Exercise Prescription in Cardiac Rehabilitation: A Pilot Randomized Control Trial

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ABSTRACT

BACKGROUND
Exercise intensity appears to be the most important factor in improving cardiorespiratory fitness. Current guidelines recommend that CR programs use a heart rate (HR) or ratings of perceived exertion (RPE) based approach when prescribing exercise. Recent studies have suggested that common methods to guide exercise intensity in cardiac rehab (CR) may produce no change in exercise capacity. Therefore, current methods of prescribing and progressing exercise may need to be reexamined.

OBJECTIVE
Exercise can be prescribed in CR using either RPE or a target heart rate range (THRR). However, it is unclear which method leads to the greatest gains in exercise capacity. The purpose of this study was to determine if exercise capacity gains are impacted by baseline exercise testing and the use of a THRR. Additionally, feasibility, protocol fidelity, and effect sizes were examined in preparation for a larger trial.

METHODS
In this pilot study, patients referred to CR were randomized to one of three groups: RPE of 3-4 on the 10-point modified Borg, 60-80% of heart rate reserve (HRR) with heart rate (HR) monitored by ECG telemetry, or 60-80% of HRR via personal heart rate monitor (HRM), allowing patients to adhere to their THRR. For each daily CR session, we noted exercise heart rate, reported RPE, and frequency of changes in exercise workload. At program completion, we measured changes in functional exercise capacity based on metabolic equivalents of task (METS) calculated from exercise workloads in CR.

RESULTS
Of 48 participants randomized, 4 patients dropped out, 20 were stopped prematurely (COVID-19 pandemic), and 24 completed the protocol. Among patients not impacted by the pandemic, adherence to THRR was high (83±11 and 89±12% of sessions for THRR and HRM, respectively), patients attended a median (IQR) of 33 (23,36) sessions. After randomization, HR increased by 1±6, 6±5, and 10±9 bpm (p=0.021); exercise capacity increased by 1.5±1.0, 1.8±1.3, 2.4 ±1.0 METs (η^2= 0.11); but RPE ratings were similar for the RPE, THRR, and HRM groups, respectively.

CONCLUSIONS
Compared to patients prescribed exercise with RPE, patients randomized to the THRR and THRR+HRM group had more frequent upward adjustments in exercise intensity but similar RPE ratings. We also noted large effect sizes on changes in CR METs and changes in HR, although these results were not statistically significant likely due to the small sample size. These findings should be confirmed in a larger and more definitive trial as they suggest patients randomized to THRR may have better outcomes than patients prescribed exercise using RPE. The AACVPR guidelines recommend the use of RPE to prescribe exercise and RPE is widely used in CR facilities across the country. If these findings are further explored in a larger trial, there is potential to change the policies and guidelines surrounding exercise prescription in CR.

BACKGROUND

- Methods for prescribing exercise in CR
  - HR based (THRR)
    - Requires graded exercise test (GXT) to identify accurate peak HR
    - GXT increases burden by increasing cost and delaying start of CR, but exercising below 46% HRR has demonstrated no improvements in cardiorespiratory function
  - RPE based
    - Commonly used guideline that is easy to implement and readily available
    - Patients typically underestimate exercise intensity guided by RPE, causing HR to be 15% lower than known THRR

Hypothesis 1) Baseline exercise testing and a THRR would lead to greater increases in achieved HR, METS, and VO2peak 2) the use of a HRM would lead to better adherence to the THRR

