

Anabolic Steroids: Hormonal Headscratchers

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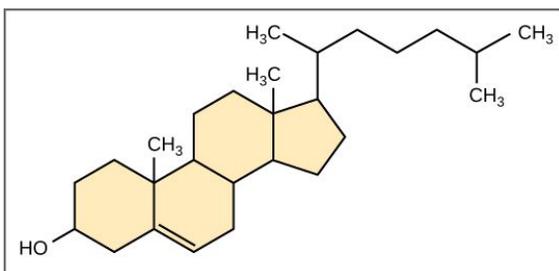
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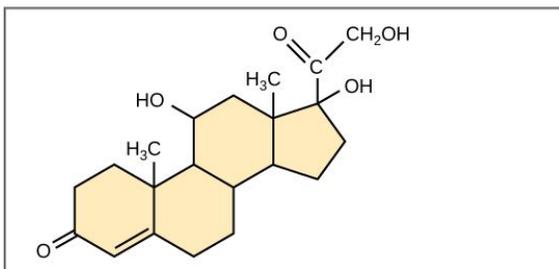
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Introduction

In a day and age where not only professional athletes and bodybuilders, but also regular gym goers are continuously trying to push their bodies their respective physical limits and muscular capacities, anabolic steroids have become a significant part in helping these people achieve their individual bodily goals. While there is a blatant taboo on performance-enhancing drugs in most professional sports leagues—as seen by recent doping scandals in Major League Baseball—as well as many reports discouraging steroid use due to their various potential detrimental effects, the anabolic steroid industry curiously manages to remain alive and well. While many people have negative preconceived notions of anabolic steroids that are fed to them by the mainstream media, most people do not understand what anabolic steroids truly are, how they affect one's body, and furthermore, how to objectively and subjectively determine if someone is a steroid user or not, as it is extremely common for lifters to be wrongly accused of steroids use due to a lack of knowledge by the accuser. Overall, this essay seeks to provide the reader with useful and accurate information about steroids while also dispelling false beliefs commonly held by the general public.



Cholesterol



Cortisol

What are steroids?

For starters, it is important to distinguish between anabolic steroids and the biological steroids that are naturally present in one's body. Scientifically, steroids are organic molecules composed of 17 carbon atoms. These atoms are organized into 4 isoprene rings, many of which (like cholesterol and cortisol) have isoprene tails. The type of structure(s) and

functional groups attached to this four-ring base determine the specific type of steroid one has.¹ For example, steroids with the functional group OH are called sterols. While steroids do differ from most other lipids due to their structure, they are still considered lipids due to the fact that they are hydrophobic and insoluble in water.

Cholesterol is the most common steroid, as it is the starting chemical of which many mammalian hormones, such as testosterone and progesterone, are made of. Cholesterol is also a vital component of the phospholipid bilayer and plasma membrane of many animal cells, as it make the plasma membrane less permeable. The decrease in permeability ensures the structure and stability of the membrane and prevents certain fluids from leaking into and out of the cell which could interfere with the cell's internal functioning.²

Neurosteroids are hormones produced by the central and peripheral nervous systems, mainly in glial cells and the hippocampus.³ They alter brain activity and the functioning of the central nervous system by either blocking or activating neurotransmitter receptors. The most well known neurosteroid is progesterone, which is important due to its activation of luteinizing hormone (LH), which stimulates ovulation in females and testosterone production in males.⁴

Put simply, *anabolic* steroids are *synthetic* (man-made) variations of male sex hormones like testosterone.⁵ One should also note that anabolic steroids should more properly be called “anabolic-androgenic” steroids. “Anabolic” refers to skeletal muscle building caused by the drugs while “androgenic” refers to the increased male sex characteristics that are brought about.

¹ <https://www.boundless.com/biology/textbooks/boundless-biology-textbook/biological-macromolecules-3/lipids-55/steroids-301-11434/>

² <http://www.livestrong.com/article/293784-why-does-cholesterol-lower-membrane-permeability/>

³ <https://www.ncbi.nlm.nih.gov/pubmed/9924747>

⁴ <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3356049/>

⁵ <https://www.drugabuse.gov/publications/drugfacts/anabolic-steroids>

History of Anabolic Steroids

The use of pure testosterone to enhance one's athletic performance can be traced back to the first Olympic Games in Athens where competitors consumed large animal testicles before competing.⁶ While it is doubtful that these competitors understood the full effects of what they were ingesting, it is interesting to see that "doping" has been happening for a lot longer than one would think.

A major development was made in 1849 when German scientist—and father of modern endocrinology—Arnold Adolph Berthold removed testicles from Cockerels (a bird). After the amputation, Berthold observed that the bird lost many of its male characteristics, a discovery that demonstrated the importance of a male's testicles, and more importantly, the hormones that it creates. Jumping ahead about 80 years, in 1931 German chemist Adolf Butenandt was able to locate and extract androteston (an ester of testosterone) from a few liters of urine. Shortly thereafter, German chemist Leopold Ruzicka discovered the ability to synthesize these types of compounds to make them safe for human consumption, and in 1935, Ruzicka and Butenandt produced the first batch of anabolic steroids, which led to them receiving a Nobel Prize in 1939. Nonetheless, at the time of their infancy, these steroids were used to treat hypogonadism, a condition in which one's body either does not produce enough testosterone or has impaired sperm production (or both).⁷ Hypogonadism, which arises from either decreased testosterone production during fetal development or delayed/abnormal development during puberty, comes from either a problem in the testicles (primary hypogonadism) or a problem in the hypothalamus

