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The Application of Individualized Fitness Systems for Cardiovascular Training

Matt Rhea, PhD, CSCS,*D

RACE Rx
Exercise and Sports Science Company

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In the design of exercise programs, numerous concepts serve as foundational directives to enhance the safety, effectiveness, and efficiency of training. These principles include overload, progression, periodization, dose-response, and rest-recovery. By relying on each of these principles, exercise professionals are guided in their design of effective exercise programs.

One concept that has received some focus in exercise prescription discussions is individualization. The manner in which an exercise program should be altered or tailored to an individual is vital to ensure the safety and effectiveness of training. Challenges arise, however, when customizing cardiovascular exercise programs in determining the appropriate training intensity, exercise tolerance, or motivational levels of each client. In resistance training, a program can be personalized based on the client's current fitness level or training age. For example, a 1RM test is often performed, followed by the calculation of training loads relative to maximum strength capacity. This allows for the application of relative loads (i.e., 65 – 85% of 1RM) that have been shown in research to elicit a certain muscular fitness benefit (i.e., strength) (3, 5).

In cardiovascular training, the concept of individualization is undoubtedly vital to optimal exercise prescription, but methods for achieving this degree of specificity in program design are somewhat controversial. The most common practice employed to personalize cardiovascular exercise intensity is the use of age-predicted equations for estimating maximal heart rate (3). The most common of these equations is:

$$220 - \text{Age} = \text{Max Heart Rate}$$

At present, little evidence exists to support the validity or accuracy of this equation. In a sample of 50 middle-aged exercisers of various fitness levels, it was found that discrepancies between age-predicted and measured maximum heart rate ranged from -20 to +19 (4). The mean difference was -2.08 ± 9.68 beats per minute. While the mean difference between measured and predicted maximum heart rate was found to be small, the large range in differences is troublesome, as it appears that age is not sufficient to accurately predict the many variables that may be related to maximum heart rate.

Two dichotomous results manifest themselves when relying solely on such an equation for determining exercise intensity. If maximum heart rate is underpredicted, prescribed exercise intensity is too low, resulting in little benefit for the participant. Similarly, if maximum heart rate is overpredicted, the prescribed exercise intensity is too high, which may lead to increased risk of acute cardiac problems due to excessive exercise stress. Neither case is acceptable or appropriate.

Many other equations have been suggested as alternatives to 220–Age. As previously mentioned, little supporting evidence or anecdotal documentation has been presented to ensure these equations are accurate. In addition, neither of these equations factor in fitness level in determining appropriate heart rate training zones. If an equation were found to be valid, age alone would only provide a prediction of maximum heart rate with no measure of fitness being included in program individualization. Consequently, this results in people of the same age but vastly different fitness capacities being prescribed exercise at the same level of intensity. The Heart Rate Reserve formula has been presented as an alternative to include personalized programming for fitness (3).

$$220 - \text{Age} - \text{Resting Heart Rate } (0.60 \text{ and } 0.80) + \text{Resting Heart Rate} = \text{Exercise Heart Rate Lower and Upper Limits}$$

Unfortunately, the formula begins with an age predicted maximum heart rate using 220-Age. Therefore the inaccuracies that have been previously described immediately affect the validity of this equation. Furthermore, the Heart Rate Reserve formula relies on resting heart rate as a measure of fitness. While resting heart rate decreases as cardiovascular fitness increases (2) there is no apparent link between baseline resting heart rate and cardiovascular fitness. Resting heart rate may be more related to genetically-determined physiological parameters such as heart size, stroke volume, etc., and therefore may not accurately represent the current fitness level.

An additional problem with the Heart Rate Reserve formula occurs when resting heart rate is entered back into the equation. High or low resting heart rates result in what appear to be inappropriate adjustments to training zones. Individuals with high resting heart rates, supposedly signifying a person of lower fitness capacity, would receive a higher training intensity prescription than individuals with low resting heart rates (those with supposed higher fitness capacity):

Sample

Exerciser #1 Age: 45; Resting Heart Rate: 90 bpm

Formula: 220 – 45 – 90 (0.60 and 0.80) + 90 = 141 – 158 bpm

Exerciser #2 Age: 45; Resting Heart Rate: 45 bpm

Formula: 220 – 45 – 45 (0.60 and 0.80) + 45 = 123 – 149 bpm

While a valiant attempt to consider fitness level in the prescription of a cardiovascular training program, applying an exercise intensity that is higher for individuals who are presumed to be of lower fitness capacity presents a serious flaw. Despite the fact that this formula and approach to creating heart rate programs continues to be presented as appropriate and valid in virtually all current college texts related to exercise prescription, there exists far too much error and imprecision to truly help our individual clients achieve their fitness goals in the most effective and efficient manner. Unfortunately the inaccuracies of age-based equations have resulted in a negative perception among many cardiovascular exercisers toward heart rate training. Heart rate is a very good measure of exercise intensity and can provide valuable information for programming, but more effective means of identifying ideal individual intensity parameters are much needed.

Accurately prescribing exercise intensities requires some measurement of speed/pace, metabolics, heart rate (either maximal or submaximal), or other variables related to exercise tolerance or fitness. Measuring maximal heart rate would provide an accurate starting point, but may not be appropriate for all exercisers due to an increased risk of cardiovascular complications due to the extreme nature of a maximum stress test. Speed or pace is a useful measure, but primarily used only for those who compete frequently in racing events. In addition, competition may result in higher speeds due to the increased catecholamine response (i.e., epinephrine) or race environment, which would produce paces that may not be appropriate for daily exercise sessions. The measurement of metabolic variables such as VO2 max and anaerobic threshold are valuable for individualizing cardiovascular exercise programs but, once again, carry some increase in cardiac health risk due to extreme testing intensities. In addition, the cost of the testing equipment and the discomfort accompanying such testing is a deterrent to many in the general population.

Field-based methods for gathering data that can be used to easily and accurately individualize cardiovascular exercise intensity are much needed. Relying solely on prediction equations of either fitness or age is simply not sufficient for accurately prescribing cardiovascular exercise intensity. The development and validation of appropriate methods for establishing individualized training intensity is a primary need in the area cardiovascular exercise research.

References

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