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Follow Your Heart Rate?

Brian MacKenzie and Anthony Roberts explain the origins of the maximum-heart-rate number and why it so often tells us so little.

By Brian MacKenzie with Anthony Roberts **October 2011**

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Most people are familiar with the formula $E = mc^2$, even if they can't explain Einstein's theory of relativity.

Luckily, most don't need to explain the speed of light in a vacuum, so this isn't much of a problem.

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What about this formula?

220 - age = MHR

Most probably know that one, too. It's the standard formula for determining maximum heart rate, or MHR. Subtracting your age from 220 represents the highest heart rate one can safely achieve through exercise stress. This formula tells us a 15-year-old has a maximum heart rate of 205 and a 25-year-old has a maximum heart rate of 195.

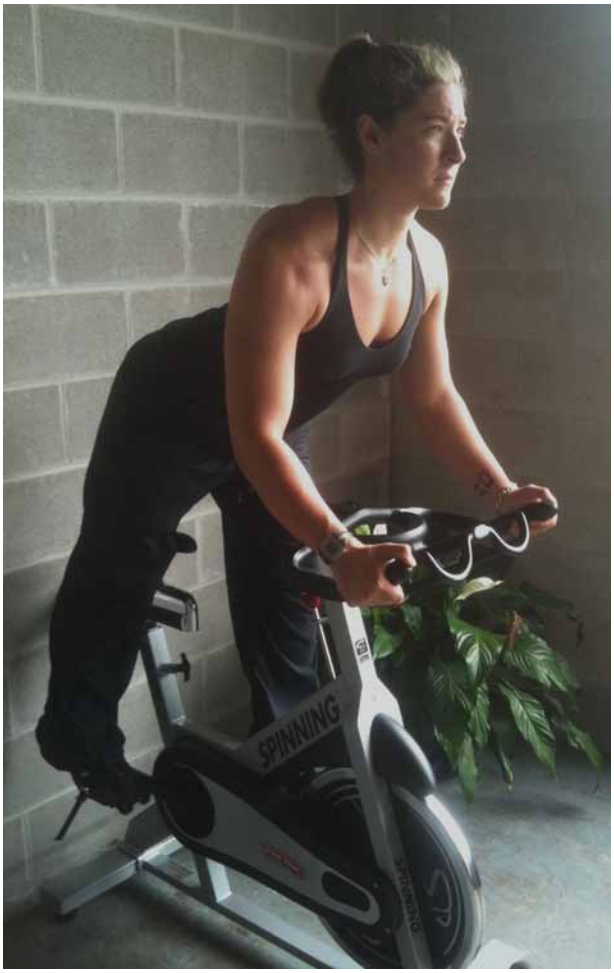
If I started training for 5K races at the age of 15 and continued for 10 years, my MHR still would be 195, according to this formula. After 10 years of endurance training, it would be lower, according to the formula. It tells me I'd have the same maximum heart rate as an untrained person of equal age after endurance training for an entire decade!

It's pretty well known that 220 minus your age is the standard for your maximum heart rate. Yet, after a few years of training, it becomes just as well known that this is a dog-shit marker.

Ever wonder where MHR estimates or heart-rate training came from? Have you ever strapped on an HR monitor to see what your heart is doing? Or maybe you checked your resting pulse? It must be important, right? The mainstream medical industry, as well as the general fitness community, has set up parameters for what is healthy based on your resting HR, or RHR. Fair? Not in the slightest.

A Formula's Origins

It's pretty well known that 220 minus your age is the standard for your MHR. Yet, after a few years of training, it becomes just as well known that this is a dog-shit marker. With regard to HR, the most common thing I've seen with every athlete I've ever tested or worked with, and even with myself, is the number was never correct. Ever. In fact, our research has shown it's roughly 15-20 percent off with athletes.



Courtesy Jamie Filer

"Grab handles to measure heart rate" ... or don't.

The formula itself relied on metadata originally compiled for a 1971 study that examined physical activity and the prevention of coronary heart disease. Obviously, this formula is biased in origin; it was developed to help prevent heart disease.

Even worse is the fact that the formula, which has numerous flaws for the purposes of athletics, has become so ingrained in the training world that we never question it, and most people don't even know where it came from.

