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Understanding adherence in patients with coronary heart disease: Illness representations and readiness to engage in healthy behaviours

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RUNNING HEAD: ADHERENCE IN CORONARY HEART DISEASE

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Abstract

In people with Coronary Heart Disease (CHD), poor adherence to medication, exercise, and dietary recommendations can compromise prognosis. This study investigated respective associations of the Commonsense Self-Regulation Model (CSM), the Transtheoretical Model (TM), and trait affect with patients' self-reported adherence to treatment. One hundred and forty-two CHD outpatients completed the Illness Perceptions Questionnaire Revised, Self Efficacy, Stage of Change, Positive and Negative Affect Scale, and General Adherence Questionnaire. Stage of change and self-efficacy were associated with self-reported medication, diet, and exercise adherence. In comparison, the CSM accounted for a smaller proportion of variance in adherence. In hierarchical regression the variance from CSM variables associated with exercise adherence was no longer significant when TM variables were in the equation. For dietary and medication adherence, in contrast, both emotional representations (CSM) and TM variables contributed independently to the regression equation. There was some evidence that trait affect moderated the associations between the CSM variable of emotional representations and dietary adherence. Results suggest that the largest effects for improving adherence to medication, exercise and dietary recommendations would occur by increasing readiness to change for exercise, increasing domain-specific self-efficacy, and decreasing negative emotions about CHD. Additional implications for research and practice are discussed.

Keywords: Coronary Heart Disease, Illness Perceptions, Self Efficacy, Self-Regulatory Model, Transtheoretical Model, Treatment Adherence

Understanding adherence in patients with coronary heart disease: Illness representations and readiness to engage in healthy behaviours

Cardiovascular disease is an Australian National Health Priority Area and one of five areas targeted as part of the National Chronic Disease Strategy (National Health Priority Action Council, 2006). Complementing improved biomedical approaches to preventing and treating cardiovascular disease has been growing recognition of the importance of behavioural factors and behavioural approaches to optimal management (National Collaborating Centre for Primary Care, 2007). For example, changes in lifestyle-related risk factors such as smoking, cholesterol, and blood pressure have been estimated to contribute approximately 44% to 76% of reductions in mortality from coronary heart disease (CHD) that have occurred in most Western countries since the latter part of the twentieth century, with direct medical treatments such as surgery and coronary care unit admissions estimated to contribute approximately 23% to 47% of these reductions (Ford & Capewell, 2011). CHD is a major cause of death (Rosamond et al., 2008) and adversely affects survivors' quality of life (Garster, Palta, Sweitzer, Kaplan, & Fryback, 2009). With its application of biopsychosocial approaches to understanding and managing health problems, health psychology is contributing to efforts to understand and manage CHD (Byrne, Walsh, & Murphy, 2005; Whalley et al., 2011).

An important area of current investigation is treatment adherence (Davies et al., 2010). The World Health Organisation has defined adherence to long-term therapies as “the extent to which a person's behaviour – taking medication, following a diet, and/or executing lifestyle changes, corresponds with agreed recommendations from a health care provider” (Sabate, 2003, p. 3). Poor adherence to CHD medication is associated with increased re-hospitalisation (Sokol, McGuigan, Verbrugge, & Epstein, 2005) and mortality (Horwitz et al., 1990). Conversely, adherence to recommended intensive lifestyle changes following CHD has been associated with reduced coronary atherosclerosis and decreased cardiac events over a one to

five year follow-up (Ornish et al., 1998). However, adherence is complex and determining how best to direct health resources to improve adherence to CHD treatments is a challenge. For example, although it is recommended that tailored psychological therapy such as CBT should be offered only to selected patients undergoing cardiac rehabilitation (National Collaborating Centre for Primary Care, 2007), the moderators that would aid in selecting patients to be offered such interventions are not fully understood (Whalley et al., 2011).

Research points to the importance of investigating adherence in multiple domains, because adherence and its predictors vary in relation to both treatment and patient characteristics (Vermeire, Hearnshaw, Royen, & Denekens, 2001). Adherence interventions have been shown to be more effective if they address multiple health behaviours rather than single behaviours (Johnson et al., 2008) and if they integrate affective, cognitive and behavioural elements (Roter et al., 1998). However, models of health behaviour that have been applied to adherence tend to focus more on some of these elements than on others. Research that recognises the strengths of different models of health behaviour via integrating models can help to advance conceptual development and intervention effectiveness (Hagger, 2009).

The present study examined adherence regarding medication, exercise, and diet in Australian patients with CHD. Potential predictors of adherence that were studied were cognitive and affective factors from the Commonsense Self-Regulation Model of Illness (CSM; Leventhal, Nerenz, & Steele, 1984); more proximal motivational and behavioural factors from the Transtheoretical Model (TM; Prochaska & DiClemente, 1983); and a potential moderating influence of trait affect. These models were expected to complement each other by addressing different explanatory factors that may work together to explain adherence. Examining the models in combination, with regard to each of the three health behaviours, allowed investigation of which constructs from the models predict adherence and

therefore might be most useful to target in future interventions (Hagger, 2009; Maes & Karoly, 2005).

