Acta Cardiol Sin 2015;31:202–208
Original Article
doi: 10.6515/ACS20150204A

Cardiovascular Surgery

Application of the Transtheoretical Model to Exercise Behavior and Physical Activity in Patients after Open Heart Surgery

Hsin-Yi Huang,[1] Yu-Shan Lin,[1] Yi-Cheng Chuang,[1] Wei-Hsuan Lin,[1] Li Ying Kuo,[1] Jui Chun Chen,[1] Ching Ling Hsu,[1] Bo Yan Chen,[1] Hui Yu Tsai,[1] Fei Hsin Cheng[1] and Mei-Wun Tsai[2]

Purpose: To assess exercise behavior and physical activity levels after open heart surgery.

Methods: This prospective cohort study included 130 patients (70.8% male, aged 61.0 ± 12.2 years, 53.8% coronary bypass grafting) who underwent open heart surgery. The exercise behavior and physical activity of these patients were assessed at the 3- and 6-month follow-up appointments. Additional interviews were also conducted to further assess exercise behavior. Physical activity duration and metabolic equivalents were calculated from self-reported questionnaire responses. Moreover, possible related demographic factors, clinical features, participation in cardiac rehabilitation programs, and physical activity levels were additionally evaluated.

Results: Six months after hospital discharge, most patients were in the action (39.2%) and maintenance (37.7%) stages. Other subjects were in the precontemplation (11.5%), contemplation (5.4%), and preparation (6.2%) stages. The average physical activity level was 332.6 ± 377.1 min/week and 1198.1 ± 1396.9 KJ/week. Subjects in the action and maintenance stages exercised an average of 399.4 ± 397.6 min/week, significantly longer than those in other stages (116.2 ± 176.2 min/week, p = 0.02). Subjects that participated in outpatient cardiac rehabilitation programs after discharge may have the better exercise habit. Gender had no significant effect on exercise behavior 6 months after hospital discharge.

Conclusions: Most subjects following open heart surgery may maintain regular exercise behavior at 6 months after hospital discharge. Physical activity levels sufficient for cardiac health were achieved by subjects in the active and maintenance stages. Outpatient cardiac rehabilitation programs are valuable for encouraging exercise behavior after heart surgery.

Key Words: Exercise behavior • Open heart surgery • Physical activity • Transtheoretical model

INTRODUCTION

Heart disease is the leading cause of death worldwide. Numerous studies have demonstrated a better prognosis in cardiac patients who engage in regular exercise.[1,2] Recent scientific and position statements on the secondary prevention of cardiovascular disease have reinforced the importance of physical activity (PA) in a population with cardiac disease.[3,4] These studies recommended that patients should strive for 30-60 min/day of moderate-intensity PA, for at least 5 days/week (150 min/week) to reduce cardiovascular risk.[3]

Previous studies identified lower PA levels as a significant determinant of coronary heart disease and cardiac-related and all-cause mortality.[5-7] Sesso et al. evalu-

Received: June 4, 2013 Accepted: February 4, 2015
[1]Heart Center, Cheng Hsin General Hospital; [2]Department of Physical Therapy and Assistive Technology, National Yang Ming University, Taipei, Taiwan.
Address correspondence and reprint requests to: Dr. Mei-Wun Tsai, Department of Physical Therapy and Assistive Technology, National Yang Ming University, No. 45, Cheng Hsin Street, Peitou, Taipei, Taiwan. Tel: 886-933532889; Fax: 886-2-2826-7431; E-mail: mwtsai1@gmail.com

ated PA in 12516 middle-aged and older men. They observed lower PA levels (< 4200 KJ/week) in approximately 35% of the participants. Some studies examined PA levels in cardiac patients,[8-10] though the exercise behavior associated with exercise adherence and maintenance of an active, healthy lifestyle was still unknown. Evaluating exercise behavior in cardiac patients may help to determine the stages and processes of change essential for further health promotion. Open heart surgery is performed to correct cardiac disorders and to improve cardiac functional capacity. After open heart surgery, patients often participate in structured, in-hospital cardiac rehabilitation (CR) programs to increase physical ability and to learn how to lead a more active lifestyle; however, whether they maintain regular exercise and achieve adequate PA levels after discharge remains unknown.

