

The Myth Of "Maximum Heart Rate = 220-Age"

By [Richard King](#)

You've probably heard of the formula "220-your age" for estimating maximum heart rate. Unfortunately, this formula is not very useful because it can be easily off by more than 20 beats on the high or low side. For me at age 54 this formula says my maximum heart rate should be 166, but I happen to know from more accurate tests that it's at least 25 beats higher than that.

In books, on exercise machines, and on the walls of gyms, you'll often see charts of suggested exercise intensity that are based on 220-your age. It's also in calculators all over the web. I'd hardly break a sweat if I exercised at those levels. But more importantly, for some people the opposite is true and their maximum heart rate can be more than 20 beats lower than the formula predicts. If they were to exercise at the levels from the charts, their intensity could be too high, especially for anyone with a medical condition.

This formula is often quoted without any warning about its potential inaccuracy, and in addition to the inaccuracy, it turns out it has little scientific basis [Kolata, 2003]. Some people are aware that 220-age was never intended by its original authors to be a universal formula (it was intended to come up with a safe exercise level for patients in cardiac rehab and was based on a not very broad sample of subjects). But the problem is also in the basic assumption that max heart can be predicted on the basis of age alone. If you think about it, it seems nonsensical- regardless of family background, fitness level, whether we're tall or short, underweight or overweight, etc, we all have exactly the same heart rate at a certain age, and maximum heart rate declines with age in all of us at exactly the same rate?

More recent studies have tried to revisit this concept on a broader sample of the population. For example, in one study, based on thousands of subjects, male and female, ranging in age from 18 to 81, the authors came up with a "best fit" equation of:

Max heart rate = $208 - 0.7 \times \text{Age}$.

However, if you look at the data this is based on, it looks like a cloud with only a vague trend towards heart rate decreasing with age; there's a lot of scatter. The new formula is a little more accurate than the old one, but can still under predict or over predict max HR by 20 beats or so [Tanaka, 2001].

A recent review of many attempts to come up with a formula to predict max heart rate concluded that no sufficient accurate formula exists to predict max heart rate from age alone [Robergs, 2002]. In my opinion none is possible because of the large amount of scatter in the data. Exercise physiologist Dr. Fritz Hagerman, who has studied world-class rowers for three decades, has said that the idea of a formula to predict an individual's maximum heart rate is ludicrous: he has seen Olympic rowers in their 20's with maximum heart rates of 220, and others on the same team and with the same ability, with maximum rates of just 160 [Kolata, 2001].

Many books have charts with elaborate training schedules based on various zones of intensity, all based on maximum heart rate. It all may look very scientific, but it's not too worthwhile if it's based on an inaccurate number.

Another misconception I've come across is that the problem with the 220-age formula is fixed by using the "heart rate reserve" or Karvonen formula. In that formula, exercise intensity as expressed as a percentage of your "reserve capacity" between your resting heart rate (RHR) and max heart rate (MHR):

Target heart rate = X% of (MHR-RHR) +RHR

Where X% is the desired percentage. This is a useful formula because the intensities from it are related to a percentage of the heart rate corresponding to your maximal oxygen uptake VO2Max, which many exercise physiologists are fond of using. But the Karvonen formula still needs an accurate estimate of your max heart rate. If you stick in an inaccurate number based on an age related prediction like 220-age, the result will still be inaccurate.

Heart rate training can be a useful tool, if based on a good estimate of what's a valid intensity level for you. Maximum heart rate can be measured accurately in a lab, but for most of us that's kind of an expensive option. You can estimate other useful parameters like heart rate at lactate threshold from self-administered tests (see for example, [Carmichael, 2003]) and this can be used for heart rate based training. But for those of us that are interested in mostly in fitness, I question the necessity. I'm a "perceived level of exertion" kind of guy. On easy cardio days my pace is comfortable. On hard days, it feels hard, and when doing intervals, it's very hard. This leads to good and steady progress.

References

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