CSM

The CSM (Leventhal et al., 1984) suggests that patients select coping strategies based on their personal cognitive and emotional representations of the illness. Earlier versions of the model included five dimensions: *Identity* (label and symptoms); *Cause* (beliefs about cause); *Timeline* (beliefs about how long the illness will last); *Consequences* (beliefs about effects of the illness); and *Cure or Control* (perceptions about whether the illness can be modified; Leventhal et al., 1984). Later measures have separated *Cure or Control* into *Treatment Control* and *Personal Control* and added the dimensions of *Cyclical Timeline*, *Illness coherence* (extent to which the illness makes sense to the individual) and *Emotional representations* (negative emotions about the illness; Moss-Morris et al., 2002).

Meta-analysis for CHD (French, Cooper, & Weinman, 2006) and other illnesses (Hagger & Orbell, 2003) has shown that higher adherence to diet and medication was associated with higher cure/control beliefs. Cardiac rehabilitation attendance has been correlated with higher identity, consequences, and illness coherence (French et al.) as well as higher cure/control (Petrie, Weinman, Sharpe, & Buckley, 1996) and personal control beliefs (Tolmie et al., 2009). Among patients with hypertension, higher medication adherence was associated with treatment control whereas diet and exercise adherence were associated with personal control (Chen, Tsai, & Lee, 2009). In contrast, findings indicating no or weak relationships between illness perceptions and smoking, exercise, diet, alcohol use, and medication adherence among patients with CHD have also been reported (Byrne et al., 2005).

The CSM provides greater detail about individual differences in cognitions and affect specific to a particular illness than does many other health behaviour models. It has been found to add predictive value to other models for health behaviours such as dietary self-care in adolescents with Type 2 diabetes (Nouwen, Law, Hussain, McGovern, & Napier, 2009)

and attendance at appointments after cervical abnormality (Orbell, Hagger, Brown, & Tidy, 2006). However, the dynamic relations of cognition, affect and behaviour over time, as well as the complex role of affect in the CSM, are aspects of the CSM that require further research (Leventhal, Halm, Horowitz, Leventhal, & Ozakinci, 2004). The following sections introduce theoretical approaches that complement these aspects of the CSM.

TM

Prochaska and DiClemente's TM of behaviour change involves a series of progressively more committed stages: pre-contemplation, contemplation, preparation, action, and maintenance (Prochaska & DiClemente, 1983). Self-efficacy for implementing the behaviour is important at all stages of change, as described by leading researchers in both self-efficacy (Bandura, 1999) and the TM (Prochaska & Velicer, 1997). While there has been significant criticism of the TM (West, 2005), other reviewers consider that it continues to have value (Armitage, 2009). A key review of self-regulatory models including the CSM has noted that the TM complements self-regulatory models by emphasising differences between initial and long-term behaviour change, as evidenced by a number of health behaviour maintenance studies (Maes & Karoly, 2005). Similarly, findings on the interaction of the TM and CSM in people with eating disorders support attention to stage of change in interventions to address illness perceptions (Stockford, Turner, & Cooper, 2007). TM constructs would be expected to add predictive value to the CSM when these models are studied in combination, by taking more account of changes in explanatory factors and behaviour over time. The present study examined "stage" and self-efficacy, which is included in the TM and in other models of health behaviour. Three constructs that are measured in some studies of the TM, namely decisional balance, processes of change, and temptations (Armitage, 2009; Prochaska & Velicer, 1997) were not included in the present study, because the study aimed to examine key constructs theorised to be useful in combination rather than comparing models in their entirety.

The applicability of stage of change for understanding adherence in patients with CHD has been noted (Sneed & Paul, 2003). Individuals may be in different stages of change for separate treatment domains (Johnson et al., 2006). Self-efficacy has also been associated with adherence to cardiac treatment in both cross-sectional (Jackson, Leclerc, Erskine, & Linden, 2005) and prospective studies (Woodgate, Brawley, & Weston, 2005). Self-efficacy has been found to add to stage of change in predicting adherence to exercise (Marcus, Eaton, Rossi, & Harlow, 1994) and self-management for conditions such as chronic pain (Habib, 2002).

Affect

Chronic negative emotions such as depression and anxiety have been associated with CHD risk. Suls and Bunde (2005) found depression and anxiety to be risk factors for the initial development of CHD as well as increased cardiac morbidity in clinical CHD populations. Decreased adherence to cardiac treatments in patients who have depression is one potential mechanism for these relationships (Leventhal et al., 2004; Ziegelstein et al., 2000). A meta-analysis across different illnesses found that patients with depression were three times more likely to be non-adherent to medical treatments than patients who were not depressed (DiMatteo, Lepper, & Croghan, 2000). Conversely, there is some evidence for protective health effects of positive affect, but this has been studied less than negative affect (Cohen & Pressman, 2006).