The Transtheoretical Model (TTM), proposed by Prochaska, DiClemente, and Norcross,[11-13] is a framework for assessing and addressing readiness for behavioral changes. This model has been validated in numerous studies of addiction cessation and lifestyle changes related to diet,[14-16] smoking,[17-19] weight loss,[20,21] alcohol abuse,[22] and exercise.[23-29] Moreover, TTM has been used to explore how individuals adopt and maintain physical activity.[30,31] TTM application may be useful in identifying specific regular exercises required for successful modification of patient behavior essential for cardiac health promotion. Understanding the stages of change outlined in TTM may help healthcare providers to improve programs and improve strategic planning for patients who need to lead a more active lifestyle.

This study aimed to assess exercise behavior and PA levels using TTM in patients undergoing open heart surgery. Moreover, factors contributing to exercise behavior and PA levels were evaluated.

MATERIALS AND METHODS

Sample

This was a prospective cohort study which consecutively recruited 633 individuals who were one week after hospital discharge from a recent open heart surgery from November 2010 to December 2011. Subjects < 18 years of age, or who refused to join the study, or experienced verbal communication challenges were excluded. All patients received inpatient CR and were provided with lifestyle modification instruction and information regarding risk factors by physical therapists before discharge. This study was approved by the hospital's Institutional Review Board.

Measures

Based on the definitions of stages of change in TTM,[30,31] questions were developed regarding engagement in and adherence to moderate-to-vigorous exercise programs. These questions were included in a self-administered questionnaire[32-35] designed to investigate current exercise behavior. According to their responses, subjects were classified into one of the following 5 stages of exercise behavior:

1. Pre-contemplation: subjects not exercising and not intending to start in the next 6 months.
2. Contemplation: subjects not exercising, but intending to start in the next 6 months.
3. Preparation: subjects who exercised, but not regularly. Regular exercise was defined as vigorous exercise for ≥ 20 min per session for three or more sessions per week.
4. Action: subjects exercising regularly, but for < 6 months.
5. Maintenance: subjects exercising regularly for ≥ 6 months.

Moreover, the International Physical Activity Questionnaire (IPAQ), a validated self-report instrument adapted from the Seven-day Physical Activity Recall Questionnaire,[36] was used to assess PA levels in all subjects. PA levels were quantified as total energy consumption in metabolic equivalent times (MET) min/week and total number of PA minutes per week for each participant. An average MET score was derived for each type of activity listed in TTM as follows: walking = 3.3 METs, moderate PA = 4.0 METs, and vigorous PA = 8.0 METs. Using these values, 4 continuous scores were defined:

- Number of walking MET min/week = 3.3 × walking minutes × walking days.
- Number of moderate MET min/week = 4.0 × moderate-intensity activity minutes × moderate activity days.
- Number of vigorous MET min/week = 8.0 × vigorous activity minutes × vigorous activity days.
- Total physical activity MET min/week = sum of scores

for walking + moderate + vigorous MET min/week.

Total PA of ≥ 600 MET min/week was defined as moderate PA group. Total PA of ≥ 1500 MET min/week was considered high PA group. Subjects with PA levels below moderate PA group were categorized as low PA.

TTM and IPAQ questionnaires were administered preoperatively and subsequently at 3- and 6-month follow-ups after discharge. Medical charts were reviewed to determine possible demographic (e.g., age and sex) factors and preoperative clinical characteristics (e.g., heart function and cardiac functional status as per New York Heart Association classification) related to cardiac health. Heart function was categorized based on left ventricular ejection fraction. Preserved heart function was indicated by a left ventricular ejection fraction of > 50%. Mild, moderate, and severe heart dysfunction were designated as left ventricular ejection fraction of 41-49%, 35-40%, and < 35%, respectively. Participation in an outpatient CR program was also evaluated in this study.