TABLE 1: BASELINE DEMOGRAPHICS

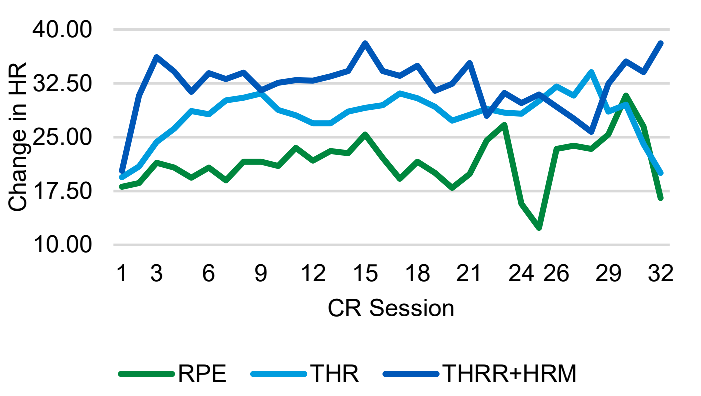
Variable	RPE (N=16)	THRR (N=16)	THRR+HRM (N=16)
CABG	6 (38%)	6 (38%)	6 (38%)
MI/PCI	10 (63%)	10 (63%)	10 (63%)
Age	67 6	69 8	65 7
Males	11 (69%)	12 (75%)	12 (75%)
Resting HR (bpm)	77 8	70 6	74 12
Baseline METS	3.1 0.6	3.4 1.4	3.4 0.9
Beta blocker equivalent dose (mg)	43 26	41 32	48 83

There was no significant difference between baseline characteristics across groups (p > 0.05).

METHODS

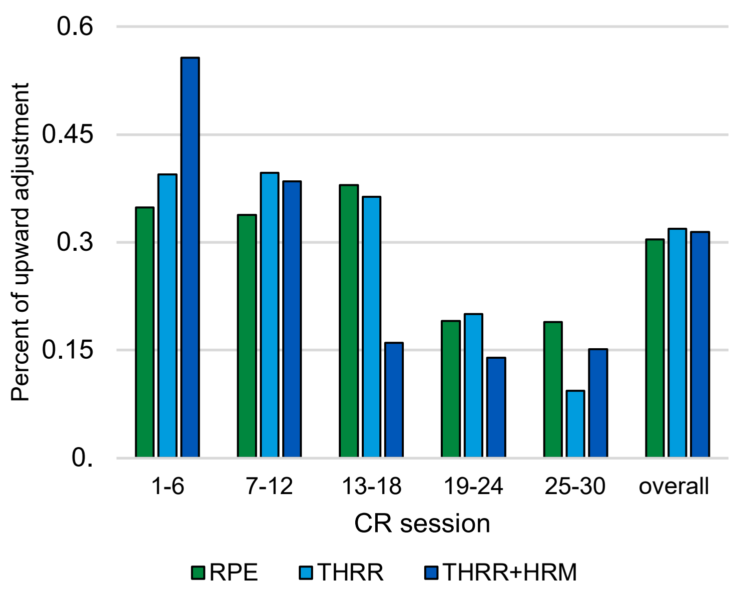
- Subjects randomized to either exercise training guided by RPE or to one of two THRR methods
- RPE group: prescribed exercise based on an RPE of 3-4 on the 10-point modified Borg
- Both THRR groups: baseline GXT to measure peak HR, used to prescribe exercise at 60-80% of HRR
- THRR group received feedback from staff only vs. THRR+HRM group received their own personal HRM that provided continuous feedback to them, as well as feedback from staff
- Exercise HR, RPE, and the frequency of adjustments to exercise workload were measured every CR session. CR METS were measured at baseline and at discharge.
- Cardiopulmonary stress test (CPX) completed at or near the completion of CR and VO2peak was measured

FIGURE 1. CHANGE IN HR FROM REST



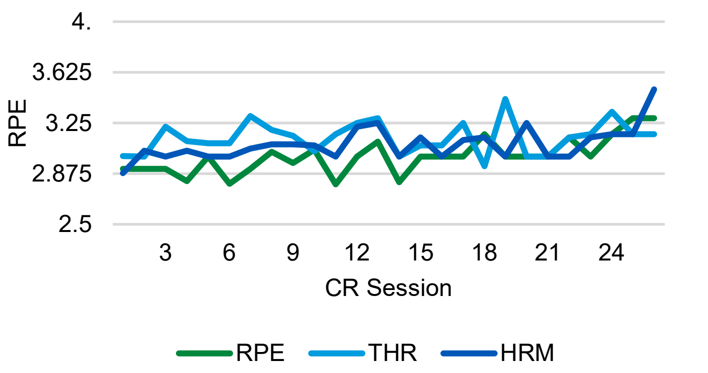
Significant interaction between time and exercise method for the change in HR from rest, subjects in both THRR groups had a significant increase in the change in HR from rest, whereas the RPE group did not η^2 = 0.26, p = 0.005