Care to guess what the American College of Sports Medicine 2001 textbook cites as the reference for this formula? The same textbook from 2000. The textbook published by the National Strength and Conditioning Association provides no reference for the 220 formula; this is how accepted it is to most. But not by us.

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The first clue: when we look at something that doesn't work for us and can't even figure out where it came from.

To put it into perspective, a ton of folks are coaching people off the 220 marker. Most commercially available HR monitors even use this formula, yet these monitors are sold to fit people and coaches. It doesn't add up.

We've long known the fitness industry is upside down in its thinking and practices.

In a 2001 *New York Times* article ("'Maxium Heart Rate Theory Is Challenged"), Donald Kirkendall, the famed exercise physiologist from the University of North Carolina, talked about how he strapped an HR monitor to a twentysomething member of the U.S. Rowing Team and had him row as hard as possible for 6 minutes. The result: a heart rate of 200 beats per minute (BPM) within a minute and a half; it continued for the remainder of the test. Impossible? Obviously not.

We've long known the fitness industry is upside down in its thinking and practices. The American College of Sports Medicine (ACSM) sets a standard of what people should be able to do, and the "fitness" world, along with exercise physiologists, is supposed to use these standards for training subjects and recording data points. Prior to rolling an ankle, Lon Kilgore wanted to test the ACSM's protocols for fitness and in doing so was actually becoming less fit as he continued. The standards for measuring MHR at the ACSM: 220 minus age.

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Does 220 minus age apply to this athlete? Why or why not?

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William Haskell first proposed the 220 formula in the '70s as an attempt to determine how strenuously heart-disease patients could exercise. As scientists typically do, he checked out existing literature (compiled by his mentor, Samuel Fox) and saw that on average the HR maximum was about 200 at age 20 and 180 at age 40 and so on. The population he examined mostly was under 55; some were smokers and/or had heart disease. By plotting a straight line through the data points, he got roughly 220 minus age.

A Rogue Equation

In 2002, a couple of scientists took the information provided in support of this infamous 220 formula, plotted a perfectly straight line through the data points and published the following:

215.4 - .9147 x age

So even internally the original formula everyone is familiar with isn't quite accurate. In 1938, the formula 212 - .77 x age was proposed (very close to what was ultimately accepted), but it never caught on. You know why? Try doing that calculation in your head, then try doing the 220 formula.

Since then, Haskell has said numerous times he never intended his formula to be used in a fitness environment or by trained individuals.

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Even if it were accurate, the standard deviation for the formula is plus or minus 16. That means our hypothetical 25-year-old me could have an MHR of 180 and 210, and 32 percent of 25-year-olds still would fall outside the 220 formula. So we're left with a formula that even on its best day is only scoring 68 percent.

One of the stopping points for me using HR monitors was when a friend and I were running and he repeatedly told me we needed to slow down because his HR was at 166 and he was going to "blow." Finally, I said, "Shut up and just run. If you were going to blow, you wouldn't be talking about it."

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How many endurance athletes out there go through this? How many people scale back their intensity during a training session because their heart rate gets too high? Lots. And if you take a look at any marathon or triathlon you will see lots of people with chest straps and fancy watches that measure that little ticker's beat. Why? They want to stay in the correct training zones so they don't blow!

Here is an interesting observation. I originally heard Greg Glassman bring this up, so I looked into it: Take a look at NASCAR drivers. They can hold their HRs exactly where a marathoner can—around 142 to 152—for three hours while driving a car around a track at 180 mph. The literature indicates drivers have HRs reasonably close to boxing, basketball and soccer athletes. Formula 1 drivers average 160 BPM—about the same as a tennis player. Do we have any doubt as to which athlete is in better shape?

Playing a game of championship beach soccer will produce an average heart rate of just more than 165, while case studies examining some collegiate baseball pitchers have demonstrated a 175.8 mean HR. This is similar to the average seen with professional rugby players. Are the demands and fitness requirements of these sports similar? Even worse, HRs for referees officiating a rugby match can approach those of the players.