Statistical analyses

Descriptive statistics were used to summarize study subject characteristics and to quantify their exercise behavior and PA levels. Measurement scaling, means, and standard deviations were determined for continuous variables, and percentages (%) were determined for categorical variables. Possible factors influencing exercise behavior and PA levels at 6 months after discharge were evaluated using Fisher's test. Independent variables included demographic information, clinical characteristics, and preoperative exercise behavior and PA levels. The significance level was set at 0.05.

RESULTS

Of the 633 subjects, 6-month follow-up was completed in 130 individuals whose data were included in the analysis. The reasons for exclusion included refusal or incomplete questionnaires. Subjects were mostly male (70.8%), most were between the ages of 61.0 ± 12.2 years, and most received coronary bypass grafting (53.8%; Table 1).

During the study, the average daily cumulative PA in all patients in the sample was 865.74 ± 959.22 METs/week. Most cardiac patients intended to exercise (contemplation stage: 27.8%). Other subjects were in the precontemplation (22.2%), preparation (16.7%), action (5.6%), and maintenance (22.2%) stages. At the 6-month follow-up, most cardiac patients were in the action (39.2%) and maintenance (37.7%) stages. Other subjects were in the precontemplation (11.5%), contemplation (5.4%), and preparation (6.2%) stages. The average exercise time was 332.6 ± 377.1 min/week and the average energy expended was 1198.1 ± 1396.9 METs-min/week, indicating that 57.7% respondents fell into the moderate- and high-PA group. Subjects in the action and maintenance stages exercised for an average of 399.4 ± 397.6 min/week, significantly longer than those in other stages (116.2 ± 176.2 min/week, p = 0.02).

Most cardiac patients in the contemplation (41.4%) or maintenance (41.4%) stages preoperatively were drifting toward the action (39.2%) and maintenance (37.7%) stages at the 6-month follow-up (Figure 1). Significant differences in PA levels were observed between subjects who preoperatively were in the low (63.5%),

Table 1. Demographic characteristics of subjects

Characters	Subjects enrolled (n = 130)	Subjects excluded (n = 550)
Age (years)	61.0 ± 12.2	62.3 ± 12.1
Male	92 (70.8%)	369 (67.2%)
Height (cm)	162.3 ± 15.4	161.9 ± 10.8
Weight (kg)	66.8 ± 12.6	65.5 ± 12.9
Preoperative LV function		
Preserved	92 (70.8%)	362 (66.3%)
Mild dysfunction	13 (10.0%)	61 (11.2%)
Moderate dysfunction	10 (7.7%)	34 (6.2%)
Severe dysfunction	14 (10.8%)	69 (12.6%)
Heart surgery		
CABG	69 (53.1%)	273 (49.6%)
Valve Surgery	45 (34.6%)	189 (34.4%)
Others	16 (12.3%)	88 (16.0%)
Preoperative NYHA functional class		
I/II	59 (45.4%)[#]	295 (53.6%)[†]
III/IV	51 (39.2%)[#]	197 (35.8%)[†]
Joined outpatient CR	63 (48.5%)	147 (26.9%)*

Data was presented as mean ± SD or n (%).
CABG, coronary artery bypass graft; CR, cardiac rehabilitation; LV, left ventricular; NYHA, New York Heart Association functional classification.
* p < 0.05, by chi-square test; [#] 20 missing data; [†] 58 missing data.

moderate (32.7%), and high (3.8%) PA group at 6-month follow-up (p = 0.01; Figure 2).

No significant differences in exercise behavior at 6-month follow-up were evident in subjects of different genders (p = 0.16) and preoperative left ventricular function (p = 0.68). Subjects who participated in outpatient CR may have superior exercise habits six months after discharge (p = 0.02; Table 2).

