The Metabolic Profiling – Metabolic Success – Why you need to get your zones checked.

Frustrated with your inability to break through performance plateaus? Perhaps the programming model that you're using for training is the problem. Using percentage of maximal heart rate (MHR), percentage of heart rate reserve (HRR), and heart rate zones based off a mathematical calculations of MHR? Throw them out – therein lies your problem…..

Remember, your metabolism is as unique as your fingerprint and impacted by a myriad of variables. If so, then why use generic mathematical formulas (% MHR, % HRR, zones) to develop training programs?

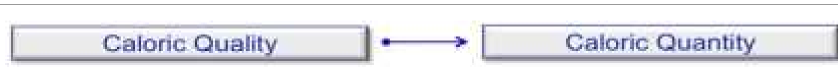
Let us look briefly at two scenarios:

Mary is your overweight client with a primary goal to reduce her body weight and body fat. She is de-conditioned with a low tolerance for exercise and is also hard-pressed to find time to exercise. Based on conventional knowledge for weight management, a standard practice is to attempt to burn a maximal number of calories (kcal) in each session in order to create caloric deficits – Aiming for CALORIC QUANTITY.

Under higher exercise intensities the body favors the use of carbohydrates as a primary fuel due to limitations in oxygen delivery to the muscle (see footnote for further explanation). The practice of continual overload on muscle glycogen stores (depletion and replenishment); coupled with a healthier diet where carbohydrates exceed the average 50 – 55 % of total daily calories drives a physiological adaptation within the muscle. This adaptation is an increase in glycogen storage capacity by 100 – 250 %. Great news if you are building an endurance athlete, but not necessarily the ideal scenario for the overweight client as each gram of additional glycogen pulled into storage pulls approximately 2.5 g of water with it. This may add significant weight, albeit good weight, to the body. More importantly, where is the opportunity to train the body to utilize fats as a primary fuel as opposed to carbohydrates – aiming for CALORIC QUALITY?

In this scenario, the body will favor carbohydrates as a fuel both at rest and during exercise. While your diet and % body fat influence the body's choice of fuel, appropriate metabolic training programs can alter fuel utilization by 15 – 16 % (altering RER scores by 0.05 points).

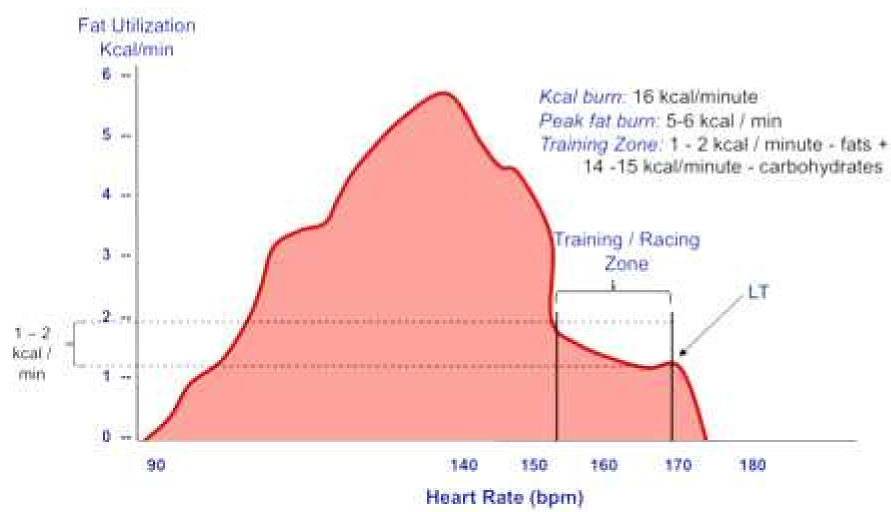
This is the fundamental philosophy behind metabolic training… target caloric quality with lower levels of intensities prior to caloric quantity with higher intensity or interval training bouts with higher post-exercise oxygen consumptions (EPOC).



