

Life Extension Magazine March 2010

## REPORT

### Don't Fall Victim to Frailty

Evidenced-based strategies for lifelong power in aging individuals

By William Davis, MD

Frailty is an age-related deterioration in physical strength and overall performance. We see it in the hunched-over elderly man or woman weakened by fatigue, brittle bones, muscle wasting, and limited mobility.

Frailty is a preeminently preventable condition.

In recent years, the pace of clinical research on how to enhance physical strength and performance in the face of aging has accelerated.

We now have at our disposal a specific set of evidence-based strategies aimed at the *underlying biological mechanisms* by which we grow weaker over time.

Armed with these techniques, you can regain waning vitality, command better memory, and tightly focus your mental power.

In this examination, we explore a multi-targeted approach to enhance physical stamina, energy, endurance, and overall performance.

Avoiding and even *reversing* the onset of age-related declines in strength and performance may be achieved simply, effectively, and naturally. The key lies in five core strategies:

- Replacement of *basic nutrients* important for performance
- Restoration of *hormones* that underlie performance
- Enhancing *physical capacity*
- *Boosting energy* through non-hormonal means
- *Enhancing sleep* to boost daytime physical effectiveness.

One of your primary goals is to have high energy from the moment you wake up and to sustain it throughout the day, followed by a healthy transition to sleep. Although there is more to supercharged physical performance than high energy, having plenty of physical and emotional stamina is a basic requirement.

Here, we will focus on the key nutritional interventions that may help boost your physical strength and performance.

### BASIC NUTRIENTS

You wouldn't drive a car without changing the oil every few thousand miles. For the same reason, two essential nutrients should be incorporated into your daily dietary regimen *before* you take any other steps.

#### **Vitamin D**

If there is any single nutrient that holds the potential for enormous health and performance gains, it's vitamin D.

Virtually ignored for decades, vitamin D supplementation may help reduce cancer risk, lessen diabetes risk, and enhance bone health, among other remarkable effects.<sup>1,2</sup> Vitamin D also enhances physical strength.



1-3A clinical study examining the effect of a miniscule dose of vitamin D (400 IU) along with **800 mg** calcium showed improved walking speed and balance by **10-20%** in elderly adults.<sup>4</sup>

As the founder of the Vitamin D Council ([www.vitaminDcouncil.org](http://www.vitaminDcouncil.org)), Dr. John Cannell has been among the most vocal advocates of higher intake of vitamin D.

Dr. Cannell reviewed scientific literature concealed for years behind the Iron Curtain during the Cold War years of the former Soviet Union and East Germany. The Russians and Germans had observed marked seasonal variation in athletic performance among athletes: running was faster, jumping higher, weights lifted greater during the summer, and reduced during the winter. Further study led to the practice of vitamin D supplementation among East German and Soviet athletes, sufficient to restore blood levels to that of summer sun exposure with resultant year-round consistent physical performance.<sup>5</sup>

I have confirmed these published findings in over 1,000 patients with *greater* effects using higher dose vitamin D supplements. In our clinic, achieving target 25-hydroxyvitamin D blood levels of **60-70 ng/mL** has yielded greatly augmented benefits, compared to those obtained at lower levels. In our experience, most men and women require average doses of **5,000-6,000 IUs per day** to achieve this blood level of vitamin D. Individual needs can vary, being substantially higher or lower. Testing blood levels is therefore an absolute necessity if precise dosing is desired.

## ***Iodine***

Iodine deficiency sets a cascade of energy-depleting effects in motion.

When iodine is deficient, thyroid function diminishes, and thyroid hormone levels drop, which may lead to a hypothyroid state.<sup>6</sup> Standard blood thyroid testing can suggest hypothyroidism if there is an increase in Thyroid Stimulating Hormone (TSH) and low free Thyroxine (T4).<sup>6</sup> Symptoms of hypothyroidism include decreased energy, sleepiness, low moods, and poor capacity for exercise.<sup>7</sup> One of the earliest and most visible signs of iodine deficiency is thyroid gland enlargement (goiter). Iodine deficiency limits physical performance from mild to profound degrees, depending on severity.