DISCUSSION

This study indicated that most subjects had regular exercising habits 6 months after discharge from open heart surgery. Most subjects (57.7%) were in the moderate and high categories on IPAQ, indicating that their PA levels were sufficient for cardiac health, and satisfied the criteria established by the American Heart Association and the American College of Cardiology.[3] However, 23.1% of subjects had not altered their lifestyles to achieve adequate PA levels. Medical professionals must undertake more intensive efforts to encourage such patients to exercise more to achieve the recommended PA levels and ensure good cardiac health.

Compared with the results of another trial in which most participants were in the active and maintenance stages at baseline,[10] the current study population represented more variations in pre-operative status. These patients may have been reluctant to participate in exercise programs or undertake vigorous PA because of their more fragile preoperative status compared with those under medication or those undergoing percutaneous coronary angioplasty. Despite the fact that 44.7% of the patients were classified as level III or IV in New York Heart Association classification system, most patients advanced to a more active stage at the 3- and 6-month follow-up. This result not only indicated good patient compliance but also represented good in-hospital health promotion. However, 23% of the population was still in pre-contemplation, contemplation and prepare stages which means they didn't exercise to a sufficient extent. And 39.2% of the patients were in the action stage, which implied that they didn't maintain for a sufficient length of time.

The TTM model has been widely applied to improve

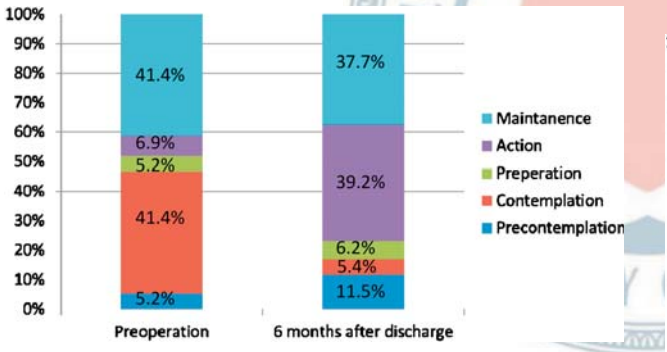

Figure 1. *Trans-theoretical model based exercise behavior before and 6 months after surgery.*

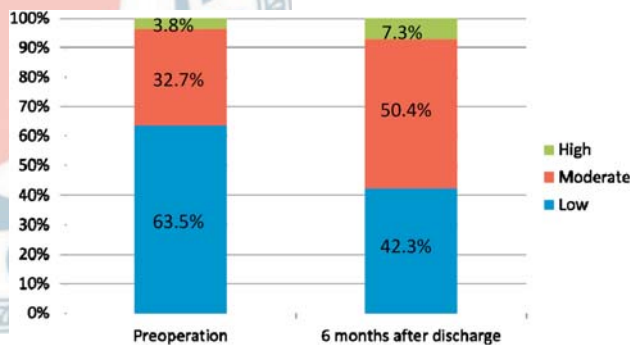

Figure 2. *Physical activity level before and 6 months after surgery.*

Table 2. Factors influencing exercise behavior after open heart surgery at 6 months after discharge

Factors		Pre-contemplation	Contemplation	Preparation	Action	Maintenance	p* value
Attained CR II	No	11 (16.7%)	2 (3.0%)	3 (4.5%)	31 (47.0%)	19 (28.8%)	0.02
	Yes	3 (4.8%)	5 (7.9%)	5 (7.9%)	20 (31.7%)	30 (47.6%)	
Gender	Male	10 (10.9%)	7 (7.6%)	6 (6.5%)	31 (33.7%)	38 (41.3%)	0.16
	Female	5 (13.2%)	0 (0%)	2 (5.3%)	20 (52.6%)	11 (28.9%)	
Age	≧ 65 y/o	8 (15.4%)	2 (3.8%)	0 (0%)	25 (48.1%)	17 (32.7%)	0.04
	< 65 y/o	7 (9.0%)	5 (6.4%)	8 (10.3%)	26 (33.3%)	32 (41.0%)	
LV function	Preserved	10 (10.9%)	5 (5.4%)	4 (4.3%)	36 (39.1%)	37 (40.2%)	0.68
	Impaired	4 (10.8%)	2 (5.4%)	4 (10.8%)	15 (40.5%)	12 (32.4%)	

CR II, out-patient cardiac rehabilitation; LV, left ventricle.

