

Original Research Article

Assessment of a cardiac rehabilitation program based on the Borg RPE Scale and six-minute walk test

ABSTRACT

Aims: The ability of cardiac rehabilitation interventions to reduce mortality in those with cardiovascular disease is well established. Despite its widespread use in the clinical setting, the Borg Rating of Perceived Exertion (RPE) scale is yet to be validated for its ability to produce equivalent physiological health outcomes to those achieved in programs where exercise intensity was prescribed on the basis of a maximal or submaximal exercise test.

Study design: Closed Cohort Study.

Place and Duration of Study: Department of Physiotherapy, Albury Base Hospital and School of Community Health, between November 2008 and November 2009.

Methodology: Fifteen participants were assessed prior to and following completion of a cardiac rehabilitation program where exercise was prescribed according to the Borg RPE scale. Pre and post Six-Minute Walk Test scores were obtained to determine the impact of the cardiac rehabilitation program.

Results: Fifteen cardiac rehabilitation participants completed all requirements of the study after an initial enrolment of 22 patients. Wilcoxon signed-ranks test showed statistically significant improvements in 6MWT scores following participation in the cardiac rehabilitation program ($p = .033$) from a median value of 412 metres to 475 metres.

Conclusion: The findings of this study indicate that cardiac rehabilitation programs, where exercise prescription is based on the Borg RPE scale, are capable of improving both heart function and exercise capacity.

Keywords: Cardiac rehabilitation, Borg rating of perceived exertion, six minute walk test, cardiovascular disease

1. INTRODUCTION

Cardiac rehabilitation forms an integral component of the complex health provision recommended for those with cardiovascular disease (CVD). Structured exercise programs within cardiac rehabilitation lead to both peripheral and cardiopulmonary adaptations whilst directly reducing mortality [1]. However, this evidence is based on studies that have prescribed and monitored exercise intensity on the basis of an initial maximal or submaximal (graded) exercise test. These findings are less relevant to a clinical setting that is becoming increasingly reliant on less objective means of exercise prescription such as the Borg rating of Perceived Exertion (RPE) scale. Despite its widespread use in the clinical setting, there is a lack of research documenting cardiac health outcomes following participation in cardiac rehabilitation programs where exercise is prescribed according to the Borg RPE Scale.

Traditionally, exercise prescription in cardiac rehabilitation has been based on the findings of either a maximal or submaximal exercise test. Results from these tests are used to ensure participants maintain the required percentage of their maximal heart rate (HR_{max}), maximal oxygen uptake (VO₂max), or oxygen uptake reserve (VO₂R) throughout the program. The rationale behind these procedures is that patients are able to train at a precise and individualised level that will both ensure safety and maintain heart rate within a range known to induce physiologic adaptations.

More recently, as a result of practical considerations, there has been an observable shift away from formal testing procedures to prescription based on the more subjective Borg RPE scale [2]. The Borg RPE method consists of a vertical scale from 6-20 with corresponding verbal expressions of progressively increasing sensation intensity (see Figure 1) [3]. Current cardiac rehabilitation guidelines recommend a “low to moderate exercise intensity” for this population which corresponds with a Borg RPE of 10-13/20 [4, 5]. Participants are required to continually monitor their perception of intensity to ensure they remain at this level throughout the exercise program.

Figure 1. Borg Rating of Perceived Exertion Scale

Category Scale	
	Descriptors
6	
7	Very very light
8	
9	Light
10	
11	Fairly light
12	
13	Somewhat hard
14	
15	Hard
16	
17	Very hard
18	
19	Very very hard
20	

Cardiac rehabilitation research has demonstrated that maintaining exercise intensity within a specified range (minimum of 40-50% VO_2R) induces physiologic adaptations and improved health outcomes for participants [6]. Documented adaptations range from those at a cellular level (such as increases in muscle mitochondria volume density) to those more grossly observable (such as increases in cardiac output) [6, 7]. Based on the close correlations shown between the Borg RPE scale and heart rate and heart rate variability [8-11], VO_2max [8, 12], and lactate threshold [13, 14], the Borg RPE scale has been readily adopted in clinical practice under the assumption that subsequent health adaptations will also correlate in a rehabilitation setting [15, 16].

