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Classes of Depression, Anxiety, and Functioning in Acute Coronary Syndrome Patients

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Abstract

Objectives—To describe change in subgroups characterized by patterns of depression, anxiety, and functional impairment; examine treatment effects on subgroup membership; examine effects of sex and age on subgroup membership.

Methods—Latent class models were used to meet the first 2 objectives using 79 patients with depression/anxiety. Generalized estimating equations were used to meet the third objective.

Results—Three subgroups characterized by different combinations of psychiatric disorders and functioning were identified. Patients who received treatment were more likely to transition to a less impaired subgroup.

Conclusions—Unique information about holistic treatment effects can be gained when multiple outcomes are considered simultaneously.

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Keywords

depression; anxiety; acute coronary syndrome; latent class analysis

Depression and anxiety are highly prevalent disorders in patients after an acute coronary syndrome (ACS).¹⁻⁷ Depression and anxiety co-occur, appear to inhibit recovery, and have a negative impact on social functioning and capacity to perform activities of daily living in patients who develop an ACS.^{3,4,6,8-14} Even though these conditions are prevalent in patients with an ACS, and are associated with poorer quality of life, these disorders are not fully recognized and adequately treated in clinical settings. Moreover, the effectiveness of intervention programs designed to increase quality and length of life after an ACS still needs to be evaluated across multiple domains.^{2,6,11} In addition, a patient's level of functioning may interact with his or her depression and/or anxiety to determine an intervention's effectiveness.^{2,6,11} Assessing the effectiveness of an intervention program across multiple domains, namely by considering the remission of symptoms of depression, anxiety, and impaired functioning simultaneously over time, may provide a more accurate assessment of its overall impact on health.

Other investigators such as the Enhanced Recovery in Coronary Heart Disease (ENRICHD) group have investigated the effectiveness of cognitive behavioral therapy (CBT) in reducing depressive symptoms as well as improving functioning in patients after an ACS.^{1,12} However, to our knowledge, there are no reports on the effect of CBT where the symptoms of depression, anxiety, and impaired functioning are considered simultaneously over time. The current study is designed to supplement the results of previously reported clinical trials primarily by considering the effect of CBT treatment on multiple outcomes simultaneously. This approach provides a way to examine the impact of treatment on patient well-being more holistically. That is, this approach takes a developmental perspective where multiple aspects of patient well-being are modeled simultaneously and dynamically.

The current study has 3 primary objectives. The first is to use latent class analysis (LCA) and latent transition analysis (LTA) to identify and describe subgroups of patients characterized by similar patterns of depression, anxiety, and functional impairment as well as to describe change over time in subgroup membership. The second is to use these same methodologies to determine whether patients receiving CBT report improvement in the 3 domains simultaneously compared to the control group. The third is to examine whether sex and age predict remission of depression, anxiety, and functional impairment. Generalized estimating equations are used to address the third objective.

METHOD

Participants

The sample for the current study consisted of 100 patients hospitalized with an ACS in 2 coronary care units at a university hospital in Boston, Massachusetts, between September 2001 and August 2003.^{13,14} Patients were 35 years or older at the time of trial entry and had symptoms of depression and/or anxiety, as indicated by a score of 7 to 15 on the depression and/or anxiety subscale of the Hospital Anxiety and Depression Scale (HADS).

Design

We identified 706 potential participants between September 2001 and August 2003; 188 (36.6%) were eliminated due to presence of exclusion criteria, and 238 (33.7%) refused to participate. Of 280 patients administered the HADS, 100 (35.7%) met the inclusion criterion of having a score of 7-15 on either or both measures of depression and anxiety. Patients with

severe depression (HADS >15) received emergent referral to psychiatry according to protocol.

