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Sleep: An Undervalued Ergogenic Aid

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We all know we need sleep, and most of us would admit that we probably need more. Unfortunately, that knowledge often isn't enough to compel us to take action to improve our sleep habits (or lack thereof). In many Western societies, the hard-charging, go-getting executive takes pride in sleeping less than his or her competitors, purportedly "getting more done" in any given day. (From a raw productivity perspective, that may be true, though research suggests that being chronically sleep deprived significantly impedes psychomotor function, memory retrieval, and... work productivity. So spending more hours getting stuff done - at the expense of sleep - makes you get less done in any given hour. Ah, the irony.) In the realm of athletics, sleep seems to be the red-headed stepchild: clumsily acknowledged, generally overlooked, yet permanently part of the family. To the detriment of our health and performance, we often don't give sleep proper priority. I think it's high time that we help sleep come in from the cold.

Sleep as a priority

In our [Whole9](#) consulting practice, we address multiple facets of a client's life, including nutrition, sleep, and training. In that order. In terms of "bang for your buck," nutrition is the linchpin, and PM is filled with excellent perspectives on Paleo and performance-oriented nutrition recommendations. There are also dozens of solid perspectives on training in PM, and there is no shortage of other resources explaining how to improve your physical fitness. However, I think that sleep has been generally undervalued as a potentially potent ergogenic aid, not to mention that it can seriously improve your quality of life. I'll try not to drift too far away from PM's performance bias, but since my best volleyball years are behind me and I'll never be an elite weightlifter (I'm not bitter at all), I tend to skew my world towards a health bias. That being said, I think there

are very few instances where a health bias will conflict with a performance-driven perspective. A healthy body simply performs well. And adequate quantity and quality of sleep confers not only significant health benefits, but also directly impacts your performance through a few different mechanisms.

With our consulting practice, and in the considerable time I've spent in various gyms over the years, I've noticed that performance-oriented athletes (and even aesthetic-driven gym rats) are very committed to their training. I've known CrossFitters to hit the gym at 5 AM for the first of their two training sessions after only five hours of sleep. ("Committed" and "neurotic" sometimes look a lot the same.) I have not, however, observed the same degree of commitment to sleep. I've long wondered why that is. I suppose sleep can seem like a benign, almost irrelevant nuisance when there's "so much to do." (This is especially true when cortisol levels are abnormally elevated in the evening, skewing one's time perception and increasing anxiety and wakefulness. More on cortisol later.) It's easy to see the direct connection between the snatch balance and getting more weight overhead, but it's a little more subtle with sleep... which is why not enough of us are hitting snooze at 5AM instead of dragging our poor, abused bodies through yet another [sexy metcon](#). However, sleep has a profound effect on athletic performance - and lack of sleep can often undermine the potential benefits of that athletic training to which we are all so devoted. Let's explore how sleep affects not only our health, but also our physical fitness.

Sleep, Defined

Sleep is divided into two broad groups, REM and non-REM (or NREM). NREM sleep has 4 phases. Phase 1 is light sleep, where you're easily awakened and your musculature relaxes. "Sleep twitches" (myoclonic

jerks) are a result of the spontaneous stimulation of motor areas of the brain. You spend about half your sleep time in phase 2, with somewhat slower brain waves. Phase 3 is the first phase of deep sleep, characterized by periods of slow (delta) waves and faster waves. In phase 4, the deepest level of sleep, the brain waves are almost exclusively delta waves. Phase 4 is also known as delta or slow wave sleep (SWS). The absence or shortening of SWS impairs how “refreshed” you feel in the morning. Folks generally are difficult to rouse from phase 3 and 4, and can feel groggy and disoriented if woken. Finally, there is REM sleep. Most adults spend about 20% of their total sleep time in this cycle – it’s the period where most dreaming occurs, and achieving several REM cycles per night is critical for the development of long-term memories.

