardiac patients (Lett et al., 2005) and a recent investigation suggested that female cardiac patients experience significantly less perceived tangible support (e.g., help with chores) than their male counterparts (Boutin-Foster & Charlson, 2007). There is also evidence to suggest that compared to male cardiac patients, female cardiac patients are more likely to attribute the cause of their illness to external factors (e.g., relationships), whereas men are more likely to identify internal factors (e.g., exercise, diet). As a result, females often experience a reduced sense of autonomy and self-efficacy related to their illness (King, 2002) that could lead to poorer affective functioning. In addition, given that both social and cultural norms can contribute to increased depression in females compared to males (Picinelli & Wilkinson, 2000), it is important to recognize female cardiac patients' multiple roles and stressors related to work, marriage and family as potential contributors to anxiety and depression (See Orth-Gomér et al., 2000, Orth-Gomér & Leineweber, 2005).

Despite the strengths of the current study (e.g., the use of a diverse sample of cardiac patients, 2 years post-hospitalization, first investigation of the mediating/moderating relationships between exercise, gender, negative affect, autonomic anxiety and depression), there are limitations that need to be considered. First, given the

recent validation of the three-factor-solution of the HADS with cardiac patients, there are no current norms, or clinically significant cut-points for assessing autonomic anxiety and negative affect with this population. Future investigations should look to establish such cut-points, as the prevalence rate of anxiety within this sample was quite elevated, particularly among the female cardiac patients. Furthermore, participants' use of coping strategies and help-seeking behaviors (e.g., psychotherapy, pharmacotherapy, social support) was not evaluated. However, it is plausible that single or combined coping strategies could lead to reduced psychological distress. Therefore, subsequent investigations should assess and/or control for the potential confounding role of help-seeking variables. In addition, it is possible that there were limitations in recall, or recall bias in relation to patients' self-reports of comorbidities, exercise behaviour and emotional functioning. Therefore, in order to increase the reliability of the current findings, future research should consider employing objective measures to confirm female cardiac patients increased experience of autonomic anxiety, negative affect and depression, and reduced exercise behaviour. Finally, although the sample size was sufficient to conduct overall analyses and it was diverse in the sense that it consisted of male and female patients with various cardiac conditions (i.e., CABG, AMI, PCI), future investigations should consider increased sample diversity (e.g., inclusion of ethnic minorities) and larger samples to facilitate subgroup analyses.

In conclusion, the present study demonstrated that female cardiac patients experience significantly greater autonomic anxiety, negative affect and depression and engage in significantly less exercise than male cardiac patients over a two-year period.

Importantly, this was the first study to show that gender discrepancies in the affective functioning and exercise behavior of cardiac patients persist over time (i.e., two years). Although gender did not moderate any of the exercise/affective relationships, exercise was significantly related to affective outcomes at various time points for both men and women. In addition, although exercise did not mediate any of the gender/affective relationships, the psychological benefits of exercise have been well documented for both male and female cardiac patients (Barr-Taylor et al., 1986; Kugler et al., 1994; Milani et al., 1996; Oldridge et al., 1991, Yoshida et al., 1999; Yoshida et al., 2001) and should be sustained with this population. However, further research is needed to clarify the complex relationships between gender, autonomic anxiety, negative affect and depression among cardiac patients. Future research should consider the use of objective measures, in addition to assessment of such factors as psychotherapy and/or pharmacotherapy use, and types of coping responses (e.g., ruminative coping style) in relation to male and female cardiac patients' affective functioning.

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Table 1.

Characteristics of Participants

Characteristic	Men (n = 604) %	Women (n = 197) %
Age		
> 65	35.8	44.2
≤ 65	64.2	55.8
Race		
White	93.5	98
Other	6.5	2
Marital Status		
Married	79.5	58.4
Other	20.5	41.6
Education		
> 13 years	38.1	25.4
≤ 13 years	68.9	74.6
Employment Status		
Employed	43.9	31
Not employed	56.1	69
Reason for Hospitalization		
AMI	35.6	38.1
PCI	37.7	37.1
CABG	26.7	24.9

Note. AMI, acute myocardial infarction, PCI, percutaneous coronary intervention; CABG, coronary artery bypass graft surgery.

Table 2.