Patients were screened within a month post-hospital discharge, and those meeting inclusion criteria who agreed to participate were randomly assigned to the intervention (ie, CBT) or control (ie, usual care) condition.^{13,14} Participants were randomized by coin flips. Due to chance, the experimental group contained 6 more patients than the control group. Eight experimental patients (15.1%) dropped out of the study prior to baseline measurement. In addition, 13 control patients (27.7%) were subsequently lost to follow-up, including one death. In sum, in the current study, there were 45 patients in the experimental group and 34 patients in the control group (n=79). Dropouts and those lost to follow-up were comparable to remaining patients on age, gender, length of hospital stay, and HADS depression and anxiety screening scores, as determined by standard t- and chi-squared statistics. Of the 79 patients in the current study, 37 (47%) met both the anxiety and depression inclusion criteria; 31 met only the depression criterion; and 11, only the anxiety criterion.

Potential study participants were identified by a research nurse through the review of hospital records and hospital census information. Diagnosis codes used to identify patients who were potentially eligible included acute myocardial infarction, unstable angina, and ischemic heart disease. Exclusion criteria included receiving mental health care in the past 3 months, using a psychoactive drug in the past year, and being diagnosed with substance abuse/dependence in the past year. After completing the baseline survey assessments, patients were assessed again at 2, 3, and 6 months to examine change in depression, anxiety, and functioning.¹³

Protocol

Patients were approached by the study coordinator, who explained the details of the study to potential participants. If the person agreed to participate, consent was obtained and signed at that time. Baseline and follow-up assessment data were collected using interactive voice recognition (IVR). To ensure participants completed all 3 follow-up assessments, an aggressive follow-up system consisting of reminder postcards, telephone call reminders, and re-mailing of questionnaires was used.

The CBT intervention consisted of a series of sessions designed to help participants identify and manage the challenges of living with a chronic medical condition. The CBT intervention has been discussed in detail previously¹³ and is briefly summarized. The intervention was goal oriented, time limited, and issue focused. It was based on other telephone interventions targeted to treat depression by modulating the risk of depression, anxiety, and functional decrements through improved adjustment to illness. Individual sessions lasted approximately 30 minutes and were conducted by doctoral-level clinicians. Patients were expected to complete 6 sessions but allowed to participate in as few as 3 if the therapist and patient agreed that all 8 issues set forth during treatment were reviewed and that treatment goals were reached. In the first contact, the clinicians introduced themselves, reviewed the protocol, answered questions, and asked about the experience of the patient's recent illness on emotional well-being and work function. The first contact reviewed 8 fears commonly experienced by those living with chronic medical conditions: loss of control, loss of self-image, dependency, stigma, abandonment, anger, isolation, and fear of death. Patients worked with their counselors to identify and rank-order barriers to adjustment to medical illness. In sessions 2 to 6, patients and counselors identified strategies to address these barriers. The counselor reviewed progress toward goals with reinforcement and encouragement. A session log tracked the issues reviewed in each session. At weekly meetings the counselors reviewed cases and notes with the research team to monitor fidelity of the intervention.¹³

In contrast, participants receiving the usual care were given standard information on coping with cardiac disease. These participants received a booklet on coping with cardiac illness, typical of those given to patients with an ACS at the time of hospital discharge, and were instructed to contact their primary care physician if they experienced signs of depression.¹³ The study design and protocol were reviewed and approved by the institutional review board of the participating hospital.

Measures

HADS—As briefly discussed above, the HADS contains 7 questions to assess depression and 7 to assess anxiety. Each subscale of 7 items is scored 0-21, where scores 4 to 7 represent subclinical depression or anxiety and 8 or above represent clinical depression or anxiety.¹³ An advantage of using the HADS, compared to other measures of depression and anxiety, is that this scale focuses on cognitive constructs, rather than somatic constructs, which minimizes the likelihood that somatic symptoms of ACS are attributed to depression. It has been reported in the literature that when using a cutoff of 7 on the HADS depression subscale, the sensitivity is approximately 81% when a diagnosis of major depressive disorder from the Primary Care Evaluation of Mental Disorders (PRIME-MD) is used as the gold standard; the specificity is approximately 53%.¹⁴ In comparison, when using a cutoff of 7 on the HADS anxiety subscale, the sensitivity and specificity are approximately 81% and 40%, respectively.¹⁴ In the current study, patients with a score of 7 to 15 on the depression or anxiety subscale at the postdischarge screening were eligible to participate. The cutoff on the depression and anxiety scales was purposely lenient to maximize inclusion of potentially distressed patients, including the upper end of subthreshold depression or anxiety.¹³