While iodine deficiency *had* been a thing of the past since the introduction of iodized salt in the early 20th century, it has returned. Iodine intake has been steadily decreasing in the US.<sup>8</sup> Ironically, insufficient iodine intake primarily affects the most health-conscious: people who avoid iodized salt, processed foods, and meat. People who exercise vigorously can be among the most iodine-deficient, since substantial quantities of iodine are lost in sweat.<sup>9</sup>

Iodine replacement is easy. There are a number of iodine supplements that provide various forms of iodine. Choices include molecular iodine (often as drops) and kelp tablets (dried seaweed). While the Recommended Daily Allowance (RDA) for iodine is 150 mcg for non-pregnant adults, some data suggest that human need for ideal health may be greater, perhaps even approaching the experience of the Japanese, who ingest milligram doses (more than 1,000 micrograms).<sup>10</sup> In my clinic, we prescribe **500-1000 mcg** (0.5-1.0 mg) of iodine per day from kelp tablets with success.

For those desiring higher levels of iodine to restore *depleted* iodine levels, a specialized form of iodine may be helpful, providing **12.5 mg** iodine (12,500 micrograms as molecular iodine and potassium iodide) per tablet. Anyone with suspected thyroid disease should consult their health provider before initiating iodine supplementation.



## **WHAT YOU NEED TO KNOW: AVOIDING FRAILITY**

- Frailty is a major concern for aging individuals.
- New strategies can be applied towards supercharging human physical performance, increasing energy, focus, well-being, and exercise performance.
- Vitamin D and iodine are two necessary nutrients that are commonly deficient, potentially limiting health and performance. Replacement to healthy levels is crucial before embarking on a performance-improving regimen.
- DHEA and pregnenolone are two “bioidentical” hormones that underlie physical performance. When supplemented to restore the levels of a 30- or 40-year old, energy, well-being, and physical performance improve.
- Muscle loss with aging is followed by reduction in metabolic rate, deterioration in insulin responses, decreased bone density, and other correlates of low performance. Improved muscle mass and strength can be achieved by combining resistance training with creatine, branched-chain amino acids, and hydroxymethylbutyrate.
- Energy-boosting supplements can help restore stamina and vigorous physical performance. These include rhodiola, taurine, tyrosine, and phenylalanine.

- Ensuring adequate duration and quality of sleep is crucial for optimum performance. Sleep quality can also be enhanced, principally by achieving deeper sleep with increased REM phase sleep using sleep-enhancing supplements, such as melatonin, tryptophan, and valerian.

## DHEA AND PREGNENOLONE: THE ULTIMATE “BIOIDENTICAL” HORMONES

Restoring hormones to more youthful levels is a key strategy for maintaining strength as you age. With the passage of time there is an inevitable decline in hormones that sustain energy and performance.<sup>11,12</sup> As these hormones recede, energy and performance diminish along with them.

There has been a lot of fuss over whether or not “bioidentical” hormones—estrogens, progesterone, and testosterone that are identical to those naturally found in the human body—are superior to *non*-bioidentical forms dispensed by the drug industry. The FDA is currently considering clamping down on the availability of bioidentical hormones and the claims that they are safer and superior to non-bioidentical hormones, despite a groundswell of grassroots support for them. The argument has pitted anti-aging practitioners and the public, as well as the likes of Oprah and Suzanne Somers, against Big Pharma and the FDA—the two forces trying to squash the bioidentical hormone movement.

Regardless of heavy-handed FDA policies, we already have access to hormones identical to the original human form that require no prescription and yield hormones the human body recognizes as bioidentical: **DHEA** and **pregnenolone**. These two hormones are precursors to the other hormones at the center of the bioidentical hormone controversy, such as estrogen and testosterone. We therefore already have, in effect, two very effective over-the-counter, non-prescription forms of bioidentical hormones.

### DHEA

Dehydroepiandrosterone (DHEA) is a hormone secreted by the adrenal glands in large quantities during our 20s and 30s. DHEA levels begin a sharp decline at age 30 in men and age 40 in women, along with declining muscle mass, bone density, sex hormones, growth hormone, and increasing body fat. The decline accelerates after age 50. By age 70, DHEA blood levels are usually **20-30%** or less of youthful levels.<sup>11</sup>

<sup>13</sup>In women with androgen deficiency, DHEA supplementation has been reported to increase alertness, stamina, and sexual interest.<sup>14</sup> DHEA supplementation increases testosterone modestly in women and slightly increases androstenedione levels in men, while increasing physical and psychological well-being in both genders.<sup>15</sup> Most studies documenting the physical and emotional benefits of DHEA have examined doses between 10 and 100 mg per day, the quantity required in most people to restore blood levels to match that of the third decade of life.<sup>11</sup> Physical performance enhancement is best obtained with doses of no more than 100 mg per day, usually **10-25 mg per day in women and 25-50 mg per day in men**. Anecdotally, benefits are amplified if DHEA is used in combination with testosterone in men, and combined with progesterone in women.