Variable	Baseline		6 months		12 months		24 months	
	M	F	M	F	M	F	M	F
Depression	4.64 (3.29)	5.45 (3.73)	3.85 (3.11)	4.73 (3.55)	4.02 (3.22)	4.51 (3.46)	3.97 (3.26)	4.76 (3.21)
Autonomic anxiety	2.43 (1.90)	3.22 (2.31)	1.95 (1.74)	2.93 (2.19)	1.89 (1.69)	2.64 (2.09)	1.88 (1.67)	2.60 (1.95)
Negative affect	4.87 (2.55)	5.51 (2.57)	4.02 (2.30)	4.71 (2.44)	3.99 (2.26)	4.56 (2.37)	3.93 (2.19)	4.66 (2.45)
Godin 2	2.44 (2.56)	1.76 (2.39)	4.28 (3.04)	2.93 (2.73)	4.31 (3.51)	2.98 (3.18)	3.09 (3.06)	2.05 (2.39)
Godin 3	5.50 (3.94)	4.47 (3.86)	8.28 (4.19)	6.84 (3.67)	8.36 (5.19)	7.10 (4.95)	6.75 (4.88)	4.95 (4.03)

Mean scores and standard deviations (S.D.) of scores on the affective and exercise scales

Note: Godin 2 = moderate and strenuous exercise; Godin 3 = mild, moderate and strenuous exercise.

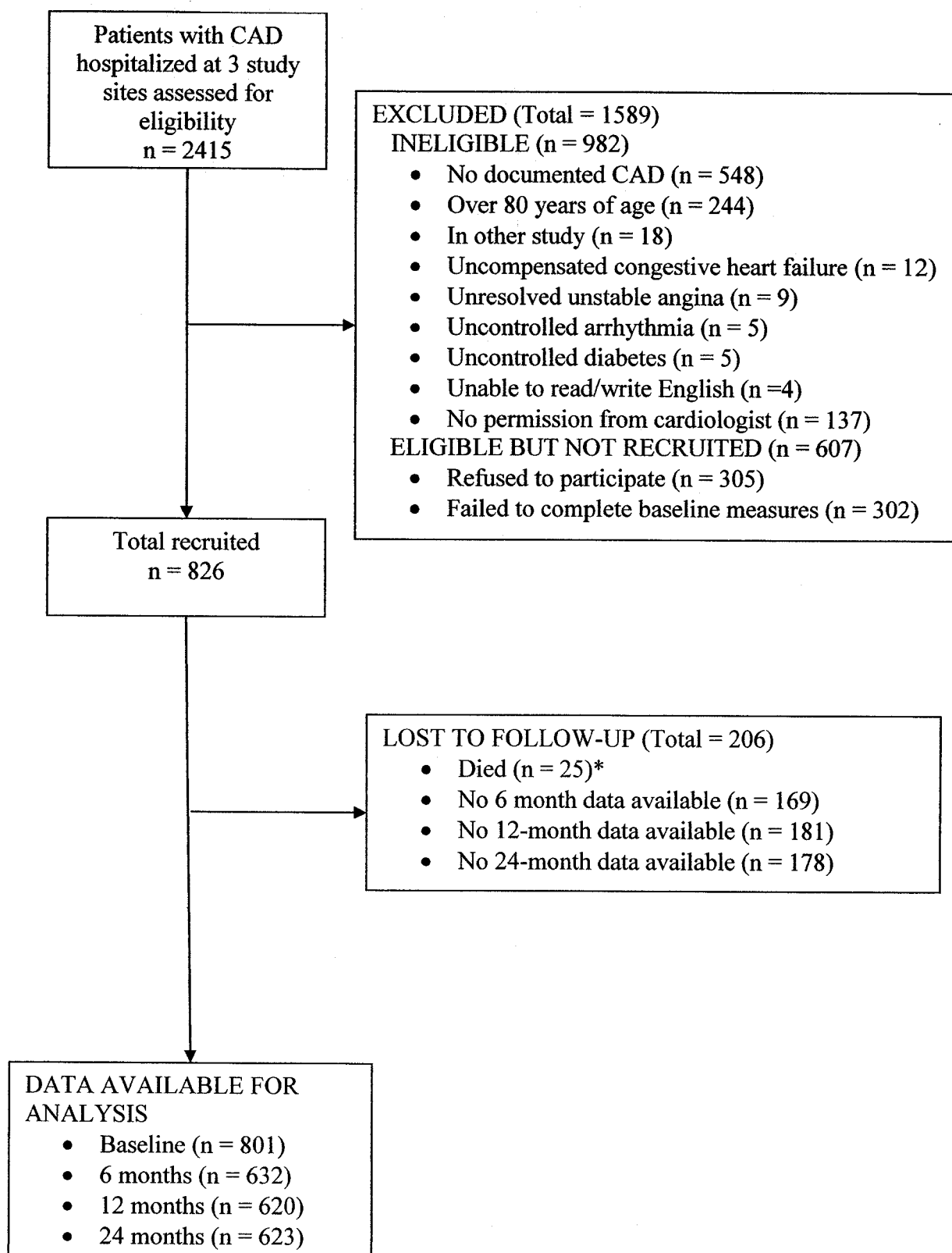
Table 3.