There is, of course, significant variability in this pattern. For those of us who are under-slept (usually of our own doing), our bodies attempt to compensate by putting us into REM sleep earlier, primarily by shortening our phase 2 (slow wave) sleep. This is perhaps the body’s way of implementing some damage control for the lack of total sleep time. The problem is, this shortened cycle still translates to “sleep debt” – the cumulative effect of not getting enough total sleep. Comparing sleep loss to “debt” implies that one can catch up on lost sleep by “paying it off” – by sleeping in on weekends, for example. However, newer research suggests that the loss of cognitive performance seen in working folks getting an average of 6 hours of sleep per night is still not fully restored even after two consecutive nights of 10 hours of sleep. (Thus, catching up on the weekend is not a viable plan for optimal psychomotor performance.) So, in general, you’re under-slept, and probably spending at least part of your day feeling tired, cranky, distracted, and un-smart. Not fun, sure... but trust me, people, that’s the least of your concerns.

Sleep, metabolism and the immune system

Enter systemic inflammation. After just one week of that same “modest” sleep restriction, your body experiences a significant increase in systemic levels of the immune mediator interleukin-6 (IL-6) and inflammatory cytokine tumor necrosis factor-alpha (TNF), which cause the release of the acute phase inflammatory marker, C-reactive protein (CRP), and the inflammatory eicosanoid, prostaglandin-E2 (PGE2), respectively. What does that mean, in terms of your health? TNF induces insulin resistance and the secretion of stress hormones from the adrenal glands. PGE2 is part of the “inflammatory cascade” and is one of the clinical manifestations of systemic inflammation. Elevated levels of IL-6 are associated with systemic inflammation, autoimmune disease, impaired glucose

metabolism and diabetes, and some types of cancer. Elevated CRP is widely recognized as a risk factor for cardiovascular disease, stroke, and diabetes. There’s more, but you get the point. And an interesting aside: chronic exposure to elevated levels of TNF can contribute to difficulty in gaining or maintaining muscle mass. Obviously, one rough week doesn’t kill you outright, but chronically having your system awash in these inflammatory chemicals is not awesome (that’s an understatement, there).

Reduction of systemic inflammation is known to be a major step in managing risk of many lifestyle diseases and conditions, and plays a significant role in recovering effectively from injury or hard training. (After all, some of the adaptive processes that occur after training are in response to microscopic structural injury.) We work so hard to remove inflammatory factors from our diet (the standard “grains, legumes, dairy, and sometimes nightshades” shtick), we judiciously take our fish oil, minimize our nut and seed intake, and eat wild-caught and pasture-raised meats, all so we can better manage systemic inflammation. But despite stringent adherence to a healthy, anti-inflammatory diet, we fail to reap the full benefits... simply because we aren’t sleeping enough.

There is a complex interaction between sleep and the immune system. Immune status can directly impact “sleep drive,” which makes good sense. In states of elevated immune activation (illness or injury), the body recovers more effectively with additional rest. Yet excessive sleep is associated with obesity and metabolic derangement. Though the intricacies of sleep-related immune function are still being uncovered, I believe a chronic sleep deficit is primarily a cause of negative physiological consequences, whereas the excessive somnolence that is associated with disease processes is primarily a symptom of that immune-sleep interaction. Let’s focus on the cause.

Sleep and Hormones

Inflammation is only one mechanism that plays into recovery from training (and life). Both are driven by complex hormonal systems, including testosterone, growth hormone (GH), insulin and stress hormones such as cortisol. An in-depth discussion of sleep’s influence on specific hormonal processes is beyond the scope of this article, though there are a few key points worth making. Testosterone is of obvious value to athletes (both male and female) for its anabolic effects. Testosterone secretion occurs primarily while sleeping, and coincides with REM sleep cycles. Most testosterone is released into the bloodstream at night, with levels gradually dropping as the day goes on. Similarly, the largest pulsatile secretions of GH – most

of your total day's worth – occurs primarily the first hour or two of sleep (this is more true for men than women). Later in the night, GH secretion tends to be correlated with REM sleep cycles. (The common suggestion to nap after training isn't because your body is tired – it's designed to boost growth hormone secretion.) Both testosterone and growth hormone are potent promoters of protein synthesis, critical for recovery from training. (Translation: disrupt these recovery processes at your own peril.)