The present study tested the proposition that the tendency to experience chronic negative emotions and/or low positive emotions could act as moderators of how illness perceptions translate into coping behaviours that affect adherence. For example, even if a patient believes that medication would help control their CHD (high treatment control), chronic negative affect may act as a barrier to acting on this illness perception and therefore reduce adherence in patients high in this trait. If found to be an important predictor, this would suggest that screening for psychological distress in CHD should include not only

current distress (as measured in many clinical services), but also lifetime history and trait affect.

Present Study

Given evidence for associations of CHD regimen adherence with the CSM (French et al., 2006), TM (Johnson et al., 2006), and mood (Ziegelstein et al., 2000), the present study investigated these models in combination. It was postulated that illness representations would be associated with adherence due to patients' selection of coping strategies (intentions); that TM variables would explain further variance in adherence regarding translation of these intentions into action; and that trait affect may act as a moderator in the relationship between illness perceptions and adherence.

Specifically, based on relations found previously in the literature cited above, it was hypothesised that (1) perceived identity, consequences, treatment control, personal control and illness coherence would have significant associations with self-reported adherence to medication, exercise, and diet; (2) stage of change and self-efficacy would have significant independent associations with adherence after illness perceptions were accounted for; and (3) trait affect would moderate the relationships between illness perceptions and adherence.

Method

Participants

One hundred and fifty-four patients diagnosed with CHD were recruited from four outpatient clinics on the Gold Coast, Australia and gave informed consent. The 142 participants with complete data consisted of 99 males aged 30-87 years ($M=64.4$, $SD=11.5$) and 43 females aged 31-86 years ($M=66.4$, $SD=14.1$). Of participants aged 65 or more, 95% were retired and 5% were working or studying; their median household income in the range \$15,000 to \$25,000 Australian dollars per annum was consistent with contemporary Australian data for this age group (Australian Institute of Health and Welfare, 2007). Among participants aged 30-64 years, 11% were retired, 56% were working or studying, 8% were

unemployed, 6% were on sick leave and 20% received a disability support pension. Among the participants aged less than 65 years, median household income was in the bracket \$26,000 to \$35,000 per annum, below the Australian median household income at the time of approximately \$50,000 per annum (Australian Bureau of Statistics, 2007). Participants' occupation or former occupation before retirement represented a spread across all major categories in the Australian and New Zealand Standard Classification of Occupations (Pink & Bascand, 2009). Marital status (70% married or partnered, 16% divorced or separated, 9% widowed, 6% single) was consistent with overall Australian population data (Australian Bureau of Statistics, 2007). Ten percent of patients reported that they currently smoked cigarettes occasionally or regularly, 53% reported former smoking and 37% said they had never smoked. These proportions were similar to smoking status in a previous study involving more than 1,000 CHD outpatients (Byrne et al., 2005).

Materials

The self-report questionnaire¹ commenced with a brief demographic section, followed by five principal measures.

Revised Illness Perception Questionnaire (IPQ-R). The IPQ-R (Moss-Morris et al., 2002) was used to assess illness representation subscales of Identity, Timeline (acute/chronic), Consequences, Personal control, Treatment control, Illness coherence, Timeline (cyclical), and Emotional representations. The Identity subscale has a *Yes/No* response format and remaining subscales use a 5-point scale from *Strongly Disagree* to *Strongly Agree*. The IPQ-R has shown good internal reliability, test-retest reliability, and construct and discriminant validity (Moss-Morris et al., 2002). In the present study, Cronbach's alpha for subscales ranged from .68-.88.

Self-efficacy. Participants rated their confidence in performing the specific health behaviour, on a scale from 0 (*Not at all confident*) to 10 (*Extremely confident*). These items were adapted from Habib (2002). For example, the medication item was "On the following

scale, please indicate how CONFIDENT you are that you can use your medications to help manage your heart condition”. Two further items assessed dietary and exercise self-efficacy respectively.

Stage of change. Stage of change for adherence with medication, diet, and exercise was measured using a single item with a five-option response format, following Sneed and Paul (2003). For example, the medication item asked “Do you consistently take your prescribed medications as directed?” The dietary item referred to trying to lose weight by eating fewer or less fattening foods and/or consistently avoiding salty foods. The exercise item was “Do you consistently get regular exercise, that is, walk (or other exercise advised for you) three times a week for at least 30 minutes?” No intention to follow the recommendation within the next 6 months was scored as precontemplation, intention to commence within the next 6 months as contemplation, intention to commence within the next 30 days as preparation, commencement within the previous 6 months as action, and implementation of the recommendation for more than 6 months as maintenance.