Variable	Baseline		6 months		12 months		24 months	
	M	F	M	F	M	F	M	F
Possible anxiety	25.2	26.3	15.8	19.8	18.2	23.3	12.5	12.6
Probable anxiety	21.3	31.4	13.7	26.3	10.8	21.3	15.2	27.7
Possible depression	12.7	17.3	12.8	13.1	10.4	13.2	5.7	10.7
Probable depression	6	10.6	1.7	7.5	4	6	7.6	8.5

Percentage of participants with “possible” and “probable” cases of anxiety and depression

Note: M = male, F= female

Figure 1: Study Flow



* Participants who died during the follow-up period were removed from the analyses

Conclusion

General Discussion

In studying a diverse sample of cardiac patients over two years, the objectives of the first investigation were to 1) examine the factor structure of the HADS, and 2) test measurement invariance between genders. The aims of the second study were to 1) examine the affective symptoms of autonomic anxiety, negative affect and depression, and 2) determine whether gender moderated the exercise/affective relationships, and 3) evaluate whether exercise mediated the gender/affective relationships.

In speaking to some of the strengths of the investigations, one important feature of both studies was the duration of evaluation. Specifically, in the first investigation, the factor structure of the HADS with cardiac patients was examined for 18 months longer than the typical time period (See Martin et al., 2008; 2003). Similarly, in the second study, there was an extended examination of the affective functioning of cardiac patients as well as the impact of exercise on cardiac patients' affective functioning (e.g., 12 months longer than the typical time period). Furthermore, both investigations offered some unique contributions to cardiac research. In particular, Study 1 was the first investigation to assess measurement invariance between genders when employing the HADS with cardiac patients. Furthermore, Study 2 was the first investigation to examine the tripartite structures of the HADS (i.e., autonomic anxiety, negative affect and depression) over two years, and it was the first study to conjointly consider the potential

moderating role of gender in the exercise/affective relationships and the potential mediating role of exercise in the gender/affective relationships.

With regard to the factor structure of the HADS, the results revealed that consistent with the hypothesis and previous research (Martin et al., 2008; 2003), a three-factor structure of the HADS emerged repeatedly and provided the best model fit at all time points. Of the seven tested models, the Dunbar et al (2000) hierarchical, correlated model provided the most statistically sound version of the HADS with cardiac patients across 24-months. Therefore, the tripartite structure of negative affect, autonomic anxiety and depression was supported when using the HADS within the sample. However, it is important to note that the correlated and uncorrelated hierarchical versions of the Dunbar et al (2000) models both performed quite similarly in terms of their psychometric properties. This is not surprising given that the models are essentially identical with the exception that one model permits anxiety and depression to correlate, whereas the other restricts this correlation. Conceptually, an argument could be made in favor of the correlated version of the Dunbar et al (2000) model as it is noted that depression and anxiety disorders are often comorbid and that symptoms frequently overlap (Gorman, 1996/1997). Moreover, a correlated model that shows the relationship between autonomic anxiety and anhedonic depression is potentially useful for distinguishing between comorbid anxiety and depression (e.g. high levels of autonomic anxiety and anhedonia) versus mixed anxiety and depression (e.g., low levels of autonomic anxiety and anhedonia) (Clark et al., 1994; Joiner & Blalock, 1995).

Interestingly, the best psychometrically performing subscale within the Dunbar et al. (2000) models was frequently the autonomic anxiety subscale. This is noteworthy given that it is only comprised of three items (e.g., 3, 9, 13; “I get a sort of frightened feeling as if something awful is about to happen;” “I get a sort of frightened feeling like ‘butterflies’ in the stomach;” and “I get sudden feelings of panic”). Consistent with the findings of Martin and Thompson (2000), the results suggest that when using the HADS with cardiac patients, there is a distinct facet that captures the fear and/or panic responses related to physiological hyperarousal from anxiety. Previous research shows that the autonomic anxiety construct is relevant and valid with various adult populations (e.g., psychotherapy outpatients, undergraduates, air force cadets) (Joiner Jr. et al., 1999). Moreover, the results from the current investigations suggest that autonomic anxiety is relevant to cardiac patients and that it is particularly prevalent among women.