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Intuitively, we know a NASCAR driver or F1 racer would be shredded by a boxer, marathoner and a soccer or rugby player in terms of endurance, even though the literature tells us they have similar heart rates during competition. Practically, we can all imagine a driver telling us he's getting out there and playing some ball to get in better shape or maybe putting in some running. But imagine if the situation were reversed: Imagine a marathoner telling us he was going to do some driving to prepare for his next race. We don't need a study to tell us this isn't going to work, even though the heart rates would be similar.

In other words, physical stress doesn't necessarily play a role in HR because sitting in a car driving around a track does not require much physical activity. And pitching nine innings is unarguably less physical than playing a rugby match.

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But if we were to include the heat and the stress of racing at 180 mph, that would change something. Now if we factor in the idea that tennis players serving the ball have a higher heart rate than those returning the serve, we start to get into the idea of psychophysical stress. This is why your heart starts beating faster when you simply think about a challenging situation or get involved with outside physical stressors that don't necessarily require action.

This is the sympathetic and parasympathetic nervous systems at work. It's why the heart rates of archers go from 71-126 BPM pre-draw to 88-147 BPM at full draw, even though they haven't done much physical work. It's also why we see a significant increase in the HRs of chess players—75-86 BPM (I must admit my heart skips a beat when I fianchetto the bishop for a Nimzo-Indian defense).

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If we ignore heart rate, what's a real measure of fitness?

What Does It All Mean?

So HR numbers—while fun to look at—don't tell us what we think they do.

If you were to run a mile with a heart rate of 140, then do that same mile with a heart rate of 160, what does it tell you? Maybe you're exerting yourself more on the second run, but are you necessarily running faster? Of course not. What if we reverse those numbers and your HR is lower on the second run? Is that because you pump more blood per stroke (from a training adaptation)? Is there more oxygen per unit of blood pumped? Or is the run actually easier, or, or, or … ?

What do those numbers tell us? Surprisingly little. They tell us that if you're a trainer earning minimum wage at a big-box gym, watching your client move from the triceps press-down to the pec-dec to the elliptical machine, you probably won't kill him if you keep his heart rate below a certain level (that knowledge only requires a second-grade math education to figure out).

Let's put it another way: according to a 2011 study, the heart rate of an experienced boxer during a sparring workout in the gym is around 180, while the heart rate of a college kid playing a boxing video game is about 90 percent of that. Is the latter actually working 90 percent as hard as the former? Can you play a boxing video game and get 90 percent of the fitness level of an actual boxer? Again, we don't need a doctorate or a bunch of scientists to tell us the answer is no.

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Even if you're a bona fide endurance athlete of the three-sport variety—swimming, biking, running—monitoring your HR is going to have severe problems in practical application. A study published by the *Journal of Strength and Conditioning Research* in 2008 showed that although the cycling and running HRs of a triathlete could be similar, additional data showed a 12-point difference in aerobic-threshold values—a huge margin of variability and potential error.

And as far back as 1998, a group of researchers at the University of Tennessee determined MHR intensity actually declined by up to 7 percent during long endurance events. But you already knew that, didn't you? After several hours of running or cycling, you can't reach the same intensity level as before. Yet your age didn't appreciably change during that time, and neither did the 220 formula.

Our personal experiences and those of our clients and friends, along with much of the published scientific data, provide incredibly strong evidence that HR is a poor correlate for intensity or training. This again shows us that not everything is what it seems. Yet, leaders in the medical industry and fitness community are basing training programs and even textbooks on a formula that's both inappropriate and inadequate.

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About the Authors

Brian MacKenzie *is the creator of CrossFit Endurance. He has worked directly with CrossFit for the last five years in developing the CrossFit Endurance Seminars. He has worked with athletes from every facet of athletics. MacKenzie has been involved with the fitness industry for 20 years, from powerlifting to ultra-running and everything in between. He and his programs have been featured in* ***Competitor Magazine****,* ***Triathlete Magazine****,* ***Men's Journal****, Tim Ferriss' New York Times best-seller "****The 4-Hour Body****,"* ***Men's Running U.K.****,* ***L.A. Sport and Fitness*** *and* ***Rivera Magazine****.*

Courtesy of Anthony Roberts

Anthony Roberts *is a CrossFit Level 1 trainer and holds a Crossfit Endurance certificate. He is also a USA Rugby Football Union Level 1 coach.*

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