FIGURE 2. FREQUENCY OF UPWARD ADJUSTMENTS IN WORKLOAD



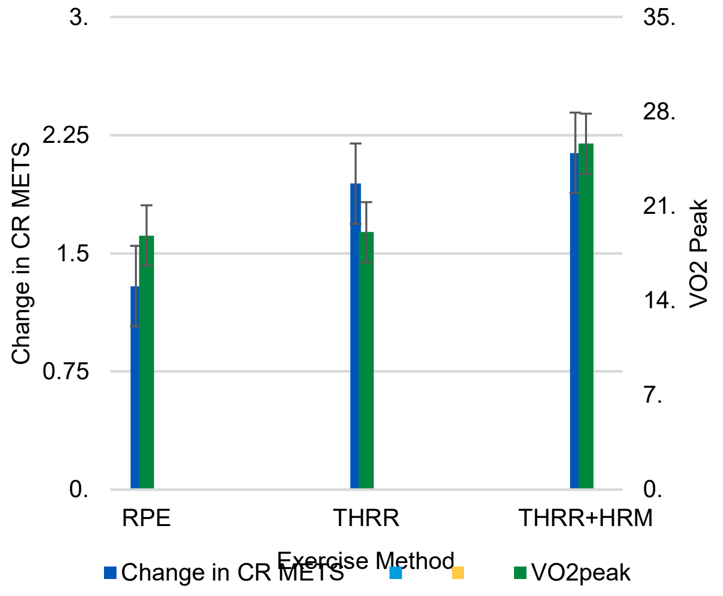
Patients in the in THRR and THRR + HRM groups, had more frequent upward adjustments in workload earlier in CR compared to subjects in the RPE group (η^2= 0.15, p = 0.008) indicating that subjects in the THRR groups were exercising at a higher intensity

FIGURE 3. RPE ACROSS TIME



RPE was not significantly different between groups or across CR sessions p = 0.94. The average RPE was 2.9 ±0.05, 3.1 ±0.06, and 3.0 ± 0.05 for the RPE, THRR, and THRR+HRM groups, respectively.

FIGURE 4. END OF TREATMENT EXERCISE CAPACITY



Patients in the in THRR and THRR + HRM groups, had a greater change in CR METS and a higher VO2peak. The THRR+HRM had the highest increase in METS and had the highest VO2peak. A large effect size was found for the change in CR METS and VO2peak (η^2= 0.11, p = 0.20, η^2= 0.13, p = 0.18, respectively)

RESULTS

- 32 subjects were included in the final analysis because they spent adequate time in the intervention (≥ 6 sessions after randomization)
- 74% of subjects completed ≥ 12 CR sessions
- Subjects exercised within their THRR for 83 ± 11 and 89 ± 12% of CR sessions for the THRR and THRR+HRM groups, respectively.

DISCUSSION

- Critically important to get exercise intensity right for CR participants to see improvements
- THRR and THRR+HRM groups gained an additional 0.7 and 1.3 exercise METS compared to subjects in the RPE group, clinical significance = 1-MET increase in exercise capacity reduces subsequent risk of mortality by ~20%
- Large effect size of 0.13 for THRR methods based on VO2peak provides evidence for the importance of exercise intensity during CR
- A personal HRM is not necessary to implement a THRR with high fidelity

CONCLUSIONS

- Exercise prescription through THRR resulted in higher frequencies of upward adjustments in exercise workload, exercise heart rate, and the change in heart rate from rest, indicating a higher exercise intensity compared to exercise prescribed based upon RPE.
- THRR based training demonstrated large effect sizes for improvement in METS and VO2peak, these findings were underpowered and need to be confirmed in a larger trial.

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