This scale is also advocated from a practical and resource-allocation standpoint. It is argued that the Borg RPE scale is a more viable option in cardiac rehabilitation as it does not require expensive equipment, lengthy testing procedures, and is unaffected by medications

that commonly alter heart-rate responses to exercise [2, 17]. Furthermore, excessive exertion demands placed on individuals undergoing an initial graded exercise test is cited as a significant contributor to attrition from rehabilitation programs [18]. Regardless of these practical advantages, the current emphasis placed on evidence-based practice necessitates that the Borg RPE scale be validated in its ability to produce equivalent health outcomes to those programs that base exercise prescription on the findings of an initial graded exercise test.

The Six-Minute Walk Test (6MWT) is frequently used as an outcome measure in Australian cardiac rehabilitation programs [19-21]. This test was originally developed for the assessment of those with chronic lung disease and its validity in providing an objective measure of functional walking capacity is widely documented in this population [22, 23]. Although there are a number of clinical trials that have used the 6MWT in cardiac populations, there are surprisingly few studies that demonstrate the utility of this measure in a cardiac rehabilitation setting. The only study found that examined this relationship was recently conducted by Fiorina et al. in 348 participants of cardiac rehabilitation [24]. A significant improvement in 6MWT scores was evident following participation in this program where exercise intensity was prescribed and monitored on the findings of an initial symptom-limited exercise test. However, no studies have documented whether equivalent improvements in functional walking capacity are likely following participation in programs based on the Borg RPE scale.

2. MATERIAL AND METHODS

A one-group pretest-posttest research design was used to examine changes in exercise capacity of participants following a six-week cardiac rehabilitation program. Baseline tests were conducted prior to commencing rehabilitation using standardised protocols and these tests were repeated upon completion of the program. The inclusion criteria for the study were in accordance with the inclusion criteria for the cardiac rehabilitation program at the Albury Base Hospital (ABH) NSW, Australia. This program receives referrals from inpatient settings following acute events, revascularisation procedures, or direct referrals from general practitioners and specialists. We did not exclude any participant on the basis of age, gender or cardiac condition with the aim of increasing the generalizability and external validity of findings. Participants were excluded if they were unable to complete the cardiac rehabilitation program within the six-week period or could not participate in the designated exercise program. A total of twenty-two participants agreed to take part in the study, fifteen of which were used for the final analysis. The project was conducted in accordance with ethics guidelines and approval from the Charles Sturt Ethics in Human Research Committee and Albury-Wodonga Joint Hospitals Ethics Committee. All participants were provided with an information sheet and consent form.

Participants attended rehabilitation once a week for six weeks. This program was divided into one hour of exercise and one hour of education. The exercise component of rehabilitation was conducted according to ABH guidelines, which have been devised in accordance with those provided by the National Heart Foundation of Australia [25]. Each participant was given an individualised exercise program consisting of aerobic (cycle ergometry, treadmill walking and rowing) and circuit training that was devised by a physiotherapist to ensure participants could exercise continually throughout the session at the prescribed level of intensity. Circuit training in this program is most appropriately classified as aerobic in nature (low resistance, high repetition). In accordance with recommendations of the National Heart Foundation, all participants were encouraged to maintain a "low to moderate" intensity (between 10-13/20 on the Borg RPE scale) throughout exercise sessions. Adjustments were made each week to the duration, speed or resistance

of aerobic exercise and to the load or number of repetitions performed during circuit training. Participants were also advised to complete a home walking program, as recommended by the National Heart Foundation to achieve 30 minutes of moderate intensity physical activity on most, or all days of the week.

The primary outcome measure used in the cardiac rehabilitation program at the ABH is the Six-Minute Walk Test (6MWT). This test consists of walking up and down a 30m indoor track as many times as possible within a 6-minute period. At the Albury Base Hospital, an unobstructed corridor of sufficient length was used each time. In accordance with the American Thoracic Society guidelines (2002) this test was conducted twice prior to commencing cardiac rehabilitation, with the best of the two tests recorded to allow for a learning effect [22]. Other information obtained from cardiac rehabilitation included medications, blood pressure, smoking status, and diabetes status. A cardiac history questionnaire was given to all participants to ascertain any other factors that may impact on their HRV as well as a post-rehabilitation exercise questionnaire to ascertain how active participants had been each week. Participants were also asked to complete a diary of additional exercise and home walking conducted outside of cardiac rehabilitation.