Though difficult to quantify, DHEA replacement helps many people feel better: more physical stamina, a brighter outlook, and more “get up and go.” Problems seem less overwhelming and “lows” tend not to be quite as low.<sup>11,15</sup> Though there are clinical data to support these “soft” effects, they are inconsistent.

In the author’s experience, people who start out with sluggishness, low energy, and a negative outlook, accompanied by a low DHEA level (measured as a DHEA-S level of **<250 µg/dL**), are the most likely to experience positive results with DHEA replacement.

Side effects at high doses (50-200 mg per day) may include acne, increased facial hair, and increased perspiration. Individuals with hypertension or who are taking the drug **diltiazem** should not supplement with DHEA except under the close supervision of a doctor. Those with breast or prostate cancer or a family history of these conditions should not take DHEA supplements unless specifically directed to do so by their doctor.



### PREGNENOLONE

Pregnenolone is an adrenal gland hormone, the first hormonal product synthesized from cholesterol, and the basic precursor from which all sex hormones (testosterone, progesterone, and estrogens) and adrenal hormones (DHEA, cortisol, and aldosterone) are made.<sup>16</sup> Like DHEA, pregnenolone levels peak during our 20s and 30s, followed by a decline with aging and the passing of the years, particularly in women.<sup>17</sup>

Pregnenolone and DHEA may have special relevance in the 21st century. The low-fat dietary mistake of the last 30 years has led to excessive carbo-hydrate intake. Pregnenolone and DHEA levels may drop dramatically in those with high carbohydrate intakes or higher levels of fasting blood sugar. In clinical studies, infusions of glucose (blood sugar) in healthy adults reduced pregnenolone levels by **51%** and DHEA levels by 57% within 80 minutes.<sup>18</sup>

Pregnenolone exerts complex effects in the human brain, and is thought to modulate stress and mood. However, among pregnenolone's effects is enhanced **acetylcholine** activity, a process that underlies memory and thinking.<sup>19</sup> Multiple experimental models suggest that pregnenolone acts as a "neurosteroid" in the brain, a potent modulator of brain excitability.<sup>19</sup>

Pregnenolone may be especially helpful for females who require increased levels of progesterone and testosterone, since this single agent can increase both. One potential uncommon downside: increased blood pressure. Pregnenolone is the source of multiple hormones, including a class of hormones called mineralocorticoids.<sup>20</sup> In susceptible people, this could potentially cause water retention and increased blood pressure.

Supplementation of both DHEA and pregnenolone is generally not advised under the age of 40, unless a health provider has documented low levels. Pregnenolone has antagonistic effects on gamma-amino butyric acid (GABA) receptors in the central nervous system; therefore supplementation with pregnenolone is not recommended for people with a history of seizures.<sup>21</sup>

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### ENHANCED PHYSICAL CAPACITY

Loss of muscle mass with aging is a common process that begins in our 40s and accelerates as the years pass. Decreased muscle mass with aging can lead to “sarcopenia,” a state of decreased muscle mass and strength that reduces metabolic rate, contributes to insulin resistance and increased risk of type 2 diabetes, promotes unhealthy blood lipid profiles, and promotes hypertension.<sup>22</sup>

However, age-related loss of muscle mass need not be the dramatic, inevitable decline expected by most people. Targeted interventions can reverse this muscle loss and improve performance as a result. Strength training by itself can help restore muscle mass and reverse the unhealthy consequences of sarcopenia.<sup>23</sup> However, results could potentially be enhanced by combining strength training with the supplements creatine and branched-chain amino acids.<sup>24,25</sup>



### CREATINE

Since its introduction in the early 1990s, creatine use has exploded among bodybuilders and athletes interested in gaining muscle mass and strength.

