Title:
A Brief Look at Adrenal Fatigue

Author:
鄭有翔。臺北市立松山工農。資訊科二年級智班

Instructor:
蔡文亮
I. Preface

Today is Day One of your new bodybuilding regime. You wake up in the morning, put in another 9 to 5 workday, and head to the gym. “No pain, no gain,” you mutter to yourself. After 45 minutes, you make your way home, stumbling and tripping from your grueling squatting session.

A week later, you’re fatigued. You no longer have the energy to go to the gym after work, and you decide to buy a caffeine supplement to give yourself a boost of energy.

Two weeks later, the one caffeine pill you used to take is no longer enough. Frustrated, you begin taking two pills, a grand total of 400 milligrams of caffeine.

Three weeks later, you’re worn and stressed out even before heading to the gym. You can’t get up in the morning, and you’re constantly yawning during work. You try taking three caffeine pills, a borderline-dangerous amount of 600 milligrams of caffeine - but even then, it doesn’t work. Your condition gets worse and worse, until finally, you ask yourself: what’s wrong with me?

Like thousands of stressed-out people around you, you are suffering from adrenal fatigue. **Adrenal fatigue is a chronic condition caused by long term sleep deprivation, stress, and of course, stimulants such as caffeine.**[^1] I am writing this thesis because many (or should I say “most”) people, specifically bodybuilders, need to know the importance of good sleep and the dangers of overexposure to stimulants. In the following sections, I will explain the pros and cons of caffeine and describe several bodybuilding supplements that include stimulants, as well as healthier alternatives to the aforementioned substances. I will also describe the specific signs of adrenal fatigue and its treatment. My thesis will end with my own conclusion and thoughts.

Tired already? Go grab a caffeine pill and get yourself ready!

II. Main Text

II-1. An Introduction to Stimulants and Bodybuilding

Bodybuilding is a hard sport. It means waking up early in the morning to hit the gym. It means eating every two hours to maintain a healthy metabolism. It means having enough left-over energy to continue on throughout the rest of the day. In order to succeed in the sport, many rely on **illegal drugs and anabolic steroids such as HGH (human growth hormone), pro-hormones, androstenedione, and testosterone.**[^2]

Fortunately, the majority of the bodybuilding population uses only supplements such as whey protein, to help protein synthesis; creatine, to aid in muscle hydration; branched-chain amino acids (BCAA), to increase muscle stamina; nitric oxide procurers, to promote blood flow throughout the body; and of course, **stimulants.**

Stimulants are among the most controversial supplements for any person. Some say they are unnecessary because a good night’s sleep is all that’s needed for good energy. Others say time is money, and continue
depriving their body of sleep. Whatever the argument is, the truth remains that people use stimulants. Stimulants are probably the most important supplements for a bodybuilder. Because more energy can directly affect the outcome of a training session, many bodybuilders opt for more powerful and of course more dangerous stimulants. Unfortunately however, not all of those substances are legal. One example of an illegal stimulant is ephedra, which refers to the plant Ephedra sinica. Ephedra is both a stimulant and a thermogenic, which helps burn body fat. It is commonly used with caffeine and aspirin, creating a powerful weight loss stack named “ECA”. However, there are many side effects of ephedra, including but not limited to the following (more common side effects are bolded):

1. Profuse perspiration
2. Nervousness
3. Dizziness
4. Headache
5. Irregular heartbeats
6. Severe skin reactions
7. Dehydration
8. Vomiting
9. Hyperthermia
10. Insomnia
11. Seizures
12. Heart attack
13. Stroke
14. Death

It is for the above reasons that the Food and Drug Administration (FDA) banned the sale of ephedra-containing supplements on April 12, 2004. Because ephedra is illegal and dangerous, I will not elaborate on the details of this drug.

II-2. Caffeine

The most popular legal stimulant is an odorless, white powder with a molecular formula of C₈H₁₀N₄O₂ and a molar mass of 194.19g·mol⁻¹. This powder’s IUPAC (International Union of Pure and Applied Chemistry nomenclature) name is 1,3,7-trimethyl-1H-purine-2,6i(3H,7H)-dione, otherwise very simply known as caffeine.
leaves, beans, and fruit of over fifty plants. Almost all stimulant products contain at least

Caffeine is an energy booster and a mild diuretic that is found naturally in tea and coffee, as well as in the leaves, beans, and fruit of over fifty plants. Almost all stimulant products contain at least 100mg of caffeine.

