Heart Rate Fundamentals for Runners

On several occasions, I've been asked about various aspects of our heart-rate [HR] and it was suggested to me that others may be interested also. This article will discuss the following heart-rate topics: Resting HR, Maximum HR, Heart Reserve, and HR Recovery.

First, a fundamental concept: "**Cardio-Output**," is simply the HR times the stroke volume [i.e., the amount of blood] per pump. Your cardio output always exactly matches your body's needs, from resting to full-speed running.

Resting Heart Rate [HRrest] is the fundamental base measurement; it is a quantitative value of the heart's potential capacity. Your resting heart rate [HRrest] is a good indicator of your heart's relative stroke volume. To illustrate, assume a sedentary person with a HRrest of 84 beats/minute [84bpm] and a runner with a HRrest of 42bpm. A person, with a HRrest of 84bpm, can only rest when their HR is 84bpm; however, the runner with a HRrest of 42bpm can actually walk or jog at the same 84bpm. The runner's stroke volume is obviously twice as great. Speed training increases the heart's stroke volume and thus is a good indication of its overall condition.

Runners, and everyone really, should know their HRrest and keep track of it as a reference. Any unaccounted for significant changes should be cause for concern. For example, if it's been 48bpm +/- 4bpm for years and then it becomes 56bpm for no apparent reason, a cardiologist should be consulted. Whenever you are involved with any medical personnel, always inform them of your HRrest and that you are a runner. Medical personnel rarely see anyone with a HRrest less than 60bpm and they have a term for this condition "bradycardia," [slow heart-rate] and may consider treatment is needed, which of course may be a false alarm.

To get started, measure and record your HRrest [count your pulse for 30 seconds and multiple by 2] before getting out of bed in the morning and at about 2PM when you are resting quietly. Some folks are lowest in the morning and some in the afternoon. Do this every day or two for about 2 weeks, until you are satisfied the HRrest measurements are stable. Then, check it every month or so and whenever your training regiment changes.

Most runners who regularly run at least 4 times a week and do some speed work should expect to have a HRrest of less than about 50bpm, and 40/42bpm, or even less, is common.

Maximum Heart Rate [HRmax] is the maximum rate at which your heart can beat. The most accurate method for measuring HRmax is by undergoing a cardiac stress test, performed by an exercise or sports physiologist. Theoretically, cardiologists can probably do it, but most of them have little experience with healthy athletes and thus do not push subjects to their absolute limit.

However, you can come close to predicting your HRmax using the following methods. Both are best done with a heart-rate monitor. I recommend all serious runners have one. Go to the track or to a flat or slight upgrade hill, preferably with someone who can run faster than you. Warm up for a ½ mile or so, do 3 or 4 short sprints, and then run about 800m [½ mile] at about 90%. Rest for 60 seconds. Finally, run as fast as you can for about 1200m [3/4mi]. The "someone faster than you"s responsibility is fuss and cuss to drive you to your maximum rate. He or she should run a step ahead of you, to "pull" you along. The benefit of a heart-rate monitor for this test should be obvious. Without one, stop at about 1000m and immediately count your beats for 10 seconds and multiply by 6.

The second method is simpler, monitor your heart rate during races. Obviously, it requires a HR monitor. Most folks find their maximum rate occurs about 100 to 200 meters just before the finish.

You should repeat the test several times over about a month, at least until your measurements are stable and repeatable. In the next topic "Heart Reserve," I'll address how you can use this information in your training program.

Your HRmax is dependant upon your age, your genes, muscle-mass utilized and, to some extent, your cardiovascular condition. Let's consider each of these factors.

Several formulas have been derived to predict HRmax as it relates to age. The most respected formula is HRmax = 206 - (0.685 x age). Undoubtably you have heard or read about the 220-age formula; it is somewhat inaccurate. For example, at 15, the 220-age formula predicts HRmax= 205bpm and the 206 - (0.685 x age) formula predicts 196bpm. At 70, the 220-age formula predicts 150 and the 206 - (0.685 x age) formula predicts 158. Check your predicted HRmax using both formulas. The standard deviation [variance] for all formulas has not been established. I've seen everything from +/- 2bpm to 12bpm in the literature. Note, this formula predicts that we lose about 7bpm every 10 years.

Generally, professional heart experts believe that HRmax, for heathy persons, is primarily determined by age and genes, and that it is independent of their sport-condition. However, case studies can easily be found that report finding a HRmax increase observed when sedentary, older people embark on a strenuous exercise program. Personally, I've observed that most new runners, especially those over 40 and whose HRmax is less than the predicted rate by the formula above, will see a HRmax increase as they train to run faster. There is no evidence that training can increase HRmax once the maximum is achieved.

Our HRmax is directly affected by muscle-mass utilized during exercise. For example, most everyone has a higher HRmax when running than when biking, typically about 10bpm. Thus, our HRmax is sport specific and must be measured performing that sport. Maximum perceived effort is necessary, but not sufficient. Your measured HRmax will only occur when you are running at your extreme limit and your perceived effort will likewise be maximum. However, you can have a maximum perceived effort at a heart-rate far less than your HRmax. Lifting weights is a good example.

Heart Reserve

Recall, in the first paragraph under "Resting Heart Rate," I said that a sedentary person with a HRrest=84bpm, can only rest when his or her HR is 84bpm; the runner can actually walk or jog at a reasonable pace with a HR of 84bpm because the runner's stroke volume is obviously twice as great. This simple observation illustrates the fallacy of the so called "Heart Target Training Zones" and "Heart Rate Training Targets" often mentioned in running magazines.

Your Heart Reserve determines your cardiovascular's ability to meet your exercise demand. Let's illustrate. Your Heart Reserve is simply HRmax - HRrest. Assume your numbers are 175bpm and 45bpm; thus, your reserve is 130bpm. Looking at this another way, your HR can vary from 45bpm to 175bpm. Our sedentary friend's heart rate, assuming he or she is heathy and is the same age, can only vary from 85bpm to 175bpm, i.e., only 90bpm.

The bottom line is that your Heart Reserve must be used for training purposes, and not simply a percentage of your HRmax. For example, assume you plan to run a long run at 50% and your reserve is 130bpm. Your target HR is 45bpm + .5x130 = 110bpm. Our sedentary friend at 50% will have a HR of 85bpm + .5x90= 130bpm.

There is simple way to do mental arithmetic for calculating your target rate. Just take your reserve, e.g., 130 and divide it by 10, use this as beats/10%. For example, assume a reserve of 130, divide by 10, and get 13/10%. Now assume you want a 90% HR training interval, target HR = 175-13= 162.

Keep in mind that at HRmax the conditioned heart, as indicated by the slow HRrest, will have a greater stroke-volume. This obviously provides for a superior endurance and hill climbing ability, etc.

Heart Rate Recovery

Slow Heart-Rate Recovery immediately following strenuous exercise near HRmax is an indicator of a potentially serious heart condition. To measure your recovery rate, exercise to raise your HR to near maximum and record it. Then wait exactly 2 minutes and measure the rate again. You should expect a difference of at least 20bpm. If it is less, consider seeking a professional cardiology evaluation.