Even if you're not interested in building big muscles like a bodybuilder, there are health benefits to increasing muscle mass. By increasing muscle mass, you can support bone density, improve balance, and reduce injuries, along with preventing debilitating muscle wasting.<sup>26,27</sup>

Creatine is not just for weight lifters. A study of creatine supplementation in men (average age 70 years) demonstrated that strength training plus creatine increased muscle mass by 7.26 lbs. In contrast, men who performed the same strength training program and consumed placebo gained only 2.86 lbs of muscle mass. Creatine and strength training also improved leg strength and endurance.<sup>28</sup> Strength, endurance, and lean tissue are maintained 12 weeks after stopping creatine supplementation and engaging in a reduced-intensity training program.<sup>29</sup>

Similar results were observed in another study that included women (age 65 and older), with outcomes in females comparable to males.<sup>30</sup> Increased strength and muscle mass led to 3.2% increase in bone mineral content over 12 weeks of strength training supplemented with creatine, compared to 1% decrease without training or creatine.<sup>31</sup>

The most popular form of creatine is creatine monohydrate, generally taken as a “loading” phase of **15-20 grams per day** (generally split into 3-4 doses of 5 grams) for 5-7 days, followed by weeks to months of **2-5 grams per day**.<sup>32</sup> An alternative form, poly-ethylene glycosylated (PEG) creatine, provides similar effects at one-fourth to one-half the dose of creatine, i.e., **1.25-2.5 grams per day**.<sup>33</sup> Athletes taking creatine for up to 21 months have shown no adverse effects on kidney function, lipid values, or other basic health measures.<sup>34</sup> People with kidney diseases (such as glomerulonephritis, glomerulosclerosis, or interstitial nephritis) should not take creatine supplements unless so directed by their physician.

### BRANCHED-CHAIN AMINO ACIDS (BCAA) AND HYDROXYMETHYLBUTYRATE (HMB)

The so-called branched-chain amino acids (valine, isoleucine, and leucine) are amino acids that are essential to muscle maintenance and growth. BCAA are widely used by athletes and weight lifters to accelerate recovery after exercise.<sup>35</sup>

When combined with strength training, BCAA protein powder supplements reduce muscle soreness and accelerate recovery. Doses of BCAA used successfully have varied widely in studies, generally from **5 g up to 20 g per day**.<sup>36</sup>

Leucine has been shown to increase muscle protein synthesis.<sup>36</sup> A metabolite of leucine called hydroxy-methylbutyrate (HMB) is

useful to help non-athletes gain muscle mass and increase physical performance. A study of 31 men and women, average age 70 years, showed enhanced muscle growth and fat loss with supplementation of HMB, **3 g** per day, combined with strength exercises performed 5 times per week.<sup>37</sup>

While HMB and creatine each possess unique muscle mass-increasing effects, additive benefits develop when the two are combined with resistance exercise. In one study, over a 3-week training period, those who supplemented with both creatine and hydroxymethylbutyrate (HMB) gained more lean mass than those who only utilized one of the supplements.<sup>38</sup> By increasing strength and muscle mass, we can expect bone density to increase, balance to improve, metabolic rate to accelerate, and insulin responses to normalize.

## ENERGY BOOSTERS

Energy boosters are supplements that increase energy, but not through replacement of low hormone levels or correcting nutrient deficiency. These agents boost energy and performance through a variety of unique mechanisms.

### RHODIOLA

The **adaptogen** rhodiola (*Rhodiola rosea*) is a relatively recent discovery to the US, but has been used for centuries to enhance strength and resilience by people in the mountainous regions of northern Europe and central Asia.

... Valine, isoleucine, and leucine are essential to muscle maintenance and growth... and are used by weight lifters to accelerate recovery after exercise.

Recent randomized, double-blind research confirms the observations made in real-world experiences. Individuals with stress-related fatigue experienced increased stamina and mental focus upon supplementing with **576 mg** of rhodiola extract per day.<sup>39</sup> In this study, a reduction in cortisol response to awakening stress appeared to be part of the explanation behind the observed effects. No side effects were observed in the treatment group.

In another study, increased exercise endurance was observed in young healthy volunteers who supplemented with rhodiola, **200 mg per day**.<sup>40</sup>

Interestingly, a double-blind study involving a competitive rowing team showed that rhodiola supplementation increased total antioxidant levels in the plasma of those taking the supplement vs. those taking placebo.<sup>41</sup>

### TYROSINE

L-Tyrosine (tyrosine) is the amino acid source that provides the starting material for the synthesis of several neurotransmitters, including dopamine, epinephrine (adrenaline), and norepinephrine, and is also involved in the function of organs responsible for making hormones, including the thyroid gland.