In accordance with the American Thoracic Society guidelines (2002), 6MWT results were expressed as an absolute value (i.e. the participant walked 60m further) [22]. Research suggests that a minimum of 10% change in scores is necessary to allow 99% confidence that a real change occurred in cardiac-diseased populations [24]. Therefore, the current study judged an improvement in functional capacity to be a >10% improvement in 6MWT scores between pre and post-testing.

Statistical analysis was performed using Microsoft EXCEL (Copyright Microsoft Inc) and SPSS Version 20.0 (Copyright IBM Inc). Descriptive statistics were initially computed so that data could be compared to previous studies. The Wilcoxon Signed-Ranks Test was used to compare HRV parameters pre and post cardiac rehabilitation as data was not normally distributed. For consistency, this test was used to compare the 6MWT pre and post cardiac rehabilitation. Differences were considered significant when $p < 0.05$. Chi-square analysis was used to allow for grouping of data into positive change, negative change and no change. Positive change was considered as >10% toward the expected norm, negative change was considered as >10% away from the expected norm, and no change was considered < 10% change in either direction. Expected normal values were gathered from a group of age-matched controls without known cardiac disease. All Chi-square analyses were considered significant if $p < 0.05$.

The impact of participant attribute variables on results was also considered. These included participant age, gender, cardiac condition, cardiac surgery, medications, adherence to the prescribed home walking program, and waiting times between cardiac event and commencement of rehabilitation. Although small subgroup numbers meant that these data were not amenable to statistical analysis, their influence was assessed through examination of trends within Chi-square results. Participants were divided into subgroups under each examined variable and trends plotted as a percentage improvement for that total population. These methods therefore do not provide insight into the differences in magnitude of change on any variable.

3. RESULTS AND DISCUSSION

A total of twenty-two people agreed to participate in the study. Seven people were unable to complete the cardiac rehabilitation program within the six-week period due to illness and

personal circumstances. Fifteen cardiac rehabilitation participants completed all requirements of the study. Demographic data for these participants are outlined in Table 1.

Table 1. Demographic data for participants

	Number of Participants (N)
<i>Subjects (N)</i>	15
Age (years) (mean $\pm$ SD*)	67 $\pm$ 9
Male	10
Female	5
Diabetic	1
Smoker	0
<i>Reason For Referral</i>	
Post AMI	7
Post AMI + Stent	3
Post AMI + CABG	1
CAD + Stent	1
CAD + CABG	1
Post NSTEMI + Stent	2
<i>Elapsed Period of Time Between Cardiac Event & Commencement of Rehabilitation</i>	
Less Than 2 Weeks	4
Between 2 and 4 Weeks	6
Between 4 and 8 Weeks	2
Greater Than 8 Weeks	3

*SD, standard deviation; AMI, acute myocardial infarction; NSTEMI, non ST elevation myocardial infarction; CAD, coronary artery disease; CABG, coronary artery bypass graft

An overview of the cardiac rehabilitation exercise program is outlined in Table 2. Details are provided for both supervised exercise and participation in the prescribed home walking program. The supervised sessions were tailored to ensure each participant could maintain the prescribed level of intensity (Borg RPE between 10-13/20) for the duration of the 1-hour program. Time spent on each modality varied between participants to allow for maintenance of this intensity.

Table 2. Overview of Participation in Cardiac Rehabilitation Exercise Program

	Number of Participants
<i>Attendance</i>	
All 6 sessions	15
< 6 sessions	0
<i>Modalities used</i>	

Treadmill Walking	13
Exercise Bike	15
Upper body free weights	14
Lower body cuff weights	4
Squats	9
Step ups	9
Rowing	4
Sit to stand	5

Frequency of Home Walking

6-7 days/week	5
3-5 days/week	4
1-3 days/week	0
Non walkers	6

Average Duration of Home Walking

> 30 minutes/day	1
30 minutes/day	7
< 30 minutes/day	1
Non walkers	6

177
178 Wilcoxon signed-ranks test showed statistically significant improvements in 6MWT scores
179 following participation in the cardiac rehabilitation program ($p = .033$). Data provided in Table
180 3 pertain to the thirteen participants who completed both pre and post 6MWT. These
181 participants improved for the 6MWT from a median value of 412 metres to 475 metres.
182

183 **Table 3.** Effect of Cardiac Rehabilitation on 6MWT

6MWT Distance			z value	p value
Subjects	Before Training (m)	6MWT Distance After Training (m)		
Minimum	265	140		
Maximum	490	560		
Median	412	475	-2.127 (b)	.033