With respect to measurement variance, the results showed that the seven tested HADS models were invariant by gender across baseline, six month, 12 month and 24 month samples; thereby supporting the null hypothesis. Interestingly, invariance between genders persisted regardless of the factor structure tested (e.g., uni-dimensional, two-dimensional, three-factor) suggesting that both male and female cardiac patients approach and respond to the HADS items in a similar manner. Therefore, the HADS appears to afford a gender-impartial assessment of anxiety and depression symptoms with this population. Furthermore, in speaking to the clinical relevance of this finding, clinicians can confidently employ the HADS as a screening instrument with cardiac patients knowing that there will be no bias in the responses based on gender.

In turning to some of the main results from Study 2, the prevalence of elevated anxiety in the sample was consistent with previously reported ranges of 18.5- 26% (See Mayou et al., 2000, Moser & Dracup, 1996), and the finding that women have greater anxiety scores than men (See Cardiac Care Network of Ontario, 2002). The rates of elevated depressive symptoms were much lower in the current sample than reported in previous investigations (See Grace et al., 2005, Frasure-Smith et al., 1999). However, consistent with previous research (Cardiac Care Network of Ontario, 2002 ; Frasure-Smith et al., 1999), women had elevated depression scores compared to men. It is possible that the gender differences in cardiac patients' anxiety and depression were attributable to the fact that women tend to report more psychological symptoms compared to men (Picinelli & Wilkinson, 2000). However, there are potentially multiple factors that can both contribute to and/or perpetuate the gender differences in men and women's affective functioning, which will be discussed in a later section.

In further reviewing some of the prevalence data, consistent with the hypotheses, gender differences emerged in relation to affective functioning with women showing greater autonomic anxiety, negative affect and depression than men across all time periods. This finding is also in line with previous research (Cardiac Care Network of Ontario, 2002; Frasure-Smith et al., 1995; Frasure-Smith et al., 1999; Grace et al., 2002a; Grace et al., 2002b), and notably highlights that the affective gender discrepancy persists over a two-year time frame. Consequently, compared to male cardiac patients, female cardiac patients appear to suffer more extensively from affective distress, both in terms of symptom prevalence and duration. Furthermore, women's elevated affective symptoms

leave them increasingly vulnerable to recurrent cardiac events and mortality (Van Melle et al., 2004; Frasure Smith & Lespérance, 2008). Therefore, in order to better address female cardiac patients' mental and physical health outcomes over time, it is apparent that interventions intended to reduce affective distress should be tailored to gender. Moreover, the present results highlight the need for ongoing monitoring (e.g., > 1 year) of female cardiac patients' affective symptoms in order to assess intervention effectiveness.

In speaking to the moderation results, surprisingly, gender did not moderate any of the exercise/affective relationships when using absolute values. Nonetheless, exercise was significantly, negatively related to autonomic anxiety, negative affect and depression at various time points (e.g., baseline and/or 24 months) for both men and women. Therefore, exercise appears to have similar effects on cardiac patients' affective functioning (e.g., low exercise is associated with high affective symptoms) irrespective of gender. Similar results emerged from the moderation analyses using change scores. Although none of the exercise changes/affective changes relationships were moderated by gender, small, significant negative relationships emerged for men between baseline and 6 months such that increased exercise led to decreased depression, negative affect, and autonomic anxiety. Surprisingly, between 12 and 24 months, decreased exercise was associated with reduced affective distress among men. However, it is important to note that these changes were quite small. In fact, in general, given the small effect sizes that emerged between the exercise/affective relationships, it appears that strategies in addition

to exercise (e.g., medication , counseling) are likely needed in order to reduce cardiac patients' affective distress.

With regard to the results of the mediation analyses, the results indicated that exercise did not mediate any of the gender/affective relationships. Therefore, although gender differences in the exercise behaviour and affective distress of cardiac patients were demonstrated, exercise did not account for these differences. It is possible that the lack of mediation could be the result of unmeasured factors. For instance, both pharmacotherapy and psychotherapy have demonstrated effectiveness for treating affective disturbance in cardiac patients (ENRICH, 2003). Therefore, future investigations should consider the potential roles of both medication and counseling in affective changes with this population. In addition, it is important to note that self-report measures of exercise were used in the current investigation. Therefore it is possible that there was some discrepancy between cardiac patients self-reported exercise versus the actual amount of activity they performed. Accordingly, future studies should consider the use of objective measures to increase the reliability of the results.