Work and Social Adjustment Scale (WSAS)—The WSAS was used to assess functioning. It is a validated measure of self-reported functional impairment at work, in home management, during social and private leisure, and in personal relationships. Impairment in each of the 5 domains is scored zero to 8, where a score of zero represents no impairment and 8 represents severe impairment, with scores 3 to 5 suggestive of moderate impairment.^{13,14} In the current study, only the impairment at home and work subscale was included in the analysis. Participants who scored below 15 on the impairment at home and work subscale were classified as being without functional impairment (ie, nonimpaired), and participants who scored 15+ were classified as having moderate to severe impairment in their functioning at home and work (ie, impaired).¹³

Analysis

Descriptive analyses of participant baseline characteristics, consisting of *t*-tests and chi-square tests as appropriate, were conducted to verify that the randomization process eliminated differences in baseline characteristics between participants randomly assigned to the experimental and control groups.

To address the first objective of the current study, LCA and LTA were used to identify subgroups of patients with similar patterns of depression, anxiety, and functional impairment as well as to describe change over time in subgroup membership. Latent class models may be used to identify a set of mutually exclusive and exhaustive unobserved subgroups in the population based on a set of observed items.¹⁵⁻¹⁷ When the items in the model are discrete, as in the current study, there are 2 sets of parameters of interest. The first set, called *latent class membership probabilities*, expresses the proportion of the population expected to be members of each latent class. These probabilities are used to examine the distribution of the classes in the population. The second set, called *item-response probabilities*, expresses the probability of giving a particular response to a particular item (eg, “depressed” or

“impaired”), conditional on membership in a particular latent class. Additional details of the latent class mathematical model are available in a variety of resources.¹⁵⁻¹⁷

LTA is a longitudinal extension of the traditional latent class model¹⁷ that additionally models change over time in subgroup membership. In addition to the latent class membership and item-response probabilities, a third set of parameters is of interest. This third set, called *transition probabilities*, expresses the conditional probabilities of transitioning from one latent class at time t to another latent class at time $t+1$. That is, LTA combines the cross-sectional measurement of a discrete latent variable and the description of longitudinal change in categories of the latent variable.

To address the second objective, a grouping variable for experimental-group versus control-group assignment was added to the LTA. Adding this grouping variable allowed for an examination of treatment effects on subgroup membership and change over time in subgroup membership. When a grouping variable is added to an LTA, both the latent class membership probabilities at baseline and the transition probabilities from time t to time $t+1$ are allowed to vary across groups.^{18,19} By using this methodological approach, it was possible to examine the impact of the CBT intervention on changes in depression, anxiety, and functional impairment simultaneously.

Finally, to address the third objective, participants were assigned to a latent class at each time based on their posterior probabilities of membership in the classes at each time. Generalized estimating equations were then used to examine whether sex and age were predictive of remission of depression, anxiety, and functional impairment. It should be noted that it is possible to incorporate covariates into the LTA directly, but “hard assignment” to latent classes was used in the current study due to estimation instability because of the small sample size. Adequacy of the assignment was investigated prior to fitting the generalized estimating equations.

RESULTS

At the time of randomization, the control and experimental groups were well balanced with respect to a variety of patient characteristics, as shown in Table 1. Both groups were composed predominantly of white, older males. Average depression and anxiety scores were slightly higher for the intervention group at baseline, but the differences between groups were not statistically significant.