Kathy is our endurance athlete who is struggling to complete her distance events. When examining her metabolic profile in figure 1, you notice poor fat utilization in her training ranges, leading to rapid glycogen depletion and “bonking” or the inability to finish her event. While she burns an impressive 16 kcal / minute, only 1 - 2 kcal / minute is derived from fats in her training zone, while the balance (14 – 15 kcal / minute) is derived from carbohydrates. This translates to 3.5 g of glycogen per minute or 630 g of glycogen in 3 hours of training which is more than she has combined between her current glycogen storage capacity and her incremental feeding of 60 g of carbohydrates / hour. Kathy’s profile also reveals poor peak fat utilization of only 5-6 kcal / min at a HR of 140 bpm where she was at moderate intensities burning a total of 10 kcal / minute.

Aerobic “fat-burning machines” can fuel 70 – 80 % of their fuel from fats at moderate intensities (where oxygen delivery exceeds energy demand), yet Kathy is only able to contribute 50 – 60 % of her fuel from fat. Kathy is a classic example of an over-trained athlete who is in need of “metabolic rehabilitation” where she will train her body to burn fat more efficiently in moderate intensities and in her training zones.

Figure 1: Metabolic Profile Fat Utilization



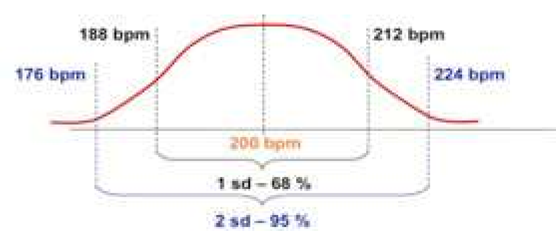
MHR training programs continue to thrive despite demonstrated inaccuracies. MHR varies individually and is:

- Determined by genetics
- Influenced by sports-modality – can vary between different sports and body positions
- Impacted by medications

- Correlates poorly with performance and is not generally influenced by training (may even lower with training)
- Varies significantly amongst people of the same age
- Higher in smaller individuals with smaller hearts (argument for 226 – age for females)
- Altitude-sensitive decreasing by 1 bpm / 1,000' elevation

More importantly, no strong correlation exists between MHR and athletic performance therefore it should not be used as a marker of intensity or performance. Most importantly, MHR formulas derived from mathematical calculations demonstrate large standard deviations. For example the Fox and Haskell Formula of 220 – Age demonstrates a standard deviation of ±12 bpm. This standard deviation implies that for 68 % of a normal population the true MHR will vary by 12 beats on either side of the calculated score. The remaining 32 % will fall even further outside of that margin (i.e.) for 2 standard deviations or 95 %, the true MHR will be 24 beats on either side of the calculated score. Keep in mind that this formula they created was never intended to be used with whole populations, but rather to explain the data in their research, but has been embraced and adopted due to its simplicity of use.

Figure 2: Standard deviation with the Fox and Haskell formula for 20-year olds (220 – 20)



This formula also has a tendency to overestimate MHR in younger adults and underestimate MHR in adults over 40 years of age. For example, a 25-year old may never reach 195 bpm, yet a 60-year old may easily exceed 160 bpm. This introduces the potential to over- and under-train individuals (a philosophy behind zone training is that different adaptations occur at different intensities, thus over- and under-training may not lead to goal attainment).

Finally, using % MHR to develop exercise programs fails to accommodate discrepancies in resting heart rate (RHR) in same-age individuals. For example, taking two 20-year olds to 70 % MHR creates discrepancies in the intensity of exercise when one has a RHR of 60 and the other has a RHR of 80. This would require the individual with the lower RHR to raise his or her heart rate (HR) by 80 bpm versus only 60 bpm for the 2nd individual (70 % of 200 = 140 bpm).

The Heart Rate Reserve (HRR) and Karvonen's formula are certainly improvements in programming as they do accommodate discrepancies in RHR. However, they still have their error in using a calculation of MHR. Regardless, if you are deadest on using MHR, then select a formula with a lower standard deviation.