Taken together, the two studies raise some interesting findings and questions related to the role of gender in both the assessment of affective functioning, as well as the symptom presentation of autonomic anxiety, depression, negative affect and exercise behaviours among cardiac patients. Specifically, although the HADS provides a gender-impartial assessment of anxiety and depression symptoms with cardiac patients, the fact remains that female cardiac patients have higher rates of anxiety and depression compared to male cardiac patients as evidenced in the current investigation and previous

research (Cardiac Care Network of Ontario, 2002; Frasure-Smith et al., 1999; King, 2001). Therefore, although this discrepancy does not appear to be attributable to measurement variance when using the HADS scale, it is important to consider why the gender differential in anxiety and depression persists. Similarly, although gender differences in the affective functioning and exercise behaviour were clearly apparent in the second investigation, with females demonstrating increased autonomic anxiety, negative affect and depression and reduced exercise compared to males, ultimately, exercise did not explain the differences in men and women's affective functioning. Therefore, if exercise is not accounting for the gender differences in cardiac patients affective functioning, further research is needed to determine what is contributing to the discrepancy. This includes consideration for such factors as distressing life events and experiences, sociocultural roles and beliefs (Piccinelli & Wilson, 2000), coping styles (Nolen-Hoeksma, 1991) and perceptions of control and social support (Lett et al., 2005).

Exploring Gender Differences

Although the gender differential in depression is well established, it is unclear why this differential persists. Various researchers of differing theoretical backgrounds have attempted to address this issue, but the results remain largely inconclusive (Joiner & Blalock, 1995; Nolen-Hoeksma, Larson & Grayson, 1999). Nonetheless, some researchers have argued that there are certain life events and experiences that contribute to gender differences in affective functioning. Specifically, Piccinelli & Wilson (2000) reviewed gender differences in depression and identified several risk factors related to the predominance of depression among women. The identified risk factors included

increased likelihood of; sexual abuse and adverse events in childhood, prior depression and anxiety disorders, and sociocultural roles and associated role strain (Piccinelli & Wilson, 2000). With regard to the latter, researchers have highlighted the need to examine socially constructed gender differences with regards to health (Pittman, 1999; Doyal 2001). For instance, in western cultures, women frequently have multiple responsibilities across domestic, caregiving and work domains (Piccinelli & Wilson, 2000). Furthermore, health campaigns often emphasize women's caring for others versus themselves (Doyal, 2001). Consequently, compared to men, women may have greater challenges in reaching their optimal mental health potential when confronted by multiple roles and caring for others.

Other researchers have suggested that individuals coping styles and responses will influence the maintenance and duration of affective symptoms. According to Teasdale's (1988) Differential Activation Theory, negative memories and schemas will typically be activated among persons with depressed mood. However, it is argued that individuals will differ in their initial patterns of thinking and interpretation of constructs with the onset of depressed mood. In particular, it is suggested that the more negative representations and schemas that are activated, the more likely the situation will be interpreted as negative and uncontrollable, which can in turn lead to passive coping styles (e.g., focusing inward on negative cognitions) that can perpetuate a sense of helplessness and depressed mood. Conversely, if negative schemas are not readily activated or interpreted as uncontrollable, this can lead to active coping skills (e.g., distraction, optimistic cognitions) and create a sense of mastery (Teasdale, 1988).

Building on this work, some researchers have highlighted the important role of gender in responses to depression. For example, according to Nolen-Hoeksema's (1991) response styles theory, men and women engage in different responses, or coping styles to depression that can impact both the presence of symptoms and duration of depressive episodes. Specifically, it is argued that women are more likely than men to engage in ruminative coping responses (i.e., passive and repetitive focus on symptoms, meanings and consequences of distress), whereas men are more likely than women to engage in distracting coping responses (e.g., physical activity, socializing). As a result, women may experience increased depressive symptomatology and prolonged depression, whereas men may experience reduced depressive symptomatology and duration (Noelen-Hoeksema, 1991). Furthermore, some researchers have argued that given women's tendency to ruminate more than men, they may also be more indecisive with their negative attributions and consequently experience both symptoms of anxiety and depression symptoms versus depression symptoms alone (Joiner & Blalock, 1995). Given the consistent findings that compared to male patients, female cardiac patients experience increased presence and duration of both anxiety and depressive symptoms (Frasure-Smith et al., 1995; Frasure-Smith et al., 1999; Grace et al., 2002a; Grace et al., 2002b), future research should investigate the role of ruminative coping styles on affective functioning with this population.