* p value was obtained by comparing the maintenance stage and other behavior stages (Fisher's exact test).

health-related behavior, including exercise.[13-23] Behavioral change interventions should assist clients in resolving their ambivalence and reluctance to change by addressing the cognitive, behavioral, and environmental factors involved. Understanding exercise behavior in patients after open heart surgery helps medical professionals to support them in cultivating more active and healthier lifestyles. Further studies may be needed to explore the optimal intervention for subjects in different stage of TTM.

As Marcus et al. reported,[30] measuring and understanding the processes of exercise behavior change may assist health professionals in designing and testing specific interventions to help individuals move more quickly from one exercise stage adoption to another. Compared to non-participants, patients participated in an outpatient CR was more in maintenance stage and less in pre-contemplation in our study. This result showed that attending a CR program may influence patient exercise behavior after discharge. Pinto et al.[9] followed-up cardiac patients for 12 months. They observed that patients in the telephone-based intervention group reported higher PA levels than those in the control group at 6 months (240 min/week versus 160 min/week), although patients in both groups exceeded PA guidelines. These differences became significant at 12 months, indicating that as the time after discharge increased, exercise levels in the control group decreased. Stevenson et al.[10] observed increased PA levels during the early stages of outpatient CR programs; however, coronary risk reduction targets were not achieved when patient participation stopped. Moreover, these studies demonstrated that participation in such programs helped to maintain good exercise habits, preventing regression in motivational readiness for exercise and improving physical function.

Exercise requires structural, planned, and repetitive bodily movements. Positive correlations have been observed between these movements and physical fitness.[37] Previous studies reported that certain psychological constructs, adequate social support, and problem-solving abilities reduced exercise barriers and influenced the maintenance of good exercise habits in women and sedentary participants.[38-41] Participants in outpatient CR programs may have overcome some exercise barriers through structured exercise plans developed in collaboration with physical therapists after discharge. They had significantly better exercise habits at 6 months after discharge than the non-participants in these programs. Thus, keeping people engaged is a critical first step in changing behavior and making exercise a regular part of patients' lifestyle after open heart surgery.

This study had some limitations. First, the relatively small sample may not have represented the condition of all patients after open heart surgery. The cases enrolled for analysis had higher CR attendance rate than cases excluded (Table 1), which may limit the extrapolation. Nevertheless, there were still half of the studied cases not joining CR; the results would have the clinical implication. Secondly, a longer follow-up period may be needed to evaluate postoperative adherence behavior and exercise involvement. Thirdly, socio-economic status, such as income, education, urban/rural residence, and family support was not collected in the analysis, which may be key factors to affect outpatient CR attendance and exercise behavior in advance. Further study may be needed to examine the relationship between socio-economic status and exercise maintenance after open heart surgery.

CONCLUSIONS

Most subjects maintained a regular exercise regimen at 6-month follow-up after open heart surgery. Active and maintenance stage subjects achieved sufficient PA levels essential for cardiac health. The current study results provide a meritorious argument for the value of outpatient CR programs to establish good exercise habits in patients after heart surgery. Referral to such programs and support for more active involvement in PA after discharge are important interventions to be provided by clinical medical staff.

ACKNOWLEDGEMENTS

This work was supported by Cheng Hsin General Hospital (S.J.S: 101-12). We thank the Chief of the Heart Center of Cheng Hsin General Hospital, Dr. Jen Wei, and the Chief of the Cardiovascular Surgery Department of Cheng Hsin General Hospital, Dr. Yi-Cheng Chuang, for

their contributions to this project and helpful comments. We also thank all participants and staff at the Heart Center of Cheng Hsin General Hospital for their cooperation in this study.