Tyrosine supplementation has been studied and applied successfully by the US military as a means of maintaining performance and mood in the face of prolonged, stressful situations such as battle or sleep deprivation.<sup>42,43</sup> Tyrosine appears to reduce the perceived effects of stress, though relatively high doses may be required for these effects (up to 100 mg/kg, or **7,000 mg** for an averaged-sized adult).<sup>44</sup>

Tyrosine supplementation has been observed to decrease rather than increase blood pressure.<sup>45</sup>

Theoretically, the combination of tyrosine with tryptophan (a precursor of serotonin) could have potential for even more marked energy and mood-elevating effects.<sup>46</sup> The long-term safety of L-tyrosine in excess of 1,000 mg per day, however, is not known.

## SUGGESTED SUPPLEMENT DOSES

SUPPLEMENT	DOSAGE
Vitamin D	5,000-6,000 IU per day
Iodine	500-1,000 mcg per day
DHEA	10-25 mg per day (women) / 25-50 mg per day (men)
Pregnenolone	100-300 mg per day
BCAA	5-20 grams per day

<b>HMB</b>	3 grams per day
<b>Creatine</b>	15-20 grams per day (loading phase) / 2-5 grams per day
<b>Rhodiola</b>	200 mg per day
<b>Tyrosine</b>	1,500-7,000 mg per da
<b>Phenylalanine</b>	50-100 mg per day
<b>Taurine</b>	1,500 mg-6,000 mg per day
<b>Melatonin</b>	1-3 mg per night, 1-2 hours before sleep
<b>L-Tryptophan</b>	250-2,500 mg at bedtime
<b>Valerian</b>	300-600 mg, one hour before bedtime

## PHENYLALANINE

**phenylalanine**, provides the backbone for the body to synthesize the hormones that modulate the stress response, epinephrine and norepinephrine. Low phenylalanine means low adrenaline and low energy. Adequate availability of phenylalanine means access to epinephrine and norepinephrine when you need it. Because depression may, at least in part, be related to lower levels of these hormones, phenylalanine in the amount of **150-200 mg per day** has been used successfully for treatment of depression, with effects similar to prescription drug **imipramine**.<sup>47</sup>

Please use judgment in your use of phenylalanine. If used properly, it can suit your needs: boost energy, and smooth the inevitable fluctuations in mood and stamina. If used unwisely, trouble can result, including high blood pressure and anxiety.<sup>48</sup>

Low doses and *occasional* use are the keys with phenylalanine, e.g., **25-50 mg**, 2 times per day. Evening doses should be avoided, since insomnia can result.

People with the genetic disorder called **phenyl-ketonia** (PKU) need to avoid phenylalanine-containing foods and supplements and therefore should not take phenylalanine. Also, anyone with hypertension should use phenylalanine carefully under the supervision of a health provider.<sup>48</sup> People with tardive dyskinesia may not be able to correctly process phenylalanine, and should therefore avoid phenylalanine supplementation. L-phenylalanine competes with several other amino acids for uptake into the body and the brain. For best results, phenylalanine should therefore be taken between meals, or away from protein-containing foods.

## TAURINE

Taurine is an amino acid found particularly in protein-rich foods like eggs, meat, and fish. Among its many effects in the human body, taurine is an important constituent of bile and participates in the absorption of fats and fat-soluble vitamins.<sup>49</sup> Some studies have suggested that, along with omega-3 fatty acids, taurine is the component of fish that confers its substantial cardiovascular benefits.<sup>50</sup>

Several studies have suggested that taurine supplementation at a dose of **2,000 mg** enhances endurance exercise performance (cycling, running, rowing), possibly by reducing lactate production; its effects may be enhanced when taken in combination with caffeine.<sup>51,52</sup> Studies of mental performance and information processing have also suggested positive effects of taurine, also in combination with caffeine and glucuronolactone.<sup>53,54</sup> Taurine supplementation is safe in adults at doses of **1,500-6,000 mg daily**.<sup>49</sup>

## SLEEP ENHANCEMENT

In the modern world, people are forever searching for ways to abbreviate the need for sleep. Sleep is commonly sacrificed for the sake of enjoying more waking hours. The National Sleep Foundation recommends that adults sleep at least 7 hours nightly, but **29%** of US adults fail to get even this much sleep.<sup>55</sup> Chronic sleep deprivation can lead to overreliance on stimulants to boost energy and to compensate for the performance-reducing effects of sleep deprivation.

