Mike Nichols MD
Health Management

Nam et ipsa scientia potestas est.
Knowledge is power. - Francis Bacon

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Intensity

If I fail to teach anything else please help me succeed at teaching this: in the health effects of exercise intensity is far more important than quantity.

A recent article in the Journal **Neurology**, the November 24 issue, bears directly on this point. The article looked at the relationship between exercise and incidence of stroke. Exercise amount, as measured by time, frequency or calories burned did not correlate with stroke risk or incidence. Intensity did. The more intense the exercise, the fewer strokes. Period. Were there any nuances or unanswered questions? Of course there were, but the take away was: exercise intensity protected against strokes.

Now here is more of the detail of what I want to succeed at teaching: the mechanism of protection by which exercise intensity works is that it and it alone increases mitochondrial power and health.

Mitochondria are the little power plants in all self-replicating human cells and most of those that do not replicate like spermatozoa. Mitochondria are the very energy of biological life. The more and better your mitochondria the more biological power you have to drive your immune system, to help the heart pump, to store and maintain memories: the more biological power the longer and healthier you will live. This does not mean that the guy with the biggest muscles will live longer because he is 'more powerful.' Biological power is not the shoddy goods of a great physique. It is the precious commodity of the

14583 Big Basin Way, #2B, Saratoga, CA 95070
Main 408.647.2130 | **Fax** 1.888.362.6713
mike.nichols.md@gmail.com

vital energy of each cell in your body and the great news is you can make it better.

To do so you need to understand a little chemistry and physiology so that your understanding can turn into effective exercise rather than 'bigger, faster, stronger' ending in injury, fatigue and exercise avoidance.

OK; what are these little guys, these mitochondria? There is a great back story about evolution, bacteria, parasitism and symbiosis that answers one sense of this question but this is not the answer to my intended question.

Most of us have seen, at one kid's birthday party or another, be ye parent or grandparent, the good old 'jump house.' Shaped like some cartoon character and when pumped up often found full of kids bouncing on the 'balloon' of the floor mat. Well, for purposes of visualization and illustration, mitochondria are like one of those jump houses. Except what keeps it inflated is not an electric air pump but an ion pump, actually several pumps, which create a powerful ion and pH gradient across the wall(s). When the mitochondria has good 'pressure'- ion gradient- from the ion pump it provides the energy to phosphorylate ADP (adenosine diphosphate) and turn it into ATP (adenosine triphosphate) which is the coin of the realm of biology; the energy currency which the cells use to allow us to push/pull/breath/think/laugh/sleep/love and hope.

How big are these little guys? Many cells have hundreds, even thousands of these little balloons or jump houses inside them. Now here is where intensity comes in: what keeps one of those cartoon character jump houses full and yet yielding enough to be bounceable

is the dynamic balance between air pumped in and leaked out; it is an open system requiring continuous energy expenditure for the pumping of air. Now if you cut a hole in the jump house wall and it is small enough that the pump can keep up the house stays up but if too large then the house collapses. Two available solutions, sew the hole closed or get a more powerful pump. Now to the mitochondria: as they produce energy in the form of ATP they deflate, to inflate they need for oxygen and carbon to release bond energy which drives the ion pump to keep the mitochondria inflated, to keep the ion gradient, so that it can drive ADP conversion to ATP. As long as your energy use is low enough and doesn't deplete the ion gradient too much you continue to generate ATP; the hole is not too big and it stays inflated. Any energy use, ATP use, below the capacity of the ion pump to maintain the ion gradient is more or less sustainable for very long periods of time; say to run a Marathon or The Western States 100. Energy in and energy out below deflation levels is handled without positive adaptive demand for the mitochondria to improve; except, and we won't get into this, for the waste products. By the way 'positive adaptive demand and capacity' is an important concept to work with and a wonderful gift of the body; it you ask of it the right question- may I be stronger please?- accompanied by the right behavior- i.e. that which creates biological power- the body will respond by providing that which is asked for. It will adapt in a positive way. Once you realize that the body hates, as wasteful, excess manufacturing capacity, you will understand why exercising in a way below the threshold of posing the question "may I be stronger please" gets you no healthier and no more biologically powerful. Run all day, this necessarily means below deflation rate of energy use and the system will not adapt to a more powerful state. If you demand, this is

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intensity, if you demand by intermittent query, by intermittent, time dependent, excessive energy expectation, that is by powerful behavior, if you do this the body will respond by making both more and more powerful mitochondria. A stronger, more efficient pump, this is actually called the respiratory chain - don't think lungs as this is on the mitochondria- and Krebs cycle is created and thus a mitochondria harder to deflate and thus capable of a higher level of ATP production; a higher throughput.

At a practical level this means your exercise should predominately consist of short burst intense interval work. Sprint intervals, squat sets in rapid succession, power clean cycles; these things need to be done *gracefully* and *precisely* but they must be done in short cycle sets to exhaustion. Not the "I'm beat up and burned 1,000 calories" kind of exhaustion, but 10, 20 and 30 second bouts of brief exhaustion with 10, 20 and 30 second cycles of recovery and totaling 45 minutes or less no more than 4 times a week and more likely 2 to 3 times per week.

Train all day if you want to but do not be misled this is for your head and not your body; in fact it will hold back positive power adaptive change. I bet you have better things than working out to do with your increased biological power.

God Speed,

Dr. Mike

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