So improving the duration and quality of sleep will help you take advantage of your nocturnal hormonal response, which means you'll better recover from exercise. However, the solution might not prove as easy as "just sleep more." If, due to dietary and lifestyle factors, you have some elements of cortisol dysfunction or overt adrenal fatigue, you might have a hell of a time actually going to sleep. The daily ebb and flow of cortisol should peak in the early morning, and generally decline as the day progresses. Cortisol prevents serotonin from converting into melatonin, a hormone that facilitates restful sleep. If cortisol is abnormally elevated in the evening, it will disrupt normal sleep patterns and delay slow wave sleep. Elevated cortisol is a good thing in the morning, but not so good when you should be winding down. If you've got some of this stuff going on, you might need to re-examine your lifestyle. Overtraining (or under-recovery, if you prefer that concept), poor nutrition, chronic stress, and excessive caffeine intake can all contribute to elevated levels of cortisol. The irony is that although you're desperate to restorative sleep more now, getting adequate sleep on a regular basis could have helped to prevent such a scenario from occurring in the first place.

From a hunger regulation and weight management perspective, reductions in slow wave sleep (common with chronic sleep loss) cause significant decreases in insulin sensitivity, and tend to increase cortisol levels. In addition, sleep loss causes decreased levels of leptin (a hormone that tells your brain that you're not hungry) and increased levels of ghrelin (a hormone which stimulates hunger and appetite), and as such, is associated with obesity. Depressed leptin and increased ghrelin contribute to an uptick in appetite, particularly cravings for carbohydrates. Being sleep deprived means that you're more likely to make poor choices about which foods you eat and how much of them you consume, especially in the hours after dinner when elevated cortisol has you "fired but wired". Combined with the direct effects of sleep loss on insulin sensitivity, this can be a destructive situation for one's metabolic state.

Sleep and Performance

As if inflammation, hormonal imbalances and metabolic dysfunction weren't bad enough, lack of sleep affects your performance in another more subtle way. It's been found that, with acute sleep deprivation for only 1-2 nights, the deterioration in quantifiable psychomotor performance correlates highly with self-rated perceptions of fatigue and daytime sleepiness. (Meaning, after a night or two of virtually no sleep, you're well aware that you're not performing at your best.) However, when compared to a milder, chronic sleep deficit (defined by researchers as 6 hours per night), the psychomotor performance deterioration is similar, but the perception of those deficits is significantly reduced. So while you think you're doing just fine on 6 hours of sleep a night, you definitively are not. And I know plenty of people who survive on less sleep than that - survive, but not thrive. Think this doesn't correlate with your performance in the gym? You may think you're on point with your workouts, your technique and your intensity, but how can you be if you're chronically sleep deprived?

All that being said, the negative effects of running a chronic sleep deficit does not inherently prove the opposite - that getting more sleep has an ergogenic effect. So how about this, then? There have been a series of studies demonstrating that elite collegiate-level athletes that get "extra" sleep perform better on a battery of sport-specific performance measures, with results ranging from faster sprint times and better scores on agility tests to higher serving accuracy to increased free throw percentages. What do these measures have in common? Among other things, a huge neurological component. We're not talking about mindless chest-and-bis here (and even a pithed frog could do wall-ball). Weightlifting and functional, high-intensity conditioning both have huge neurological components. Like a football player's agility drills, performing the snatch or C&J requires tremendous CNS activation, and improvements in the brain's ability to coordinate sport-specific demands with muscular activation leads to improved performance. In summary, weightlifters, generalists and competitive athletes would all perform better if they slept more.

Recommendations:

Sold yet? If you're ready to start taking sleep seriously, here are Whole9's guidelines to help you fall asleep faster, stay asleep longer and stop shooting yourself in the foot by pushing sleep to the bottom of your priority list.

Sleep in a cool, dark, quiet room. Cover all your windows and block out as much light as possible from other sources. Turn down the thermostat, too.

Unplug everything electrical in your bedroom, and put your mobile in a non-transmitting ("airplane") mode. Electromagnetic fields (EMF) disturb melatonin production from serotonin, which is critical for restful sleep.

Get more sleep in the winter, and worry less about it in the long summer days. This is straight out of the Lights Out playbook, and I like it.