REFERENCES

1. Pate RR, Pratt M, Blair SN, et al. Physical activity and public health. A recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. *JAMA* 1995;273:402-7.
2. Balady GJ, Ades PA, Comoss P, et al. Core components of cardiac rehabilitation/secondary prevention programs: a statement for healthcare professionals from the American Heart Association and the American Association of Cardiovascular and Pulmonary Rehabilitation Writing Group. *Circulation* 2000;102:1069-73.
3. Balady GJ, Williams MA, Ades PA, et al. Core components of cardiac rehabilitation/secondary prevention programs: 2007 update. *J Cardiopulm Rehabil Prev* 2007;27:121-9.
4. King SB, Smith SC, Hirshfeld JW Jr, et al. 2007 Focused update of the ACC/AHA/SCAI 2005 guideline update for percutaneous coronary intervention. *Circulation* 2008;117:261-95.
5. Rockhill B, Willett WC, Manson JE, et al. Physical activity and mortality: a prospective study among women. *Am J Public Health* 2001;91:578-83.
6. Haapanen-Niemi N, Miilunpalo S, Pasanen M, et al. Body mass index, physical inactivity and low level of physical fitness as determinants of all-cause and cardiovascular disease mortality--16 y follow-up of middle-aged and elderly men and women. *Int J Obes Relat Metab Disord* 2000;24:1465-74.
7. Sesso HD, Paffenbarger RS Jr, Lee IM. Physical activity and coronary heart disease in men: The Harvard Alumni Health Study. *Circulation* 2000;102:975-80.
8. Taylor RS, Brown A, Ebrahim S, et al. Exercise-based rehabilitation for patients with coronary heart disease: systematic review and meta-analysis of randomized controlled trials. *Am J Med* 2004;116:682-92.
9. Pinto BM, Goldstein MG, Papandonatos GD, et al. Maintenance of exercise after phase II cardiac rehabilitation: a randomized controlled trial. *Am J Prev Med* 2011;41:274-83.
10. Stevenson TG, Riggin K, Nagelkirk PR, et al. Physical activity habits of cardiac patients participating in an early outpatient rehabilitation program. *J Cardiopulm Rehabil Prev* 2009;29:299-303.
11. Prochaska JO, DiClemente CC, Norcross JC. In search of how people change: applications to addictive behaviors. *Am Psychol* 1992;47:1102-14.
12. Prochaska JO, Norcross JC, DiClemente CC. Changing for good: a revolutionary six-stage program for overcoming bad habits and moving your life positively forward. New York, NY: Avon Books; 1994.
13. Prochaska JO, Redding CA, Evers KE. The transtheoretical model and stages of change. In: Glanz K, Lewis FM, Rimer BK, eds. *Health Behavior and Health Education: Theory, Practice, and Research*. 3rd ed. San Francisco, CA: Jossey-Bass, 1998.
14. Greene GW, Rossi SR, Rossi JS, et al. Dietary applications of the stages of change model. *J Am Diet Assoc* 1999;99:673-8.
15. Greene GW, Rossi SR, Reed GR, et al. Stages of change for reducing dietary fat to 30% of energy or less. *J Am Diet Assoc* 1994; 94:1105-10.
16. Laforge RG, Greene GW, Prochaska JO. Psychosocial factors influencing low fruit and vegetable consumption. *J Behav Med* 1994;17:361-74.
17. Fava JL, Velicer WF, Prochaska JO. Applying the transtheoretical model to a representative sample of smokers. *Addict Behav* 1995;20:189-203.
18. Velicer WF, Fava JL, Prochaska JO, et al. Distribution of smokers by stage in three representative samples. *Prev Med* 1995;24: 401-11.
19. DiClemente CC, Prochaska JO, Fairhurst SK, et al. The process of smoking cessation: an analysis of precontemplation, contemplation, and preparation stages of change. *J Consult Clin Psychol* 1991;59:295-304.
20. O'Connell D, Velicer WF. A decisional balance measure and the stages of change model for weight loss. *Int J Addict* 1998;23: 729-50.
21. Nigg CR, Burbank PM, Padula C, et al. Stages of change across ten health risk behaviors for older adults. *Gerontologist* 1999;39: 473-82.
22. Snow MG, Prochaska JO, Rossi JS. Process of change in Alcoholics Anonymous: maintenance factors in long-term sobriety. *J Stud Alcohol* 1994;55:362-71.
23. Marcus BH, Emmons KM, Simkin-Silverman LR, et al. Evaluation of motivationally tailored vs standard self-help physical activity interventions at the work place. *Am J Health Promot* 1998;12: 246-253.
24. Marcus BH, Rakowski W, Rossi JS. Assessing motivational readiness and decision making for exercise. *Health Psychol* 1992; 11:257-61.
25. Armstrong CA, Sallis JF, Hovell FM, et al. Stages of change, self-efficacy and adoption of vigorous exercise: a prospective analysis. *Journal of Sport and Exercise Psychology* 1993;9:216-23.
26. Myers RS, Roth DL. Perceived benefits of and barriers to exercise and stage of exercise adoption in young adults. *Health Psychol* 1997;16:277-83.
27. Cardinal BJ. Construct validity of stages of change in exercise behavior. *Am J Health Promot* 1997;12:68-74.
28. Pinto BM, Clark MM, Cruess DG, et al. Changes in self efficacy and decisional balance for exercise among obese women in a weight management program. *Obes Res* 1999;7:288-92.
29. Marcus BH, Banspach SW, Lefebvre RC, et al. Using the stages of change model to increase the adoption of physical activity among community participants. *Am J Health Promot* 1992;6: 424-9.
30. Marcus BH, Rossi JS, Selby VC, et al. The stages and processes of