Identifying Subgroups of Depression, Anxiety, and Function

LCA was used to explore solutions with competing numbers of classes at each time (eg, baseline, month-2 follow-up, etc.). This was done to provide an idea of how many classes were appropriate to explore with LTA. Then, LTA models with 2, 3, and 4 classes were fit and compared. Fit criteria for the models are shown in Table 2. Identification of the maximum likelihood solution for each model was confirmed using 100 sets of random starting values for the iterative estimation algorithm. As shown in Table 2, the 2-class model had the lowest BIC, and the 3-class model had the lowest AIC. A comparison of the parameter estimates from the 2- and 3-class models revealed the emergence of a latent class characterized by both psychiatric disorders but no functional impairment. Because of the potentially important differences between members of this class and members of the class with both psychiatric disorders and functional impairment, which appeared in both the 2-class and 3-class models, the 3-class model was selected as the optimal model.

Latent class membership probability estimates at each time and item-response probability estimates for the 3-class model are shown in Table 3. The item-response probabilities

describe the probabilities of particular responses to particular items conditional on latent class membership; they were restricted to be equal at all times to keep the interpretation of the latent classes consistent across time. These item-response probabilities were used to describe the characteristics of subgroup members. For example, from Table 3, members of latent class I had a 94% chance of reporting depression, a 79% chance of reporting anxiety, and an 84% chance of reporting impaired functioning. This latent class was labeled “depression, anxiety, and impaired function.” Latent classes II and III were labeled in a similar way using the item-response probabilities; latent class II was labeled “depression and anxiety,” and latent class III was labeled “no impairment.” The key difference between latent classes I and II was that although members of both classes reported both psychiatric disorders, members of latent class I also reported impairment in their functioning whereas members of latent class II did not.

Latent class membership probabilities describe the distribution of the latent classes at each time. These probabilities were used to describe the sizes of the subgroups at each time. As shown in Table 3, the prevalence of “depression, anxiety, and impaired function” decreased over time among those in the experimental group. In other words, the probabilities of membership in the “depression and anxiety” and “no impairment” latent classes increased over time among those in the experimental group, meaning that participants receiving the treatment reported reduced functional impairment over time. Participants in the control group also showed a similar decreasing trend in membership in the “depression, anxiety, and impaired function” latent class, but this decrease was less pronounced than in the intervention group.

Transitions Between Subgroups Over Time

Although the latent class membership probabilities discussed above describe the prevalence of the latent classes at each time, they do not indicate whether the same participants belong to the same latent classes at each time. Transition probabilities describe how individuals transition between classes over time. Transition-probability estimates by treatment group are shown in Table 4. The probabilities in each row of the table sum to 100%, and individual entries are interpreted as the probability of time $t+1$ latent class membership (columns), conditional on time t latent class membership (rows). As shown in Table 4, most participants in the control group remained in the same class between any 2 times, with no remission or reappearance of symptoms over time. For example, the probability of belonging to latent class I (ie, “depression, anxiety, and impaired function”) at month-2 follow-up, conditional on belonging to the same latent class at baseline was 60%. Participants in the experimental group had a 27% chance of showing remission of both psychiatric disorders and improved functioning (ie, transitioning from latent class I to latent class III) from baseline to month-2 follow-up whereas participants in the control group had a 0% chance of making that transition. In addition, 65% of participants in the experimental group who did not have impaired functioning showed remission of both psychiatric disorders (ie, transitioning from latent class II to latent class III) whereas 11% of participants in the control group showed such remission. There was also some improvement in depression, anxiety, and function at the later follow-ups, but this improvement was less pronounced than that observed between baseline and month-2 follow-up.

Predicting Response to the Treatment

To consider the effects of age and sex in predicting remission of depression and anxiety symptoms and impaired function, posterior probabilities were calculated and used to assign participants to particular latent classes at each time point. That is, at each time point, participants were hard classified as being members of the latent class for which they had the highest probability of membership. The hard-assignment variable indicating class

membership was the dependent variable in the general estimating equations described below. Although it is possible to incorporate covariates directly into the latent transition model,¹⁸ due to the small sample size in the current study, the hard-assignment approach was preferred due to issues with model estimation. The quality of the latent class assignment was evaluated by examining the average posterior probability of participants assigned to classes at each time point. The averages were high for each latent class at each time, ranging from .75 to .99. This indicates a high likelihood of participants belonging to the class to which they were assigned.