The Positive and Negative Affect Scale (PANAS). The PANAS (Watson, Clark, & Tellegen, 1988) was used to measure participants’ trait levels of negative (NA) and positive affect (PA). Participants rated the degree to which they *generally* experienced a list of 20 mood related adjectives (10 positive and 10 negative) on a scale from 1 (*Very slightly or not at all*) to 5 (*Extremely*). The scale has shown high internal consistency, test-retest reliability, and discriminant validity (Watson et al.). In the present study, Cronbach’s alpha was .87 for both PA and NA.

General Adherence Scale. The General Adherence Scale (DiMatteo, Hays, & Sherbourne, 1992) was used for the three outcome measures regarding a participant’s propensity to follow medical recommendations regarding medication, diet, and exercise respectively. For each domain, patients rated five statements (e.g., “I have difficulty doing what my doctor recommends with regard to exercising”) on a five-point scale from 1 (*None of*

the Time) to 5 (*All of the Time*). Cronbach’s alpha of .80 or higher has been reported previously (DiMatteo et al.). In the present study, Cronbach’s alpha was .74, .89 and .91 for medication, diet and exercise respectively.

Procedure

Following ethics committee approval, questionnaires and reply paid envelopes were made available at each clinic. Eligible patients were informed about the study by their medical practitioner, receptionist or the researcher and then completed questionnaires on site or at home.

Results

Data Screening and Statistical Approach

Twelve participants omitted one or more scales. Because these cases did not otherwise differ from complete cases, only complete cases ($N=142$) were analysed subsequently. Four cases contained univariate outliers of more than three standard deviations from the mean. These cases each had a single outlying variable, due to one case with a high score on negative affect and three others with low scores on personal control, treatment control, and dietary adherence respectively. These cases were retained for analysis but the outlying scores were replaced with a score one unit higher or lower than the next most extreme score to reduce their influence on statistical results (Tabachnick & Fidell, 1989). There were no multivariate outliers. Skewness was identified in medication adherence; medication, diet, and exercise self-efficacy; illness coherence; and negative affect. Also, due to ordinal measurement of stage of change, the stage of change variables were dummy coded by dichotomising into pre-action stages compared to action and maintenance, which is the most meaningful theoretical division (Armitage, 2009). Table 1 shows the transformations used to correct skewness, as well as descriptive statistics and correlations among variables.

Insert Table 1 about here

ANOVA was used to compare adherence among health behaviour domains. Hierarchical multiple regression was used to investigate the contributions of the various factors to adherence. Due to the absence of correlations between demographic variables (age and sex) and the outcome measures, demographic variables were not entered into the regression models. Illness representations were entered first, given that the CSM posits that such representations affect behaviour indirectly, via coping strategies. TM variables, which are more directly linked to the behavioural outcomes and therefore theoretically considered more proximal to the outcome variables, were entered next. To examine hypothesised moderator effects of trait affect, the recommendations of Howell (2002) were followed: Illness perception and trait affect variables were centred, and a moderator term (e.g., centred emotional representations x centred positive affect) was created. Moderator terms were included for all illness perception variables that had a significant independent association with adherence at Step 1 of the regression. The trait affect and interaction terms were entered last in hierarchical regression, to examine potential moderator effects.

Adherence Compared Among Treatment Domains

Repeated measures ANOVA showed that self-reported adherence differed among treatment domains, $F(2,282)=79.84, p<.001$. Post-hoc comparisons with Bonferroni correction revealed that all three domains differed significantly from each other: Medication adherence was significantly greater than dietary adherence, and dietary adherence was significantly greater than exercise adherence ($ps<.001$).

Relationships Between Explanatory Factors and Adherence to Medication, Diet and Exercise

As shown in Table 1, adherence measures for medication, diet, and exercise all showed correlations with CSM, TM, and trait affect variables, but not with demographic variables. The specific associations are discussed below in relation to multiple regression analyses.

Correlations among the outcome variables (adherence to each domain) and explanatory factors (demographics, illness perceptions, self efficacy, stage of change, and positive and negative affect) are also shown in Table 1. Medication adherence did not correlate with dietary or exercise adherence. However, dietary and exercise adherence were correlated. Self-efficacy showed significant correlations among all three treatment domains. Medication, dietary and exercise stages of change did not correlate with other. Table 2 shows the numbers of participants in each stage of change for each of the three health behaviours.

Insert Table 2 about here

Adherence, CSM, TM and Trait Affect

Medication. A hierarchical multiple regression showed that the CSM, TM, and trait affect variables together accounted for 23% of the variance in medication adherence, $R^2_{adj} = .23$, $F(14, 127) = 3.99$, $p < .001$ (see Table 3). Significant changes in medication adherence variance accounted for at both Steps 1 and 2 indicated a significant association of the block of CSM predictors with adherence as well as a significant increment added by TM variables. Lower emotional representations had significant independent associations with higher medication adherence at Steps 1 (6% of variance), 2 (5%) and 3 (6%). Higher medication self-efficacy (6% of variance at Step 2, 5% at Step 3) and higher medication stage of change (5% at Step 2, 6% at Step 3) also had significant independent associations with adherence. Neither trait affect nor moderation terms for the interaction between trait affect and emotional representations were significantly associated with medication adherence when the CSM and TM factors were in the regression equation.