No TV, computer or video games within an hour (minimum) of bedtime. Even better, avoid exposure to electronic screens and blue light after dark – the intensity of light and duration matter, too. Dim your lights after dark.

Try to make your sleep/wake times regular. Your body likes rhythm.

Take naps. The studies that demonstrate increased athletic performance prescribed additional sleep. If you're peaking for a competition, take the two weeks prior to your event to sleep a LOT.

Avoid sugar and starchy veggies within a 1-2 hours of bedtime, as elevated blood glucose dramatically impairs the secretion of growth hormone in early sleep. Free fatty acids (FFAs) in the bloodstream have a similar effect. If you're on a mass gain program and are eating at every opportunity, choose a chunk of protein as your pre-bed snack. Even if you're desperate to ingest more total calories, the additional intake of significant quantities of carbs and fat shortly before sleep might not confer the big picture benefit desired.

Alcohol, although it expedites most peoples' initial trip to Dreamland, causes fragmentation of late sleep, decreasing SWS (the really good stuff). It also suppresses GH secretion at a "dose-dependent rate" (i.e. drinking less is better). I'm not suggesting you drink in the morning, but before bed is especially detrimental to your sleep.

No [caffeine](#) after noon. Play with caffeine timing if you want, but don't trust your defensive "I can slam an espresso right before bed and be totally fine" justification. Caffeine can have subtle influences on the quality of your sleep. Sleep disturbances, like poor

nutrition, can have insidious and creeping effects on your well-being, often undetectable on a day-in, day-out basis. If you use caffeine as an ergogenic aid when you train in the afternoon or evening, do so with caution. Potentially higher performance in training that compromises your recovery (due to reduction in sleep quality/quantity) is a net loss. If you have an afternoon/evening competition, however, the case could probably be made that increased performance in (infrequent) competition outweighs the sleep disruption of occasional late-day caffeine intake. (P.S. Your regular training is not "competition". It's training.)

If you do shift work, you're already a little bit screwed. Remember that total sleep cycles count, so even if you're napping in church, get those hours in any way you can. Your tolerance of sleep cycle disruption is that much smaller, so you might consider avoiding caffeine altogether, since it worsens aspects of adrenal fatigue that may already be present due to your daily schedule.

If you don't get 6 hours of sleep, you don't get to train (and I know you want to train). Turn off the TV, stop browsing the web (even if you're learning good stuff about healthy living - there's that irony again) and get to bed. Optionally, spend a few minutes winding down, reading an actual book or published article about nutrition or training or whatever won't stress you out or wind you up. (No work.)

Training in the late afternoon or evening can be a problem for some people, since high-intensity exercise releases neurotransmitters that are stimulatory, and make it harder for some people to fall asleep. Assuming adequate sleep the night before, we generally like training in the morning. The natural "ramping up" for the day corresponds with (healthy) morning elevations in cortisol, and training in the morning seems to make good sense to us.

If you're having trouble sleeping, make sure you're doing at least some activity during the day, albeit at a much lower intensity. Even walking or easy swimming can help with sleep quality that night.

If you're generally unexcited about training on any given day, take that day off, and use that time to sleep in or prepare some delicious food for the next couple days. In our experience, general apathy and/or disinterest in training

are common symptoms of chronic sleep loss. You'd be better served by reversing that trend than exercising your personal discipline and training even if you don't feel like it. If you're generally under-slept, it'll eventually catch up to you, and will either undermine training progress or create an adrenal fatigue scenario... or both.

If you're perpetually holding a gun to your own head to get to the gym, you ought to take a good, hard look at your lifestyle over the past few months, and consider taking a few (sleep-rich) weeks completely off to allow your neurological, immune, and endocrine systems

to recover.

Bottom line: depriving yourself of adequate sleep on a regular basis has insidious consequences to your health and your performance. Both chronic and acute sleep reductions lead to measurable decreases in psychomotor function, though your own perception of those deficits is likely inaccurate. Getting adequate sleep improves health via a number of direct and indirect mechanisms, and has been shown to directly improve athletic performance.

Tonight, I hope you dream of PRs. If you sleep long enough, your dream might become a reality.

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