Generalized estimating equations were then used to determine if age and sex were predictive of depression and anxiety remission and improved functioning. The covariates were included individually and then combined for a total of 3 models. Sex was found to be a statistically significant predictor of remission ($P < .05$). Women showed a significant response to CBT, such that women in the intervention group were more likely than men to transition from latent class I (ie, “depression, anxiety, and impaired function”) and latent class II (ie, “depression and anxiety”) to latent class III (ie, “no impairment”).

DISCUSSION

The first objective of the current study was to describe change in subgroups characterized by patterns of depression, anxiety, and functional impairment in ACS patients. Our results showed that patients with an ACS could be classified into 3 different latent classes or profiles. The first class was labeled “depression, anxiety, and impaired function”; the second class was labeled “depression and anxiety,” and the third class was labeled “no impairment.” Our findings showed that depression and anxiety were highly prevalent disorders in latent classes I and II in this group of patients. The clinical implication of these results is that it is important to assess and consider both disorders together in order to better diagnose and treat ACS patients.

Change in Symptom Profiles

Another objective of this study was to examine treatment effects on subgroup membership in ACS patients who were randomized to CBT and usual care treatment. Patients in our study had a high likelihood of belonging to the latent class characterized by depression, anxiety, and impaired function at baseline (almost 50% in the control and more than 70% in the treatment group). This probability decreased over time in both the treatment and control groups, but it decreased more in the treatment group. The treatment-group patients were more often characterized by moderate symptoms of anxiety, no symptoms of depression, and normal function at home at the time of the study follow-up visits. This suggests that patients in the treatment group showed important improvements in their symptoms of depression and impaired function at home over time. Patients in the control group showed higher probabilities of belonging to the latent class that reported depression, anxiety, and impaired function (latent class I) and the latent class that reported depression and anxiety (latent class II) over time. In summary, when comparing the symptomatology profiles of the treatment and control groups, patients in the treatment group showed important improvements in their symptoms of depression and function at home, with moderate persistence of anxiety. Conversely, patients in the control group reported persistence of symptoms of depression and impaired function over time. In this randomized controlled trial, the difference between the 2 groups is likely due to the effect of CBT.

Effects of CBT on Depression, Anxiety, and Function in ACS patients

Our results showed a significant effect of CBT in the treatment group, with the highest effect observed between baseline and the second month of follow-up. This effect is

important to consider when deciding the type and timing of implementing an intervention in ACS patients. Prior research has shown that depression, anxiety, and impaired function persist over time in ACS patients, and treatment response to CBT is still controversial. In another randomized clinical trial, 60 subjects who had been hospitalized for a coronary event and were psychologically distressed received CBT, stress management, and relaxation or cardiac rehabilitation.²¹ At 6 months, the CBT group experienced a significant reduction in depressive symptoms, compared with the cardiac rehabilitation group.²¹ There were several limitations of the study, such as low representation of women (12%), several interventions were administered simultaneously, and there was a lack of a true control group. Results reported from one of the largest studies of ACS patients with depressive symptomatology, the ENRICHD trial, were somewhat mixed. Improvement in the assessed depressive symptoms was reported at the 6-month evaluation for patients receiving CBT in comparison with the control group, but this improvement did not persist at the 30-month evaluation.¹¹ The findings of our study are somewhat similar in the sense that the effectiveness of CBT was more significant between baseline and second month of follow-up, but in the one-year follow-up, the 2 groups, intervention and control, became more similar in their symptomatology patterns. The ENRICHD investigators reported also a trend in the direction of treatment efficacy for white men and individuals with moderate levels of depression.²⁰ Thus, it is plausible to think that more intensive cognitive behavior therapy or alternative methods of treatment may be warranted for patients with more severe symptoms.