In addition to increased rumination among women, Noelen-Hoeksma et al. (1999) have suggested that compared to men, women experience a reduced sense of mastery over their lives. In speaking to this issue, some researchers have looked at the roles of

illness attributions and beliefs as well as perceptions of control. For instance, King (2002) examined the role of gender on illness attributions and beliefs in MI patients.

Interestingly, although both male and female cardiac patients cited stress as a common cause of their illness, men were more likely than women to cite external sources of stress (e.g., poor exercise, diet) as potential causes of illness, whereas women more frequently cited internal sources of stress (e.g., difficult relationships). Furthermore, compared to men, women were more likely to report concerns for loss of autonomy and self-efficacy in relation to the MI event (King, 2002).

In addition to studying illness beliefs and attributions in relation to cardiac events, researchers have also begun to examine perceptions of control and affective responses in cardiac patients. For instance, in an investigation of gender differences in perceived control and negative affect among CABG patients, it was found that although men and women shared similar, low levels of perceived control related to their CABG event, women experienced greater physical and emotional symptoms of distress (Bar-Tal, Gardosh & Barnoy, 2006). In addition, other investigators have found that perceived control is negatively associated with affective responses in cardiac patients. Specifically, in a recent study of heart failure (HF) patients, higher perceived control was associated with less depression (Heo, Moser, Lennie & Chung, 2006).

Taken together, it is possible that female cardiac patients low perceived control in relation to their cardiac event and/or tendency to attribute illness causation to external factors may in part contribute to the gender discrepancy in affective distress among cardiac patients. However, this is a fairly new area of research with cardiac patients, and

several investigations have been limited by small sample sizes (e.g., 24-121 participants) with specific groups of cardiac patients (e.g., MI, CABG, heart failure) that make it difficult to generalize the results (See Bar-Tal et al., 2006, King, 2002; Heo et al., 2006). Future research is needed to further examine and clarify the relationships between gender, perceived control and affective distress among cardiac patients. Furthermore, it is important to recognize that in addition to considering components of control related to illness causation and beliefs among cardiac patients, it may be useful to examine perceptions of control related to other domains such as social functioning. This would seem particularly important given that both poor social support (See Lett et al., 2005) and marital distress (See Orth-Gomér et al., 2000; Orth-Gomér & Leineweber, 2005) have been shown to negatively impact the affective and physical functioning of cardiac patients.

Low social support is recognized as a risk factor for both the development and worsening of depressive symptoms among cardiac patients (Lett et al., 2005). Furthermore, a recent review of social support and its impacts on coronary heart disease progression and prognosis revealed that compared to men, women are more likely to experience health benefits from positive support and suffer health consequences from negative support (Lett et al., 2005). Indeed, the quality of relational support has been highlighted as a significant variable of study. For instance, studies with heart failure (HF) patients have shown that marital quality (as measured by marital satisfaction, marital routines and useful illness discussions) predicts 4-year and 8-year survivorship.

Moreover, this association was stronger for female compared to male HF patients even when controlling for HF severity (See Coyne et al., 2001, Rohrbaugh et al., 2006).

Interestingly, marital distress has emerged as significant predictor of cardiac prognosis for women. Specifically, studies have shown that compared to female cardiac patients reporting mild-low levels of marital stress, female cardiac patients with high levels of marital distress are at increased risk for experiencing recurrent cardiac events (Orth-Gomer et al., 2000, Orth-Gomer, 2005) and further depression (Orth-Gomer & Leineweber, 2005). Moreover, female cardiac patients who experience both work stress and marital stress are at increased risk of suffering a recurrent cardiac event compared to patients who experience work or marital stress alone (Orth-Gomer & Leineweber, 2005).

Evidently, when female cardiac patients are experiencing relational distress in marital, or other social domains, they have an increased risk for physical distress (e.g., recurrent cardiac events,) and psychological distress (e.g., depression), both of which could possibly interact with, or perpetuate one another. More generally, it is arguable that female cardiac patients' multiple roles and stressors related to work, marriage and family are contributing to their experiences of elevated anxiety and depression (See Orth-Gomér et al., 2000, Orth-Gomér & Leineweber, 2005). Therefore, further exploration of these relationships appears merited.