<table>
<thead>
<tr>
<th>Product</th>
<th>Serving size</th>
<th>Caffeine per serving (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coffee (Starbucks)</td>
<td>12fl oz</td>
<td>240</td>
</tr>
<tr>
<td>Caffeine tablet</td>
<td>1 tablet</td>
<td>200</td>
</tr>
<tr>
<td>Coffee (drip)</td>
<td>200mL</td>
<td>175</td>
</tr>
<tr>
<td>Coffee (brewed)</td>
<td>200mL</td>
<td>135</td>
</tr>
<tr>
<td>Coffee (espresso)</td>
<td>60mL</td>
<td>100</td>
</tr>
<tr>
<td>Soft drink (Mountain Dew)</td>
<td>355mL</td>
<td>54</td>
</tr>
<tr>
<td>Tea (green)</td>
<td>180mL</td>
<td>30</td>
</tr>
<tr>
<td>Dark chocolate</td>
<td>43g</td>
<td>31</td>
</tr>
</tbody>
</table>
Caffeine, when ingested by a healthy adult, has a *biological half-life of about four hours*.\(^6\) That means the boost of energy will last around eight hours. But it is not without drawbacks! Everyone who has had a cup of coffee before will know about the energy crash that occurs once the caffeine effects wear out. In addition to the energy crash, tolerance and addiction for caffeine builds up very quickly: Individuals consuming 300mg of caffeine three times a day for 18 days will develop complete tolerance to it, which means they can drink a cup of coffee right before bedtime and still sleep soundly! Addiction or reliance to the substance will also occur.

While it is relatively hard to overdose on caffeine \(\text{LD}_{50}\) of around 150mg/kg\(^7\), death may result in extreme cases and hospitalization required for as little as 2g of caffeine within a certain time frame. With this in mind, let's examine what happens to caffeine inside the human body.

### A. Caffeine in the Body

Once ingested into the human body, caffeine is completely absorbed by the stomach and small intestine within 45 minutes. It is metabolized by the liver into three metabolic dimethylxanthines:

1. **Paraxanthine (84%)**: Increases lipolysis, the breakdown of fat in fat cells, which leads to elevated glycerol levels in blood plasma.
2. **Theobromine (12%)**: Vasodilator and mild diuretic. Theobromine is the main alkaloid in cocoa.
3. **Theophylline (4%)**: Relaxes muscles of the bronchi.

Paraxanthine leads to the breakdown of fat in fat cells, which is the main reason many people use caffeine-containing products to lose weight. Theobromine is a vasodilator and mild diuretic. Vasodilators dilate the blood vessels to increase blood flow throughout the body. Similar to electrical conductance, the wider the surface area of our blood vessels, the more blood flows through. (In electric engineering, this is known as \(G = \frac{\rho}{\pi t}\), meaning the electrical conductance is in direct proportion to the surface area of the object). Good blood circulation is imperative, because there are so many nutrients carried around in the blood. Without clean and fresh blood going through our muscles, they won't grow at all. Diuretics are drugs that get rid of extra water in the body. Because proper de-hydration before a bodybuilding contest is important (to achieve the dry and hard look), bodybuilders look to diuretics to take the extra water out of their bodies. **Caffeine can do a pretty good job at de-hydration**\(^8\), which is why every time you finish a cup of coffee, you’re always so thirsty afterwards!

### B. Caffeine in Bodybuilding

As mentioned before, stimulants like caffeine are very important in the tough sport of bodybuilding. Table 2–1 already showed one supplement that contains caffeine: the caffeine pills.
A typical caffeine tablet contains 200mg of caffeine, but notice the extra ingredient on the supplement label above: calcium. Caffeine has several adenosine receptors, each with different anatomical distributions. A1 receptors inhibit calcium uptake. Therefore, it is important to supplement with calcium when taking caffeine. Other supplements like Controlled Labs White Flood boost energy and increases nitric oxide production.