The final aim of this study was to examine effects of sex and age on subgroup membership. Our results also demonstrated that women reported a higher response to CBT showing a more significant remission of symptoms linked to depression and function than did men. Women were more likely to transition from latent classes I and II (those that reported depression and anxiety with or without impaired function) to latent class III (no impairment). These results may be explained by a *selective* effect of CBT on depression and function in women. Different results were described in a study conducted by researchers at the Montreal Heart Institute.²² A group of 1376 post-MI patients (30% women) were randomly assigned to usual care or a phone-intervention program that consisted of emotional support, education, and practical advice. The intervention was administered monthly for a year period. The goal of this program was to reduce psychological distress that followed the occurrence of myocardial infarction. The authors reported no significant changes on depression and anxiety after one year of follow-up.²² Moreover, researchers reported that women showed a significant negative response to the intervention. Women showed worsening of depressive symptoms in the treatment group when compared to men over time. One possible explanation for this finding is that men in general tend to receive a more aggressive treatment after an ACS,²³ and the aggressiveness of this medical treatment could in part be associated with more moderate symptoms of depression and anxiety over time.

It is important to take into account when comparing these 2 studies to our findings that our sample was smaller, and the follow-up period was shorter than the ENRICHD and the Montreal studies. One important strength of our study is the use of latent transition modeling, which allowed us to conduct modeling of depression and anxiety subscale scores of the HADS and home function jointly. Due to the co-occurrence of these psychiatric disorders and function in ACS patients, we believe that combining information from these 3 indicators may help us to obtain a more accurate assessment of the effectiveness of the intervention in multiple domains, namely remission of symptoms of anxiety, depression, and function over time.

Strengths and Limitations

Latent transition models have some important strengths in cases in which it is appropriate to think of the underlying phenomenon of interest in discrete terms. One important strength is

that examining the prevalences of the latent classes and the transitions from one latent class to another provides a detailed look at change over time that is difficult to obtain in continuous data analyses.^{15,16} A latent class-based approach, in particular, can show very clearly whether a given class is particularly prevalent at certain times or for certain subgroups, whether individuals in a certain class are more or less likely to undergo a transition, and whether there are qualitative differences between groups.^{15,16} From a policy and clinical point of view, a latent class-based approach can help identify developmental periods in which interventions are most likely to be effective and what behaviors should be the target of action at different time points.

Future longitudinal studies would benefit from longer duration of follow-up, an increase in the number and variety of sites, and a larger and more representative sample. Patients with very severe depression/anxiety and also patients who had received mental health care in the prior 3 months or had a diagnosis of substance abuse during the past year were excluded from this study. Thus, our findings may not apply to these high-risk individuals.

It would also be of importance to examine additional study outcomes such as frequency of rehospitalizations after an ACS, compliance with medications, workplace performance, and other risk factors that can contribute to depression in patients after an ACS (eg, social support, family involvement). Future studies examining patterns of change in these psychiatric disorders and function as they are related to clinical outcomes, and response to CBT and other meaningful interventions, may provide a better understanding of how to approach and treat ACS patients with psychiatric disorders and impaired function.

The implementation of statistical models such as LTA that are not frequently used in clinical trials can help us to combine multiple indicators or multiple sources of information into one unique outcome in order to provide a more complete and multidimensional understanding of change over time. In our study, disregarding the high levels of correlation among depression, anxiety, and impaired function in ACS patients over time may cause important information to be missed that may be crucial to understanding how and when an intervention should be implemented and in which populations its implementation would be most effective.