In truth, there is simply no healthy means to reduce your need for sleep. The fact is, we need our sleep. Any effort to reduce our need for sleep forces us to pay the price with reduced physical, mental, and emotional performance—even increased mortality.<sup>56</sup> If we accept this fact, then let's ask the question: can we enhance *sleep quality* to derive greater daytime physical performance?

First, a brief sleep primer. Sleep is a mind-active, body-inactive state. Like the seasons of the year, the brain proceeds through a predictable series of phases distinguishable by intensity, frequency, depth, duration, and content. The effects of disrupting sleep phases, even with a full night of sleep, are serious, as evidenced by sleep disorders like sleep apnea, a condition involving pauses in breathing that occurs during sleep. They include snoring, disturbed sleep, reduced concentration and memory, mood disorders, excessive sleepiness and, if left untreated, cardiovascular disease, decreased health-related quality of life, and

increased incidence of motor vehicle accidents.<sup>57</sup>

In general, non-restorative sleep has been associated with excessive daytime sleepiness, high blood pressure, higher levels of inflammation.<sup>58-60</sup>

One useful strategy to derive maximum benefit from sleep is to ensure, even enhance, the duration and quality of deepest phases of sleep.<sup>59</sup> Unfortunately, some prescription sleep agents, especially the benzodiazepine class, introduce some undesirable effects on sleep, including abbreviated rapid-eye movement (REM) sleep and next-day sleepiness.<sup>60</sup>

Diminished pineal gland secretion of the natural human sleep hormone, **melatonin**,<sup>61</sup> accounts for a gradual decline in sleep duration and quality as we age.<sup>62</sup>

Melatonin is available as a dietary supplement and is a useful agent to encourage the body's *physiologic acceptance of sleep*: body temperature is lowered, blood pressure reduced, and REM sleep prolonged.<sup>63,64</sup> Dose needs vary from **1-3 mg** per night to generate these effects. Melatonin is best taken at least 1-2 hours before sleep is desired, unlike the 30 or so minutes of a sleeping pill. The key is to start with a low dose, even as low as 0.5 mg, and build gradually to determine the ideal dose for you. High-dose melatonin is typically reserved for other uses, such as the treatment of cancer or sarcoidosis.

**L-tryptophan**, an amino acid that converts to the sleep-regulating hormone, serotonin, can also be useful to encourage sleep, though the effects on sleep architecture are complex.<sup>65</sup> Interestingly, tryptophan depletion is a tool used in research to explore the effects of both tryptophan and serotonin on sleep; tryptophan depletion (e.g., low-protein diet) has been found to adversely affect sleep patterns.<sup>66</sup> Tryptophan, usually in the dose range of **250-2,500 mg**, shortens the amount of time to achieve sleep (shortened "sleep latency") and increases deep sleep and REM.<sup>67</sup>

**Valerian** (*Valeriana officinalis*) is the leading medicinal herb for the treatment of insomnia. It has, in multiple double-blind studies, been shown to improve sleep quality even in people with restless leg syndrome, in which abnormal discomfort and movement of the legs disrupts sleep, using a dose of 800 mg before bed.<sup>68-70</sup> Faster sleep onset and increase in slow-wave phase sleep also develops with valerian supplementation.<sup>71</sup> The optimal dose of valerian as the extract remains uncertain, though most clinical studies have used doses in the range of **300 to 600 mg** taken one hour before bedtime; side-effects have compared favorably to placebo.<sup>72,73</sup>

## SUMMARY

Frailty—age-related deterioration in physical strength and performance—is a critical concern for aging individuals. A growing body of literature demonstrates that nutrients, hormones, and herbal extracts can be used to ward off age-related weakness and enhance human performance throughout life span. Optimizing human performance relies on five pillars: ensuring basic nutritional status, restoring performance-enhancing hormones, preventing muscle weakness and enhancing strength, boosting energy, and restoring healthy sleep. This multifaceted program can help you ensure supercharged performance—for life.

*If you have any questions on the scientific content of this article, please call a Life Extension® Health Advisor at 1-866-864-3027.*

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