Insert Table 3 about here

Diet. The combination of CSM variables predicted a statistically non-significant amount of variance in Step 1 of a hierarchical multiple regression for dietary adherence, $R^2_{adj} = .03$ (see Table 4). The two TM factors accounted for an additional 20% of the variance in dietary adherence. At Step 2, higher dietary adherence showed significant independent

associations with lower emotional representations (3% of variance in adherence) and higher dietary self-efficacy (13%).

Step 3, which added both trait affect and moderator terms for the interaction of positive affect with emotional representations, did not reach statistical significance for the amount of additional variance accounted for. The overall regression equation remained significant at Step 3 and significant independent associations with dietary adherence were found for self-efficacy (12%) and the interaction between positive trait affect and emotional representations (2% of variance). Participants reporting high negative emotion regarding CHD combined with low trait positive affect tended to report poorer dietary adherence, although positive affect was not a predictor by itself.

Insert Table 4 about here

Exercise. The CSM variables accounted for statistically significant variance in exercise adherence at Step 1 (see Table 5). There were significant independent associations with illness consequences (3% of variance), timeline cyclical (5%), and emotional representations (5%). Timeline cyclical had a larger beta weight than bivariate correlation with exercise adherence; further examination found that emotional representation was acting as a suppressor variable, because timeline cyclical had a non-significant beta weight if emotional representation was excluded from the regression.

At Step 2, TM variables accounted for a significant increment in the variance in self-reported adherence to exercise. Stage of change had a significant independent association with exercise adherence (27% of variance accounted for), but self-efficacy did not, $\beta = .08$, ns. Neither trait affect nor moderation terms for the interaction between trait affect and illness perception variables were significantly associated with medication adherence when the CSM and TM factors were in the regression equation. No moderation term was included for timeline cyclical at Step 3, given that its beta weight at Step 1 was statistically significant only due to the presence of a suppressor variable.

Insert Table 5 about here

Stage of change and adherence. As a check on whether results were due to measurement overlap between adherence and stage of change, regressions were re-run without stage of change. Total adjusted R^2 at Step 3 decreased, to .17, .19, and .24 for medication, dietary, and exercise adherence respectively, but the statistical significance of blocks of predictors was unchanged and there were only minor changes to beta weights for individual variables that did not change the overall pattern of results.

Discussion

To the authors' knowledge, no previously published study has examined CHD treatment adherence from the perspectives of both the CSM and TM, whilst simultaneously assessing trait affect. Results showed variability in adherence and the explanatory factors when assessing medication, diet, and exercise adherence respectively. Both CSM and TM variables were associated with adherence in multivariate analyses. Trait affect did not have a direct independent association with adherence when evaluated in combination with CSM and TM variables, but there was some evidence that it moderated the association between CSM variables and dietary adherence.

As expected, the treatment domains differed regarding levels of self-reported adherence. Overall, CHD patients reported high medication adherence. Greater divergence was reported in adhering to dietary recommendations, followed by exercise. The same order for levels of adherence to these three domains has been found in other conditions that have complex regimens, such as diabetes (Kravitz et al., 1993; Ruggiero et al., 1997). A slightly different pattern was found for patients on cholesterol-lowering medication, who reported highest adherence to medication, followed by exercise and then diet (Johnson et al., 2006). Thus, even though there is evidence that patients with good adherence to medication tend to have healthy lifestyles (Simpson et al., 2006), this cannot be assumed and specific

interventions may be needed regarding adherence to lifestyle recommendations as well as adherence to medication.

Both correlations and multivariate analyses showed relations between CSM and adherence measures but these varied from predictions of Hypothesis 1. When CSM factors alone were evaluated at Step 1 of multiple regressions, higher negative emotional representations of CHD were associated with poorer adherence for all three treatment domains. The expectation that higher scores on identity, consequences, control, and illness coherence would be associated with higher adherence was not supported. This contrasted with previous findings regarding the CSM and cardiac rehabilitation (French et al., 2006). Illness consequences were associated with exercise adherence but in the opposite direction: patients who believed their illness had more severe consequences reported lower adherence to exercise. It may be that patients who perceived their CHD as more serious were more concerned about potential risks of exercise when not supervised by health professionals.

