Exercise Prescription Methods

Rebuttal: Is it Time to Rethink Aerobic Exercise Prescription Methods?

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In their Counterpoint discussion, Swain and Franklin suggested that we prefer to use % heart rate reserve (%HRR) to % maximal oxygen intake (%$\dot{V}o_2$max) relationship over %HRR to % oxygen intake reserve (%$\dot{V}o_2$R). In fact, we agree that %HRR-%$\dot{V}o_2$R is less biased and adjusts the HR-$\dot{V}o_2$ relation for nonzero resting values and different maximal values.

Although the 2 reserves are theoretically equal, there are studies showing otherwise during incremental exercise and especially during prolonged exercise. Pinpointing the cause of those differences between the theoretical model proposed by Swain and the actual results found by several other studies is not an easy task. However, we believe that the reasons might stem from some methodological and physiological differences. Even if not 1:1, however, we still prefer using %HRR-%$\dot{V}o_2$R.

A 1:1 %HRR-%$\dot{V}o_2$R relationship would be true only if the relationship is linear throughout the entire range of exercise and if the HR and $\dot{V}o_2$ adjustments are similar. This may not be the case during the onset of exercise when the rise in HR from its resting level is associated more with a withdrawal of the parasympathetic nervous system than with a stimulation of the sympathetic system. Once the sympathetic system becomes dominant, the rise in HR is more closely tied to the energy demands of the exercise.

We agree that using different time periods to record HR and $\dot{V}o_2$ could be an issue, but only if the HR and $\dot{V}o_2$ values are not considered representative of that specific exercise power output (PO). Unfortunately, no study that has assessed %HRR-%$\dot{V}o_2$R relationships during incremental exercise can be certain that the HR and $\dot{V}o_2$ values obtained were not biased; this assumes that 1) there is a steady state at every PO and 2) the %HRR and %$\dot{V}o_2$R kinetics show similar adjustments over time to each PO. We cannot be sure these assumptions have been met in any study assessing the %HRR-%$\dot{V}o_2$R relationships during incremental exercise or whether the results can be transferred and applied to prolonged steady-state exercise. As an example, Cunha et al. (1) showed that the graded exercise test (GXT) protocols affect the %HRR-%$\dot{V}o_2$R relationship. Compared with the Bruce protocol with its 3-minute stages, they found that using a ramp protocol yielded significantly higher intercepts, with %HRR higher than %$\dot{V}o_2$R.

In an unpublished study by Ferri Marini et al. (to be submitted for publication soon) on 440 HERITAGE Study participants aged 17 to 66 years, 1) HRR values were higher than those of $\dot{V}o_2$R during the 15-minute steady-state exercise at 50 W and 60%$\dot{V}o_2$max and 2) using the GXT data gave more accurate prescriptions of exercise intensity than those using an assumed 1:1 HRR-$\dot{V}o_2$R relation during steady-state exercise.

If the goal is to have precise and useful prescriptions of aerobic exercise intensity, then researchers and practitioners should not assume a 1:1 %HRR-%$\dot{V}o_2$R relationship in every individual. The following points should be considered because they can affect exercise prescriptions:

- Several studies found that the relation was not 1:1;
- The interindividual variability of the %HRR-%$\dot{V}o_2$R relationship is high;

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- The %HRR-%$\dot{V}o_2$R relationship does not seem to be 1:1 during prolonged aerobic exercise (especially at higher intensities) because of such time-dependent adjustments as cardiovascular drift and the slow component of $\dot{V}o_2$ kinetics, both of which cause a rise in HR and $\dot{V}o_2$ over time.

As stated previously, there are problems with all methods for prescribing exercise intensity. Nevertheless, it is good to occasionally review what is known and what is uncertain, so that we can make minor adjustments. We do not feel that there is a need to do a major overhaul on how exercise should be prescribed.

In agreement with Swain and Franklin in their Counterpoint, we note that there is an art as well as a science to exercise prescription and that any exercise intensity marker is just a starting point that may have to be adjusted based on many factors. Some of these have been discussed by Swain and Franklin and by us.

REFERENCES

1. Cunha FA, Midgley AW, Monteiro WD, Farinatti PT. Influence of cardiopulmonary exercise testing protocol and resting $\dot{V}o_2$ assessment on %HRmax, %HRR, %$\dot{V}o_2$max and %$\dot{V}o_2$R relationships. Int J Sports Med. 2010;31(5):319–26.