184 (b) = Based on negative ranks

185 6MWT data were also compared to the only known study that has examined the use of the
186 6MWT in a cardiac rehabilitation population [24]. Table 4 highlights that the population of the
187 current study began at a higher functional capacity and saw a less significant change
188 between pre and post-testing. Both studies saw an improvement regardless of age or
189 gender.
190

191 **Table 4.** Comparison of 6MWT data with Fiorina results

	Initial Distance Walked	Final Distance Walked	%Improvement
Subjects			

	Our		Our		Fiorina	
	Study	Fiorina et al.	Study	et al.	Our Study	Fiorina et al.
Men	433 ± 44	300 ± 86	456 ± 116	429 ± 104	5.3	30
Women	414 ± 41	235 ± 82	460 ± 29	366 ± 103	11.1	35
Age < 70 years	433 ± 44	304 ± 88	484 ± 35	444 ± 102	11.3	31
Age > 70 years	392 ± 68	246 ± 81	425 ± 132	359 ± 94	8.4	31

192

193 The purpose of this study was to determine the capacity of exercise prescription using the
194 Borg RPE scale to induce physiological adaptations within the cardiovascular system in a
195 cardiac rehabilitation population. Cardiac rehabilitation exercise programs based on maximal
196 or submaximal exercise tests are widely documented to result in a number of physiological
197 health benefits as well as directly decreasing mortality rates [1, 6]. However, the extent to
198 which these findings apply to a large percentage of Australian cardiac rehabilitation
199 programs is limited by a lack of studies examining the effect of exercise prescription based
200 on the Borg RPE scale on equivalent health outcomes. This study examined functional
201 walking capacity as judged by the 6MWT as a measure of cardiac rehabilitation
202 effectiveness.

203

204 The specific level of exercise intensity prescribed in the current study must also be examined
205 as an issue of its own, separate from the methods used to prescribe it. In accordance with
206 national cardiac rehabilitation guidelines, a low to moderate level of intensity was prescribed
207 for all participants. Low to moderate intensity correlates with a Borg RPE of 10-13/20 and a
208 HRmax of 35-69% [5]. Although no minimum values have been established for exercise and
209 associated changes in HRV in those with cardiovascular disease, a recent overview of
210 cardiac rehabilitation research found that 45% VO₂R (oxygen uptake reserve) is the
211 minimum intensity required to improve aerobic capacity in this population [26]. This equates
212 to approximately 60% of HRmax [27], and it can therefore be seen that those in the current
213 study training at the lower level of the prescribed guidelines were working significantly under
214 the threshold needed to induce an aerobic training effect. Based on the current research it
215 seems likely that the training intensities employed may have been adequate for improving
216 cardiac function. However a larger sample size needs to be employed to verify these results.

217

218 Exercise frequency in the current study pertains to both the number of supervised exercise
219 sessions and participation in the prescribed home walking program. Our findings indicate
220 that a larger percentage of those who participated in home walking saw an improvement
221 (results not shown) and would suggest that an increased exercise frequency is associated
222 with a decreased risk for recurrent cardiac events. These trends support a recent meta-
223 analysis of cardiac rehabilitation training modalities where greater frequency of sessions had
224 a greater training effect in this population [6].

225 Although all forms of additional aerobic and resistance training were documented, we did not
226 attempt to quantify incidental forms of exercise or lifestyle changes that may have explained
227 these findings. It is often argued that these lifestyle changes and the development of a
228 knowledge base has the greatest impact on mortality rates in cardiac rehabilitation [18]. The
229 improved heart health seen in the current study regardless of exercise frequency is an
230 interesting finding and one that has potential implications for the clinical setting, which will be

discussed further. In addition to participation in home walking, age was found to have some influence on results.

This study is the first to demonstrate improvements in 6MWT scores following participation in a cardiac rehabilitation exercise program based on the Borg RPE scale ($p = .033$). Participants of the current investigation were divided into subgroups to allow for comparisons to be made with the only other known study examining the impact of cardiac rehabilitation on the 6MWT (see Table 4) [24]. Although the percentage of improvement seen by Fiorina et al. was greater than that seen in the current study, both investigations saw an improvement in 6MWT scores regardless of age or gender. Inspection of Table 4 reveals that the participants in the current study began at a higher baseline level of functional capacity and therefore may explain a less-significant improvement following completion of the program.