These supplements not only contain caffeine, but also acids like GABA (Gamma-Aminobutyric Acid) and antioxidants such as coenzyme Q10.
But notice the location of caffeine on the above nutrition label. In America, it is required that the order in which ingredients are labeled accord with the amount of the ingredient in the product. Caffeine is the fourth ingredient in almost 4 grams of a proprietary blend. I would say that means at least 1-1.5g of caffeine. And provided you know the lethal dose of caffeine mentioned on section II-2, it would be very dangerous to overdose on this product.

There are, of course, healthier alternatives to caffeine. The vitamin B complex, especially B₆ and niacin, provide a notable boost of energy. Though clearly not as effective as caffeine, vitamin B works fairly well for the average adult when taken in excess (500-700% of daily value). Supplements such as Purple Wraath contain branched chain amino acids as well as 10mg each of vitamin B₆ and niacin.
II-3. Adrenal Fatigue

So, after reading all that about caffeine and stimulants, what actually is adrenal fatigue? As mentioned in section II-2, tolerance and addiction to caffeine builds up rather quickly. Adrenal fatigue is a chronic condition in which the body has developed a tolerance to external stimulants. Adrenal fatigue is normally caused by over-ingestion of caffeine or stimulants. When the body slowly builds up tolerance to those substances, it needs more and more to give an equal boost of energy. At the same time, the liver will slow down the production of natural energy factors, meaning your body will absolutely need an external source of energy. When this happens, your body has adrenal fatigue. Signs of adrenal fatigue include:

1. **Morning fatigue**: You can’t “wake up” until around 10am
2. **Afternoon low**: Clouded thinking and a sluggish mind around afternoon
3. **Burst of energy**: Once at around dinnertime, another one at 11pm
4. **Lack of energy**
5. **Muscular weakness**
6. **Declining endurance**
7. **Unfulfilling sleep**: Though you’ve slept for 7 hours already, it doesn’t seem enough

Treatment of adrenal fatigue is extremely tiring (no pun intended!). Not only does it take a long period of time to fix, it also affects your everyday life! A typical treatment of adrenal fatigue takes around nine months to a year. During this time, you must not take any external stimulants; sleep should be around 8 hours a day, and you can’t overstress yourself. Not overstressing yourself sounds easy, but it is not! Remember, when you have adrenal fatigue, your adrenal functions are not working properly. That means without a dose of caffeine, your body doesn’t know how to get started! The six months of treatment will be filled with longings and cravings for sleep; deep inclination towards caffeinated drinks such as coffee or soda will also ensue. Studies show that ingestion of pantothenic acid may aid in restoring adrenal function, but it is not recommended because restoration of bodily functions as such should be done as naturally as possible.

Sounds bad, doesn’t it? So what can you do to prevent adrenal fatigue from even happening? Well, as mentioned on page 8, there are healthier alternatives to caffeine such as vitamin B₆. Naturally, it doesn’t work as well as caffeine containing stimulants, but it certainly gives your body a break! Another great way without even having to use any kind of external drug is just to increase your sleep. Increase the time of your sleep; increase the quality of your sleep. Also keep in mind, a nap in the middle of the day is the same as an extra hour of sleep at night.

I am slowly recovering from adrenal fatigue. How did I do it? I quit taking stimulants. I stopped doing extra things at night that needn’t be done. And I slept. Yes, it was tiring work, and yes, it took quite a long time. But in the long run, I got my body back up and running! It was a fine trade off.

III. Conclusion

Adrenal fatigue is a chronic condition in which your body’s adrenal glands slowly fail. Adrenal glands
provide a very important, often overlooked function: they are responsible for responding to every form of stress, whether it be emotional or physical. As you can see, it is very important that we take care of our bodies. Fatigue is not the only thing that can harm us: ever-changing sleep patterns and an unstable diet are also factors that lead to the slow declination of our bodies. In order to keep your body healthy, you must pay attention to every signal your body sends to you. Most of the time, we as humans choose to ignore those signals, but that ignorant feature of us often tends to lead to bad consequences for us. While adrenal fatigue can be treated under the right circumstances and with enough willpower, there are some conditions that cannot be treated no matter what. It is best to stay away from those things right from the beginning.

IV. Bibliography