Hypothesis 2 was supported for both TM variables. Medication, dietary and exercise adherence correlated positively with stage of change and this remained a significant independent association in hierarchical multiple regressions for medication and exercise adherence after variance related to CSM variables was accounted for. Stage of change for diet approached significance in the regression for dietary adherence ($p < .10$ at Steps 2 and 3) but did not reach statistical significance. Associations between stage of change and adherence were consistent with previous research (Sneed & Paul, 2003). However, among patients in the earlier (pre-action) stages of change, the majority of patients were in pre-contemplation regarding dietary adherence whereas only a small minority of these patients were in pre-contemplation for either medication or exercise (see Table 2). This occurred even though higher adherence was reported for diet than exercise overall, and suggests that different types of intervention strategies may be needed for CHD patients who are non-adherent to diet than those who are non-adherent to exercise or medication. If similar findings occurred within a

clinical service that needed to deliver a standard intervention for CHD patients, TM “processes of change” appropriate for precontemplation might be featured more heavily in the dietary component, whereas processes of change for contemplation and preparation may have more overall impact regarding medication and exercise adherence. Findings regarding stage models such as the TTM in conjunction with self-regulatory models such as the CSM have suggested that it is important to encourage setting realistic behaviour change goals at each stage (such as through motivational interviewing) and monitoring satisfaction or dissatisfaction with behaviour change at each stage (Maes & Karoly, 2005). The findings of the present study provide further support that stage of change may be helpful to target in interventions for CHD adherence that also address illness perceptions.

Self-efficacy showed a significant independent association with medication and dietary adherence. This was consistent with previous findings for CHD (Jackson et al., 2005). For exercise adherence, self-efficacy showed a significant correlation but did not make an independent contribution to adherence when stage of change was included. Self-efficacy has previously been associated with exercise in both CHD patients (Woodgate et al., 2005) and healthy older adults (McAuley, Courneya, Rudolph, & Lox, 1994). For example, McAuley et al. (1994) found that interventions enhancing efficacy were particularly effective in aiding adoption of an exercise program. Although it might be expected that CHD patients would also respond positively to efficacy-enhancing interventions, the present results suggest that other methods to increase patients’ readiness to change their exercise behaviour may have a stronger independent effect. For example, such interventions could include specific action plans and goal-setting (Maes & Karoly, 2005).

A final aim was to examine whether a patient’s general disposition regarding positive and negative affect moderated relationships between illness perceptions and adherence. There was some evidence of this for dietary adherence, where trait positive affect interacted with emotional representations. The interaction suggested that, for people with higher negative

affect concerning their CHD, high trait positive affect was associated with a buffering effect for adherence whereas the combination of low trait positive affect and high negative emotional representations of CHD explained additional variance in poor dietary adherence over emotional representations alone. A buffering role for trait positive affect has been associated previously with both health behaviours and health outcomes (Cohen & Pressman, 2006). This suggests that measuring trait affect could potentially lead to more efficient targeting of patients to be offered more intensive interventions for adherence than relying on measures of current distress alone. However, given the small amount of variance accounted for by the moderating effect, the practical significance of this finding is questionable.

Limitations

It is not known what proportion of eligible patients chose to participate, and the self-selected sample may have been biased towards patients interested in the topic. Indeed, participants' clinic attendance implies adherence intention, and thus the study's findings are perhaps most relevant to this population of ostensible adherers. It would have been helpful to collect data on additional clinical characteristics such as comorbidity and time since diagnosis. Owing to the cross-sectional design, it was not possible to test the directions of the associations found between the TM and CSM factors, affect, and adherence. Although the overall proportion of variance accounted for in hierarchical multiple regression was more than 50% for exercise adherence, in relation to dietary and medication adherence a more modest proportion of variance was accounted for. This suggests that there may be additional important predictors for adherence that were not measured in the present study and may also be associated with restrictions in range due to ceiling effects.

A further caveat to interpretation is measurement of some constructs. Items on "confidence" regarding treatment have been described as "self-efficacy", but this wording may have incorporated outcome expectancies in addition to self-efficacy. CSM items referred to "your heart condition" rather than to more detailed aspects of the illness experience such as

specific treatments. Although illness perceptions were measured with the dominant instrument for CSM research, this study's design can be viewed as testing different measures rather than the models themselves (Leventhal, Weinman, Leventhal, & Phillips, 2008).

It was also considered whether adherence and stage of change items were measuring the same or different constructs. Adherence items referred to the doctor's "recommendations" or "suggestions". Stage of change items were more behaviourally specific. However, adherence and stage of change were not so highly correlated as to suggest measurement of the same construct, and there were different patterns of results for adherence and stage. For example, diet and exercise correlated significantly for adherence but not stage. Regressions run without stage of change demonstrated that the pattern of results for the main analyses cannot be accounted for by overlap between stage of change and adherence measures.