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References

1. Mok H, Lin D. Major depression and medical comorbidity. CPA Bulletin de l'APC. Dec.2002 :25–28.
2. Ballenger J, Davidson J, Lecrubier Y, et al. Consensus statement on depression, anxiety and cardiovascular disease. J Clin Psychiatry. 2001; 62(8):24–27. [PubMed: 12108818]
3. Frasure-Smith N, Lesperance F, Talajic M. Coronary heart disease/myocardial infarction: depression and 18-month prognosis after myocardial infarction. Circulation. 1995; 91(4):999–1005. [PubMed: 7531624]
4. Frasure-Smith N, Lesperance F. Depression-A cardiac risk factor in search of treatment. JAMA. Jun; 2003 289(23):3171–3173. [PubMed: 12813125]
5. Strik J, Honig A, Lousberg R, Denollet J. Sensitivity and specificity of observer and self-report questionnaires in major and minor depression following myocardial infarction. Psychosomatics. 2001; 42:423–428. [PubMed: 11739910]

6. Strik J, Denollet J, Lousberg R, Honig A. Comparing symptoms of depression and anxiety as predictors of cardiac events and increased health care consumption after myocardial infarction. *J Am Coll Cardiology*. 2003; 10(42):1801–1807.
7. Denollet J, Strik J, Lousberg R, Honig A. Recognizing increased risk of depressive comorbidity after myocardial infarction: looking for 4 symptoms of anxiety-depression. *Psychother Psychosom*. 2006; 75:346–352. [PubMed: 17053335]
8. Murray CJ, Lopez AD. Alternative projections of mortality and disability by cause 1990–2020: Global Burden of Disease Study. *Lancet*. 1997; 349:1498–1504. [PubMed: 9167458]
9. Barefoot JC, Helms MJ, Mark DB. Depression and long-term mortality risk in patients with coronary artery disease. *Am J Cardiol*. 1996; 78:613–617. [PubMed: 8831391]
10. Penninx BW, Beekman AT, Honig A, et al. Depression and cardiac mortality: results from a community-based longitudinal study. *Arch Gen Psychiatry*. 2001; 58:221–227. [PubMed: 11231827]
11. Writing Committee for the ENRICHD Investigators. Effects of treating depression and low perceived social support on clinical events after myocardial infarction: the Enhancing Recovery in Coronary Heart Disease Patients (ENRICHD) randomized trial. *JAMA*. 2003; 289:3106–3111. [PubMed: 12813116]
12. Beltman M, Voshaar R, Speckens A. Cognitive-behavioral therapy for depression in people with a somatic disease: meta-analysis of randomised controlled trials. *Br J Psychiatry*. 2010; 197:11–19. [PubMed: 20592427]
13. McLaughlin T, Aupont O, Bambauer K, et al. Improving psychologic adjustment to chronic illness in cardiac patients the role of depression and anxiety. *J Gen Intern Med*. 2005; 20:1084–1090. [PubMed: 16423095]
14. Bambauer K, Locke S, Aupont O, et al. Using the Hospital Anxiety and Depression Scale to screen for depression in cardiac patients. *Gen Hosp Psychiatry*. 2005; 27:275–284. [PubMed: 15993261]
15. Skrondal, A.; Rabe-Hesketh, S. Generalized Latent Variable Modeling: Multilevel, Longitudinal, and Structural Equation Models. Boca Raton, FL: Chapman & Hal; 2004. p. 135–280.
16. Magidson, J.; Vermunt, JK. Latent class models. In: Kaplan, D., editor. *Handbook of Quantitative Methods in Social Science Research*. Newbury Park, CA: Sage Publications; 2003. p. 175–198.
17. Collins, LM.; Hyatt, SL.; Graham, JW. Latent transition analysis as a way of testing models of stage-sequential change in longitudinal data. In: Little, TD.; Schnabel, KU.; Baumert, J., editors. *Modeling Longitudinal and Multilevel Data: Practical Issues, Applied Approaches, and Specific Examples*. New Jersey: Lawrence Erlbaum; 2000. p. 147–161.
18. Lanza S, Collins L. A new SAS procedure for latent transition analysis: transitions in dating and sexual risk behavior. *Dev Psychol*. 2008; 44(2):446–456. [PubMed: 18331135]
19. Martin R, Velicer W, Fava M. Latent transition analysis to the stages of change for smoking cessation. *Addict Behav*. 1996; 21(I):67–80. [PubMed: 8729709]
20. Schneiderman N, Saab P, Catellier D, et al. for the ENRICHD investigators. Psychosocial Treatment Within Sex by Ethnicity Subgroups in the Enhancing Recovery in Coronary Heart Disease Clinical Trial. *Psychosom Med*. 2004; 66:475–483. [PubMed: 15272091]
21. Black JL, Allison TG, Williams DE, et al. Effect of intervention for psychological distress on rehospitalization rates in cardiac rehabilitation patients. *Psychosomatics*. 1998; 39(2):134–143. [PubMed: 9584539]
22. Frasure-Smith N, Lespérance F, Prince R, et al. Randomised trial of home-based psychosocial nursing intervention for patients recovering from myocardial infarction. *Lancet*. 1997; 350(9076): 473–479. [PubMed: 9274583]
23. White AD, Rosamond WD, Chambless LE. for the Atherosclerosis Risk in Communities (ARIC) study investigators. Sex and race differences in short term prognosis after acute coronary heart disease events: the Atherosclerosis Risk in Communities (ARIC) study. *Am Heart J*. 1999; 133:540–548. [PubMed: 10467206]