Drawing any real comparisons between the two studies is difficult as the cardiac rehabilitation protocols between these groups differ greatly. The program examined by Fiorina et al. was conducted twice daily for a period of 15 ± 3 days with exercise intensity prescribed and monitored on the basis of a symptom-limited exercise test. Exact exercise intensities were not documented.

This study is the first to provide insight into the impact of cardiac rehabilitation, based on the Borg RPE scale, on both functional walking capacity and risk for recurrent cardiac events. Findings from this study warrant investigation on a larger scale and further research in this field could spur a re-evaluation of national cardiac rehabilitation guidelines. Results suggest that cardiac rehabilitation as performed in the current study, is able to improve participants' cardiac function and is advantageous in comparison to VO_2 max testing, once considered the gold standard [2], because it measures underlying cardiac health in a manner that produces no discomfort or risk to the participant.

Finally, issues such as non-compliance with home-walking programs and waiting times between cardiac event and commencing rehabilitation are not unique to the confines of this study. They are reflective of the kinds of issues that commonly arise in these programs and the findings of this study suggest that the results previously demonstrated in the highly controlled and idyllic settings of controlled trials may not correlate with the outcomes that can be expected in a clinical setting. The results of this study are pertinent to current practice as they demonstrate the impact of cardiac rehabilitation programs currently in clinical use (once-weekly supervised exercise sessions, based on the Borg RPE scale, for 6-8 weeks) on significant health outcomes.

4. CONCLUSION

This study was the first to examine the ability of cardiac rehabilitation based on the Borg RPE scale to impact on both functional capacity and risk of cardiac-related mortality. Results suggest that programs performed in this manner are capable of having a favourable impact on cardiac function. Our analyses indicated that cardiac rehabilitation providers can be confident that a heterogeneous mix of cardiac conditions, surgeries and genders will not significantly alter participant outcomes.

COMPETING INTERESTS

There are no financial and personal relationships with other people or organizations that inappropriately influenced (bias) this work.

CONSENT

All authors declare that 'written informed consent was obtained from the patient (or other approved parties) for publication of this study. A copy of the written consent is available for review by the Editorial office/Chief Editor/Editorial Board members of this journal.

ETHICAL APPROVAL (WHERE EVER APPLICABLE)

All authors hereby declare that all experiments have been examined and approved by the appropriate ethics committee and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki."

REFERENCES

- [1] Taylor RS, Brown A, Ebrahim S, Jolliffe J, Noorani H, Rees K, *et al.* Exercise-based rehabilitation for patients with coronary artery disease: Systematic review and meta-analysis of randomised controlled trials. *Am J Med* 2004;116:682-692.
- [2] Joo K, Brubaker PH, MacDougall A, Saikin AM, Ross JH, Whaley MH. Exercise prescription using resting heart rate plus 20 or perceived exertion in cardiac rehabilitation. *JCR* 2004;24:178-186.
- [3] Fletcher AK, Dolben J. A hospital survey of the care of elderly patients with diabetes mellitus. *Age Ageing* 1996;25:349-352.
- [4] Leon AS, Franklin BA, Costa F, Balady GJ, Berra KA, Stewart KJ, *et al.* Cardiac Rehabilitation and Secondary Prevention of Coronary Heart Disease: An American Heart Association Scientific Statement From the Council on Clinical Cardiology (Subcommittee on Exercise, Cardiac Rehabilitation, and Prevention) and the Council on Nutrition, Physical Activity, and Metabolism (Subcommittee on Physical Activity), in Collaboration With the American Association of Cardiovascular and Pulmonary Rehabilitation. *Circulation* 2005;111:369-376.
- [5] Fletcher GF, Balady GJ, Amsterdam EA, Chaitman B, Eckel R, Fleg J, *et al.* AHA scientific statement: Exercise standards for testing and training. A statement for healthcare professionals from the American Heart Association. *Circulation* 2001;104:1694-1740.
- [6] Hansen D, Dendale P, Berger J, Meeusen R. Rehabilitation in patients: What do we know about training modalities. *Sports Med* 2005;35(1063-1084.
- [7] West SJ, Goedecke JH, van Niekerk L, Collins M, St Clair Gibson A, Macdonald IA, *et al.* Effects of elevated plasma adrenaline levels on substrate metabolism, effort perception and muscle activation during low-to-moderate intensity exercise. *Pflugers Arch* 2006;451:727-737.
- [8] Dunbar CC, Kalinski MI, Robertson RJ. A new method for prescribing exercise: three-point ratings of perceived exertion. *Percept Mot Skills* 1996;82:139-146.
- [9] Green JM, Crews TR, Pritchett RC, Mathfield C, Hall L. Heart rate and ratings of perceived exertion during treadmill and elliptical exercise training. *Percept Mot Skills* 2004;98:340-348.