exercise adoption and maintenance in a worksite sample. *Health Psychol* 1992;11:386-95.
31. Sneed NV, Paul SC. Readiness for behavioral changes in patients with heart failure. *Am J Crit Care* 2003;12:444-53.
32. Di Noia J, Prochaska JO, Contento IR. Application of the transtheoretical model to fruit and vegetable consumption among economically disadvantaged African-American adolescents: preliminary findings. *Am J Health Promot* 2006;20:342-8.
33. Dishman RK, Jackson AS, Bray MS. Validity of processes of change in physical activity among college students in the TIGER study. *Ann Behav Med* 2010;40:164-75.
34. Rossi SR, Greene GW, Rossi JS, et al. Validation of decisional balance and situational temptations measures for dietary fat reduction in a large school-based population of adolescents. *Eat Behav* 2001;2:1-18.
35. Fava JL, Rossi JS, Velicer WF, et al. Structural confirmation of short form instruments for the transtheoretical model. *Paper presented at the 99th Annual Meeting of the American Psychological Association*, San Francisco, CA 1991.
36. Sallis JF, Haskell WL, Wood PD, et al. Physical activity assessment methodology in the Five-City Project. *Am J Epidemiol* 1985; 121:91-106.
37. Caspersen CJ, Powell KE, Christenson GM. Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. *Public Health Rep* 1985;100:126-31.
38. Moore SM, Dolansky MA, Ruland CM, et al. Predictors of women's exercise maintenance after cardiac rehabilitation. *J Cardiopulm Rehabil* 2003;23:40-9.
39. Bock BC, Marcus BH, Pinto BM, et al. Maintenance of physical activity following an individualized motivationally tailored intervention. *Ann Behav Med* 2001;23:79-87.
40. Blanchard CM, Reid RD, Morrin LI, et al. Correlates of physical activity change in patients not attending cardiac rehabilitation. *J Cardiopulm Rehabil* 2006;26:377-83.
41. Johnson NA, Heller RF. Prediction of patient nonadherence with home-based exercise for cardiac rehabilitation: the role of perceived barriers and perceived benefits. *Prev Med* 1998;27:56-64.