Ultimately, there are potentially multiple, complex factors that contribute to the gender discrepancies in the affective functioning of cardiac patients. At present, further examination of such variables as multiple roles, illness beliefs and perceptions of control, ruminative coping styles and relational functioning (e.g., social support, marital distress)

appear to be relevant to studying gender differences in both anxiety and depression of cardiac patients. In addition, although exercise did not explain the gender differences in the affective functioning of cardiac patients in the current investigation, the results warrant replication. However, to better explore the variables of negative affect, autonomic anxiety, depression and exercise, there are a few measurement and assessment issues that will need to be addressed.

Measurement/Assessment Issues

Given that depression is associated with increased cardiovascular morbidity and mortality in cardiac patients, the American Heart Association (Lichtman et al., 2008) has recommended that health care professionals routinely administer screening tools for depression symptoms among cardiac patients. Furthermore, it is recommended that patients with positive screenings be referred for a formal assessment of symptoms and possible treatment by a qualified professional (Lichtman et al., 2008). Although the prevalence of “probable” depression (Zigmond & Snaith, 1983) was generally low in the sample, positive screenings were indicated for both men and women across time. Furthermore, the prevalence of “probable” anxiety (Zigmond & Snaith, 1983) was quite elevated within the sample, particularly among the women. Given the recent validation of the three-factor-solution of the HADS with cardiac patients, there are no current norms, or clinically significant cut-points for assessing autonomic anxiety and negative affect with cardiac patients. However, in light of the elevated anxiety symptoms among this sample, as well as recent research findings that cardiac patients with elevated anxiety are

at increased risk for recurrent cardiac events (Frasure-Smith & Lespérance, 2008), future researchers should look to establish such cut-points so that patients can be appropriately screened and referred for further assessment and/or treatment if necessary.

In addition, in order to increase the reliability of the current findings, future research should consider employing objective measures to confirm female cardiac patients increased experience of autonomic anxiety, negative affect and depression, and reduced exercise behaviour. Also, future studies should consider evaluating whether the quality of depression and anxiety (e.g., elevated depression and anxiety symptoms versus clinical depression and anxiety) as assessed by objective measures (e.g., structured clinical interview) influences exercise. Furthermore, participants' use of coping strategies and help-seeking behaviors (e.g., psychotherapy, pharmacotherapy, social support) was not evaluated. However, it is plausible that single or combined coping strategies could lead to reduced affective distress. Therefore, future investigations should consider the potential roles of help seeking behaviours and coping strategies (e.g., medication and counseling) in affective changes with this population.

Also, although exercise did not emerge as a mediator of the gender/affective relationships in the current investigation, this finding should be replicated. In particular, the results from the present study suggested that the exercise difference between men and women was rather small (e.g., standardized beta's ranged from $-.10$ to $-.16$). Consequently, with such small effects, it is difficult to demonstrate that exercise is contributing to differences in the gender/affective relationships. However, it is possible that the self-report measure used in the present investigation did not adequately capture

women's exercise behaviour. Specifically, given the recognition that women may have greater responsibilities than men, including household responsibilities (Picinelli & Wilkinson, 2000), it is important that measures recognize and capture this type of activity. Therefore future studies should consider incorporating measures that include household activities in order to produce more reliable exercise results.

Finally, although the sample size was sufficient to conduct overall analyses and it was diverse in the sense that it consisted of male and female patients with various cardiac conditions (i.e., CABG, AMI, PCI), future investigations should consider increased sample diversity (e.g., inclusion of ethnic minorities) and larger samples to facilitate subgroup analyses.

Practical Applications

The findings from the current investigations raise some important clinical and intervention issues. Specifically, the tripartite model has potential clinical relevance as it can help to identify and distinguish between features of anxiety and depression that may warrant further diagnostic follow-up, and/or clinical intervention (Cook et al., 2004). Clinically, from both a screening and assessment standpoint, it is important to distinguish between different symptom presentations of anxiety, depression, mixed anxiety and depression, and comorbid anxiety and depression, and the tripartite model is useful for making these distinctions (Joiner & Blalock, 1995; Teachman et al., 2007). Moreover, in the context of applying the HADS with cardiac patients, the tripartite model could potentially serve as a relevant screening tool to both identify and distinguish between various symptom presentations. In addition, rather than using separate symptom

screening measures for autonomic anxiety, anhedonic depression and negative affect with cardiac patients, the HADS affords a combined approach that facilitates assessment of the tripartite structures.