Future Research

This study supported the proposition that TM and CSM variables can act in combination to explain adherence to CHD treatments. Further research, such as longitudinal research that addresses the limitations described above, would help clarify the extent to which the variables found to be most strongly associated with adherence in the present study, namely stage of change, self-efficacy and emotional representations, would be useful targets for interventions that use an integrated theoretical approach. Inclusion of the additional TM constructs, especially processes of change (Armitage, 2009) is recommended. Such studies should address multiple adherence domains rather than a single domain. Because there was some evidence that trait affect moderated the association between negative emotions regarding CHD and dietary adherence, it may be valuable for Australian health psychologists to further investigate characteristics such as low trait positive affect that could help to identify individuals who would benefit from tailored psychological support during cardiac rehabilitation. More detailed exploration of affect linked to adherence in CHD, including emotional distress specific to CHD (CSM emotional representations), depression, and trait

affect, would be useful. Additional insight into the role of cognitive illness perceptions might be gained by more detailed study than available via the IPQ-R measure (Leventhal et al., 2008).

Implications for Intervention

Although self-reported medication adherence was high, adherence to diet and exercise was lower, suggesting that these domains should be a focus for intervention. Findings of the present study suggested that clinical resources might be most efficiently utilised by aiming to move patients towards the action stage for exercise, whilst bolstering patient self-efficacy for implementing domain-specific treatment recommendations and reducing negative affect concerning CHD, especially in patients with low trait positive affect. As Australian health psychologists and their colleagues continue to innovate in methods for cardiac rehabilitation, including use of mobile and computer technologies (Varnfield et al., 2011), it will be important to continue developing theory-based interventions that provide maximum clinical value.

Key Points

What is already known about this topic

- Better adherence to medication and lifestyle recommendations can improve outcomes in cardiovascular disease
- Psychological models such as the transtheoretical model and commonsense self-regulation model have been linked to adherence in these patients
- Chronic negative emotions such as depression and anxiety have been associated with increased risk of cardiovascular disease

What this topic adds

- Further support for addressing self-efficacy for adherence to specific domains such as diet and exercise
- Low trait positive affect may be a risk factor for poor adherence that interacts with current affective state
- Negative emotions specific to cardiac health were associated with poorer adherence to medication, diet and exercise, whereas cognitive representations were more selectively associated with only exercise adherence in the present study

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Endnote

¹ Available from the 4th author on request

Table 1***Descriptive Statistics and Correlations (N=142)***

Measure (& transformation)	<i>M (SD)</i>	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Demographics																					
1.Age	65.0(12.3)																				
2.Sex (<i>n</i> / <i>%</i> male)	99/70%	-.07																			
Illness Perceptions																					
3.Identity	4.2 (3.1)	-.19*	-.04																		
4.TL Acute	21.3 (5.4)	.04	-.10	.03																	
5.Consequences	19.8 (4.7)	-.21*	.16	.42***	.33***																
6.Personal Control	22.5 (4.0)	-.18*	.00	-.01	-.14	-.09															
7.Treatment Control	21.3 (2.6)	-.14	-.08	-.13	-.12	-.13	.55***														
8.Coherence ^{R,S}	18.6 (4.1)	-.09	-.08	-.08	-.19*	.01	-.22**	-.12													
9.TL Cyclical	11.8 (3.2)	-.19*	-.07	.25**	-.13	.31***	-.26**	-.20*	.38***												
10.Emotional representations	17.5 (5.2)	-.18*	-.01	.35***	.07	.51***	-.13	-.11	.12	.51***											
Self-Efficacy																					
11.Medication ^{R,I}	9.0 (1.7)	.24**	-.08	-.04	.04	-.19*	.02	-.01	-.09	-.10	-.09										
12.Diet ^{R,S}	7.9 (2.4)	-.02	-.08	.03	.11	.06	-.08	.00	.04	-.01	.07	-.20*									
13.Exercise ^{R,I}	7.8 (2.7)	.08	.05	-.15	-.32***	-.30***	.16	.05	-.01	.05	-.26**	.26**	-.41***								
Stage of Change																					
14.Medication ^D	4.7 (0.6)	-.02	.06	-.08	-.02	.01	-.02	.05	-.03	-.05	-.10	.28***	.02	-.04							
15.Diet ^D	4.0 (1.5)	-.05	-.07	.00	-.03	-.03	-.06	-.10	.04	.15	.13	.04	-.24**	.14	-.06						
16.Exercise ^D	3.8 (1.3)	.03	.06	-.08	.02	-.20*	.12	-.07	-.04	.02	-.24**	.05	-.21*	.47***	.02	.13					
Trait Affect																					
17.Positive	33.5 (7.9)	.00	-.12	-.11	-.14	-.34***	.21*	.09	.02	-.06	-.27***	.27***	-.25**	.34***	.03	.04	.23**				
18.Negative ^S	19.9 (7.2)	-.20*	.05	.36***	.05	.35***	-.16	-.18*	.13	.37***	.61***	-.16	.10	-.13	-.08	.01	-.17*	-.26**			
Adherence																					
19.Medication ^{R,L}	22.7 (3.0)	-.05	.03	.19*	-.05	.07	-.01	.07	.02	.16	.30***	-.33***	.07	-.08	-.35***	.07	-.04	-.17*	.13		
20.Diet	19.0 (4.5)	.10	-.09	-.15	-.09	-.15	.08	.06	.09	.04	-.19*	.08	-.43**	.29***	-.02	.22**	.38***	.16	-.19*	-.11	
21.Exercise	17.0 (5.7)	-.01	.10	-.14	-.10	-.30***	.11	.02	-.03	.01	-.30***	.02	-.29***	.48***	-.06	.13	.72***	.25**	-.18*	-.04	.55***