- 329 [10] Potteiger JA, Evans BW. Using heart rate and ratings of perceived exertion to monitor
330 intensity in runners. *J Sports Med Phys Fitness* 1995;33:181-186.
- 331 [11] Collins T, Smith M, Jelinek HF. Heart rate variability analysis as an indicator of heart
332 health following a rural cardiac rehabilitation program. In: Dobrescu R, ed. 17th
333 International Conference on Control Systems and Computer Science (CSCS17)
334 Interdisciplinary Approaches in Fractal Analysis (IAFA 2009). Bucharest, Romania:
335 Politehnica Press, Bucharest, 2009:42-44.
- 336 [12] Kang J, Hoffman JR, Walker H. Regulating intensity using perceived exertion during
337 extended exercise periods. *Eur J Appl Physiol* 2003;89:475-482.
- 338 [13] Heitkamp HC, Hipp A. [Lactate in cardiac rehabilitation]. *Herz* 2001;26:447-453.
- 339 [14] Binder RK, Wonisch M, Corra U, Cohen-Solal A, Vanhees L, Saner H, *et al.*
340 Methodological approach to the first and second lactate threshold in incremental
341 cardiopulmonary exercise testing. *Eur J Cardiovasc Prev Rehabil* 2008;15:726-734.
- 342 [15] Borg GA. Psychophysical bases of perceived exertion. *Med Sci Sports Exerc*
343 1982;14:377-381.
- 344 [16] Borg E, Kaijser L. A comparison between three rating scales for perceived exertion and
345 two different work tests. *Scandinavian J Med Sci Sports* 2006;16:57-69.
- 346 [17] Whaley MH, Brubaker PH, Kaminsky LA, Miller CR. Validity of rating of perceived
347 exertion during graded exercise testing in apparently health adults and cardiac patients.
348 *JCR* 1997;17:261-267.
- 349 [18] Ilaraza H, Myers K, Kottman W, Rickli H, Dubach P. An evaluation of training
350 responses using self-regulation in a residential rehabilitation program. *JCR* 2004;24:27-
351 33.
- 352 [19] Wise FM. Exercise based cardiac rehabilitation in chronic heart failure. *AFP*
353 2007;36:1019-1024.
- 354 [20] Berghmans DD, Lenssen AF, Bastiaenen CH, Ilhan M, Lencer NH, Roos GM.
355 Reliability, agreement, and responsiveness of a 6-minute walk/run test in patients with
356 heart disease. *Eur J Prev Cardiol* 2012.
- 357 [21] Jelinek HF, Huang Z, Khandoker AH, Chang D, Kiat H. Cardiac rehabilitation outcomes
358 following a 6-week program of PCI and CABG Patients. *Frontiers Physiol* 2013;4.
- 359 [22] ATS. American Thoracic Society ATS Statement: Guidelines for the Six-Minute Walk
360 Test. *AJRCCM* 2002;166:111-117.
- 361 [23] Solway S, Brooks D, Lacasse Y, Thomas S. A qualitative systematic overview of the
362 measurement properties of functional walk tests used in the cardiorespiratory domain.
363 *Chest* 2001;119:256-270.
- 364 [24] Fiorina C, Vizzardi E, Lorusso R, Maggio M, De Cicco G, Nodari S, *et al.* The 6-min
365 walking test early after cardiac surgery. Reference values and the effects of
366 rehabilitation programme. *Eur J Cardiothorac Surg* 2007;32:724-729.
- 367 [25] NHFA, ACRA. Recommended framework for cardiac rehabilitation. Canberra: National
368 Heart Foundation of Australia and Australian Cardiac Rehabilitation Association, 2004.
- 369 [26] Swain DP, Franklin BA. Is there a threshold intensity for aerobic training in cardiac
370 patients? *MSSE* 2002;34:1071-1075.
- 371 [27] American College of Sports Medicine Position stand: The recommended quantity and
372 quality of exercise for developing and maintaining cardiorespiratory and muscular
373 fitness and flexibility in healthy adults. *MSSE* 1998;30:975-991.

374

375