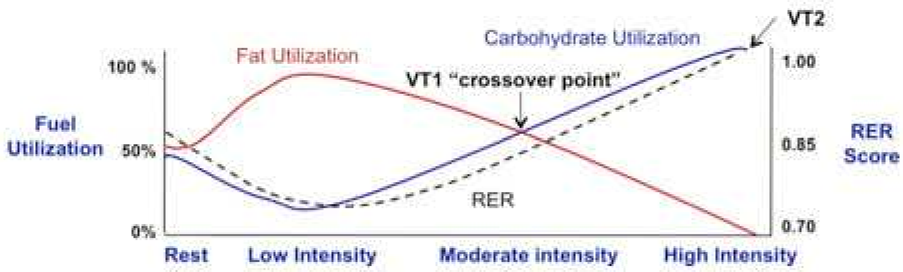
- The Tanaka Formula: MHR = 208 – 0.7(Age) shows a smaller standard deviation of 7.4 bpm and reduces the error of over-estimation in young adults and under-estimation in older adults.
- The Inbar Formula: MHR = 205.8 – 0.685(Age) has the smallest standard deviation of 6.4 bpm, but is difficult to use.
- I do like the MHR formula used by Sally Edwards as it factors in body weight which certainly can impact MHR, but the standard deviation has not been determined through research:
- Males: (210 – ½ age) – 5 % of total body weight (lbs) + 4
- Females: (210 – ½ age) – 5 % of total body weight (lbs)

Zone training has become very popular given the discoveries of different physiological adaptations that take place under different exercise intensities. But, if the zones are derived from a mathematical calculation of MHR, then they are no better than the methodologies presented above (e.g.) generic use of Sally Edward's zones or Zoladz method. However, some newer zone models are actually based off individualized sub-maximal tests that identify a metabolic marker within the body. From this result, the individual's MHR is calculated. While this method does still involve a calculation of MHR, it is based off the individual's own unique sub-maximal test and metabolism, and thus is more accurate and appropriate.

A Foster Threshold Talk test, similar to what Sally Edwards uses with her new Zone Training model is an excellent example of such. However, a key question is whether we even need MHR for exercise programming at all? The answer is no, it is not needed. If we measure one or two key metabolic markers, then nothing more is needed. Programs for weight management and performance can effectively be developed around these markers and follow-up evaluations of these markers serve as the means for progression.

These two metabolic markers where significant physiological changes occur within the body are often referred to as Ventilatory Threshold 1 (VT1) and Ventilatory Threshold 2 (VT2) or Lactate Threshold (LT)

Figure 3: Fuel Utilization with Exercise Intensity



- VT1 represents the point where the body switches over from burning a higher percentage of fats to a higher percentage of carbohydrates (VT1).
- This “crossover point” reflects the intensity where breathing becomes compromised
- From the footnote, it is evident that when fats are utilized, the amount of oxygen needed exceeds the quantities of carbon dioxide produced. Consequently, the cardiorespiratory challenge lies with inspiration and not with expiration. Thus, the ability to talk (pass a talk-test) is not compromised
- At higher intensities where carbohydrates are used primarily, the cardiorespiratory challenge lies with both inspiration and expiration, and the ability to talk (pass a talk-test) becomes compromised
- VT2 represents the point where the body switches to burning carbohydrates exclusively carbohydrates (VT2 or LT)

The goal of “Metabolic Rehabilitation” or metabolic training is to develop training zones around these markers (using the HR they correspond to). The ultimate goal is to lower the RER scores (use more fat as a fuel) during same-intensity exercise or allow higher-intensity of exercise with no increases in RER scores. This represents metabolic efficiency or the ability to utilize greater quantities of fats as a primary fuel. This is relevant for both weight loss clients (promote fat utilization) and athletes (to preserve glycogen reserves).

An effective metabolic training program lasting 8 – 16 weeks that follows appropriate progressions can establish metabolic efficiency and change fuel utilization by 15 – 16 %.

To schedule your zone check go to thirdcoasttraining.com or thrdcoasttraining.mobi. If you have any questions feel free to call me as well, Johnny 713.487.7708.