Note Means and standard deviations are from untransformed scores. Correlations use transformations, which are represented as: ^RReflected, ^SSquare Root,

^IInverse, ^LLog₁₀, ^DDichotomised. For ^{R,S} and ^{R,L} variables the direction of interpretation is reversed from the raw scores. **p*<.05 ***p*<.01 ****p*<.001

Table 2.*Numbers (and Percentages) of Participants in Each Stage of Change for Each Health**Behaviour*

Domain	Precontemplation	Contemplation	Preparation	Action	Maintenance
	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)
Medication	1 (1)	1 (1)	5 (4)	27 (19)	108 (76)
Diet	21 (15)	4 (3)	11 (8)	17 (12)	89 (63)
Exercise	9 (6)	18 (13)	29 (20)	20 (14)	55 (47)

Table 3.***Hierarchical Multiple Regression for Medication Adherence^{R,L}***

Predictor	β (Step 1)	β (Step 2)	β (Step 3)
Step 1: CSM			
Identity	.15	.14	.17
Timeline Acute/Chronic	-.03	-.01	-.02
Consequences	-.14	-.17	-.20
Personal Control	-.06	-.07	-.07
Treatment Control	.13	.14	.13
Illness Coherence	-.01	-.04	-.02
Timeline Cyclical	.01	.01	.00
Emotional representations	.32**	.30**	.36**
Step 2: TM			
Medication self-efficacy ^{R,I}		-.26***	-.26**
Medication stage of change ^D		-.25**	-.25**
Step 3: Trait affect			
Positive affect			-.07
Negative affect			-.14
Positive affect x Emotional representations			-.03
Negative affect x Emotional representations			.05
R ² change for step	.13*	.16***	.02
Total adjusted R ²	.07*	.23***	.23***

Note $F(14, 127)=3.99, p<.001$; transformations are represented as: ^RReflected, ^IInverse, ^LLog10,

^DDichotomised. For the ^{R,L} variable, the direction of interpretation is reversed from the raw

scores. * $p<.05$ ** $p<.01$ *** $p<.001$

Table 4.***Hierarchical Multiple Regression for Dietary Adherence***

Predictor	β (Step 1)	β (Step 2)	β (Step 3)
Step 1: CSM			
Identity	-.09	-.08	-.06
Timeline Acute/Chronic	-.01	.03	.03
Consequences	-.04	-.02	-.03
Personal Control	.10	.06	.05
Treatment Control	.01	.05	.05
Illness Coherence	.06	.09	.10
Timeline Cyclical	.19	.14	.12
Emotional representations	-.22*	-.21*	-.21
Step 2: TM			
Dietary self-efficacy ^{R,S}		-.37***	-.37***
Dietary stage of change ^D		.14	.16
Step 3: Trait affect			
Positive affect			-.02
Negative affect			-.03
Positive affect x Emotional representations			.17*
Negative affect x Emotional representations			.05
R ² change for step	.08	.18***	.03
Total adjusted R ²	.03	.21***	.21***

Note $F(14, 127)=3.69, p<.001$; transformations are represented as: ^RReflected, ^SSquare Root,

^DDichotomised. For the ^{R,S} variable, the direction of interpretation is reversed from the raw

scores. * $p<.05$ ** $p<.01$ *** $p<.001$

Table 5.
Hierarchical Multiple Regression for Exercise Adherence

Predictor	β (Step 1)	β (Step 2)	β (Step 3)
Step 1: CSM			
Identity	-.03	.01	.01
Timeline Acute/Chronic	.03	-.03	-.03
Consequences	-.23*	-.05	-.05
Personal Control	.15	-.09	-.08
Treatment Control	-.07	.12	.12
Illness Coherence	-.08	-.01	-.02
Timeline Cyclical	.29**	.01	.03
Emotional representations	-.30**	-.07	-.11
Step 2: TM			
Exercise self-efficacy ^{R,I}		.08	.08
Exercise stage of change ^D		.69***	.69***
Step 3: Trait affect			
Positive affect			-.01
Negative affect			.03
Positive affect x Consequences			.03
Negative affect x Consequences			.05
Positive affect x Emotional representations			.01
Negative affect x Emotional representations			.03
R ² change for step	.18***	.40***	.01
Total adjusted R ²	.13***	.54***	.53***

Note $F(16,125)=10.79, p<.001$; transformations are represented as: ^RReflected, ^IInverse,

^DDichotomised. * $p<.05$ ** $p<.01$ *** $p<.001$