Table 1

Patient Characteristics

Characteristic	Control (n=34)	Intervention (n=45)
Age (mean years)	60.7	59.9
Female (%)	35.3	31.1
White (%)	88.1	88.9
History of Ischemic Heart Disease (%)	47.8	40.0
Length of hospital stay (mean days)	3.1	3.6
Major Depression History (%)	29.4	37.8
HADS Depression Scores (mean) (SD)	6.5 (3.8)	8.5 (3.6)
HADS Anxiety Scores (mean) (SD)	7.1 (2.9)	8.1 (3.7)
Workplace social adjustment: Work (mean)	3.8(2.2)	3.6(2.1)
Workplace social adjustment: Home (mean)	3.0(2.1)	3.1(2.1)

Table 2

Fit Criteria for LTA Models

Classes	BIC	AIC	G ²	Log-likelihood	df
2	547.09	500.48	460.48	-494.47	8171
3	613.78	499.58	401.58	-465.02	8142
4	741.80	532.03	352.03	-440.25	8101

Note.

Bold-faced font indicates selected model.

Table 3

Latent Class Membership and Item-response Probabilities for LTA Model

		I	II	III
		Latent Class Membership Probabilities		
Baseline	Control	.54	.27	.20
	Intervention	.66	.16	.18
Month 2	Control	.46	.41	.13
	Intervention	.40	.24	.36
Month 3	Control	.41	.38	.21
	Intervention	.31	.36	.33
Month 6	Control	.32	.40	.28
	Intervention	.21	.43	.36
		Item-response Probabilities		
		I	II	III
Depression	Yes	.94	1.0	.05
	No	.06	.00	.95
Anxiety	Yes	.79	.75	.37
	No	.21	.25	.63
Function	Impaired	.84	.00	.05
	Unimpaired	.16	1.0	.95

Note.

Latent class I named “depression, anxiety and impaired function”; latent class II named “depression and anxiety”; latent class III named “no impairment.”

Table 4

Transition Probabilities by Treatment Group

	Control			Intervention		
	Month 2 Latent Class					
	I	II	III	I	II	III
I	.60	.39	.00	.59	.14	.27
Baseline Latent Class						
II	.42	.47	.11	.00	.35	.65
III	.14	.34	.52	.09	.50	.41
Month 3 Latent Class						
	I	II	III	I	II	III
I	.88	.00	.12	.58	.36	.06
Month 2 Latent Class						
II	.01	.94	.05	.11	.89	.00
III	.00	.00	1.0	.13	.00	.87
Month 6 Latent Class						
	I	II	III	I	II	III
I	.61	.22	.17	.59	.32	.09
Month 3 Latent Class						
II	.19	.81	.00	.09	.74	.17
III	.00	.00	1.0	.00	.19	.81