Interestingly, the autonomic anxiety construct has previously demonstrated clinical relevance in that it differentiates Panic Disordered patients from patients with Generalized Anxiety Disorder (GAD) and depression (Joiner Jr. et al., 1999). Among cardiac populations, it would seem quite feasible that patients could have difficulty distinguishing between physiological symptoms of anxiety versus legitimate cardiac distress (e.g., MI) as the two can share similar properties (e.g., heart racing, sweating, shortness of breath). Therefore, further study of autonomic anxiety would seem particularly relevant with this population. Furthermore, given that anxiety has been identified as an important, yet understudied variable among cardiac patients (Lane et al., 2003), future investigations should consider the predictive validity and relevance of the HADS autonomic anxiety subscale with respect to diagnostic distinctions (e.g., panic disorder vs. GAD) and clinical outcomes (e.g., rates of mortality, morbidity etc.).

In terms of intervention research, it is important to note that exercise was associated with some small, significant changes in the affective functioning of both male and female cardiac patients at specific time points. In particular, when reflecting upon the moderating analyses using absolute values, it appeared that exercise was particularly beneficial for men and women after their initial hospitalization and 24-months later. When reflecting upon the moderating analyses using change scores, changes in exercise appeared beneficial for changes in affective functioning for men again between baseline

to 6-months and 12-24. These findings highlight that the timing of exercise interventions may be useful for reducing affective distress in cardiac patients both initially after their hospitalization and up to six months, then again between 1-year and 2-years post hospitalization. Furthermore, alternative interventions to exercise (e.g., pharmacotherapy, counseling) may merit consideration during the 6-12 month time period in order to reduce cardiac patients affective distress during this time frame. In addition, previous research (e.g., Oldridge et al., 1991) has highlighted that a combination of exercise and cognitive behavioural therapy may afford optimal mood benefits for post-MI patients (e.g., reduction in anxiety symptoms). Therefore, combined treatment approaches may warrant further investigation with diverse groups of cardiac patients.

Summary

The results of the two studies provide new information about the psychometric properties of the HADS and the relationships between gender, exercise, autonomic anxiety, negative affect and depression up to two years after hospitalization in a representative sample of cardiac patients. The results of Study 1 demonstrated that a three-factor structure of the HADS comprised of autonomic anxiety, negative affect and depression emerged consistently over time. Specifically, the Dunbar et al (2000) hierarchical, correlated model provided the most statistically sound version of the HADS with cardiac patients across 24-months. In addition, within the sample, the HADS was invariant by gender, regardless of the model that was tested. Therefore, both male and female cardiac patients approached and responded to the HADS items in a similar manner. Based on the results from the first investigation, it can be argued that the HADS

can be appropriately used as a screening instrument for autonomic anxiety, negative affect and depression in both male and female cardiac patients.

With regard to Study 2, the prevalence of anxiety within the sample was consistent with the ranges reported in the cardiac literature, while the prevalence of depression was lower than the typical reported ranges. Distinct gender differences emerged in relation to cardiac patients' affective functioning and exercise behaviour with women showing greater autonomic anxiety, negative affect and depression and reduced exercise compared to men across all time periods. With respect to the moderating analyses, gender did not moderate any of the exercise/affective relationships when using absolute values. However, it is important to note that exercise was significantly, negatively related to autonomic anxiety, negative affect and depression at various time points for both men and women. Similarly, the results of the moderation analyses using change scores indicated that none of the exercise changes/affective changes relationships were moderated by gender. However, small, significant negative relationships emerged for men at specific time periods (e.g., the first and last six-months of the investigation). Finally, the results of the mediation analyses indicated that exercise did not mediate any of the gender/affective relationships. Based on the results from the second investigation, it is evident that gender differences are apparent in the exercise behaviour and affective distress of cardiac patients, with females demonstrating increased autonomic anxiety, negative affect and depression, and reduced exercise compared to males over two years. However, gender did not moderate any of the exercise/affective relationships, and exercise did not mediate any of the gender/affective relationships.

Future investigations should examine the predictive validity and relevance of the HADS tripartite structures with respect to diagnostic distinctions and clinical outcomes among cardiac patients and other clinical populations. In addition, further research is needed to clarify the complex relationships between gender, autonomic anxiety, negative affect and depression among cardiac patients. Subsequent investigations should consider the use of objective measures of affective functioning, in addition to assessment of such factors as psychotherapy and/or pharmacotherapy use, and types of coping responses (e.g., ruminative coping style), and the presence of multiple stressors (e.g., relational distress, work stress) in relation to male and female cardiac patients affective functioning

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