⁶ <https://www.steroid.com/History-of-Steroids.php>

⁷ <https://www.drugabuse.gov/publications/research-reports/anabolic-steroid-abuse/what-are-anabolic-steroids>

and pituitary gland (secondary hypogonadism) the parts of the brain that communicate with the testicles to produce testosterone.⁸

In the late 1930's, researchers found that anabolic steroids could increase one's muscular growth based on tests performed on laboratory animals, and modern tests have confirmed these results as well. Not long after, steroids were being used on humans for performance enhancement in athletics. The Soviet Union was particularly notorious for steroid abuse—giving it to many of its Olympic athletes—which is why it was able to dominate the sports stage in the 1940's. The Soviet monopoly ended soon however as US Olympic physician Dr. John Ziegler developed methandrostenolone (more commonly known as Dianabol), which would later go on to be marketed by Ciba Pharmaceuticals and approved for human consumption by the FDA in 1958. From there, steroids took off and began to be implemented into various other competitive fields in the 60's, 70's and 80's, as discussed later in the essay.

How do steroids work?

Before examining the details, one must recognize the basic mechanism through which hypertrophy works. At the simplest level, when we lift weight, we are creating small tears in our muscle fibers.⁹ Thereafter, when our bodies are recovering in between training sessions, the micro tears are repaired by adding bigger and stronger muscle cells. Steroids increase the rate of this muscle repairing process.

To begin, steroids need to enter one's bloodstream, which can be done by ingesting steroids via needles, transdermal administrations (eg: topical creams), or pills. Injections and transdermal administrations (eg: topical creams) are generally preferable because they do not

⁸ <http://www.mayoclinic.org/diseases-conditions/male-hypogonadism/symptoms-causes/dxc-20248457>

⁹ <https://www.livescience.com/3349-steroids-work.html>

have to be processed by the liver, whereas oral steroids must be processed by the liver. The problem that comes with being processed by the liver is that the liver is fairly reticent towards passing things back into the bloodstream because it must break compounds down into “non bioactive metabolites.” All in all, oral steroids make the liver work harder and are more damaging to the digestive system. Once steroids are in the blood, the testosterone must get to one’s cells, but not all of it can. In the bloodstream are two types of testosterone: bound testosterone (about 98%) and free testosterone.¹⁰ Bound testosterone is testosterone that is bound to either albumin ($\frac{1}{3}$) or sex hormone binding globulin (SHBG) ($\frac{2}{3}$). However, since the testosterone’s bond with albumin is extremely weak, that, along with free testosterone—which is not bound to anything—, is available for cell uptake and is therefore considered bioavailable.¹¹ The main point to understand about free testosterone is that steroids will not have much of an effect on one’s body unless they are taken in supraphysiological amounts, which is why users either swallow pills or eject themselves with 10-100 times the prescribed medical doses of steroids. If one were to instead inject normal amounts of testosterone, their bodies would adapt and produce enough albumin to keep bioavailable testosterone levels normal, which is why over-the-counter testosterone boosters do not work. In addition, albumin levels cannot be spiked because they ensure dynamic equilibrium with the concentrations of fluids between cells and their extracellular materials, but tests have shown that testosterone, unlike all other steroid hormones, decreases SHBG levels, which is part of the reason why testosterone is so powerful.¹²

¹⁰ <https://labtestsonline.org/understanding/analytes/testosterone/tab/faq/>

¹¹ <http://www.mayomedicallaboratories.com/test-catalog/Clinical+and+Interpretive/83686>

¹² <https://www.ncbi.nlm.nih.gov/pubmed/4062218>

At the end of the day, steroids work because they pump extraordinary amounts of testosterone into one's blood so that the body cannot "keep up," thereby forcing bioavailable testosterone levels to skyrocket.

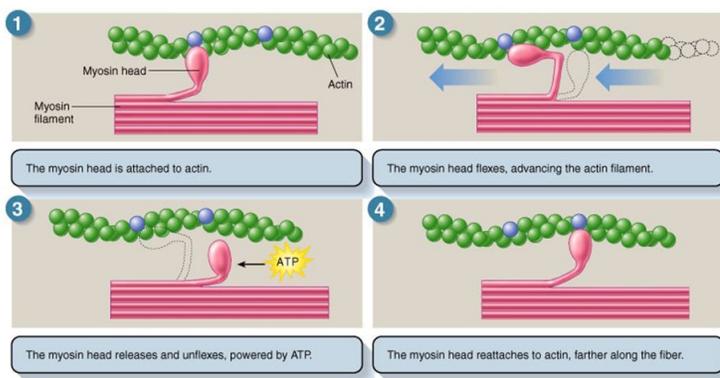
Steroids do not actually start to affect the body until they arrive at cells. Since steroids are lipid soluble, they can permeate directly through a cell's membrane and attach directly to a steroid receptor in the cytoplasm.¹³ The hormone is then able to get to the cell's nucleus to alter DNA transcription (RNA synthesis) which also affects translation (protein synthesis). By changing the proteins produced by the cell, the steroid is therefore influencing the function and behavior of the cell by increasing the production of actin and myosin, the two myofilaments that are responsible for the contraction of a muscle.¹⁴ Actin is a thin filament and globular protein that has various bonding sites to which myosin heads can attach. Myosin is a much thicker protein

composed of twisted protein strands called cross-bridges, all of which combine to form a myosin filament with protruding globular heads.

As shown in the diagram on the left, the myosin cross bridges attach to an actin binding site and bend to pull the actin filament with them. After the actin filament has shifted, the myosin head then un flexes

Myofilament Contraction

An ATP-powered myosin head-flex mechanism allows the actin filament to slide past myosin



Play Myofilament Contraction

¹³ <https://www.strongerbyscience.com/the-science-of-steroids/>

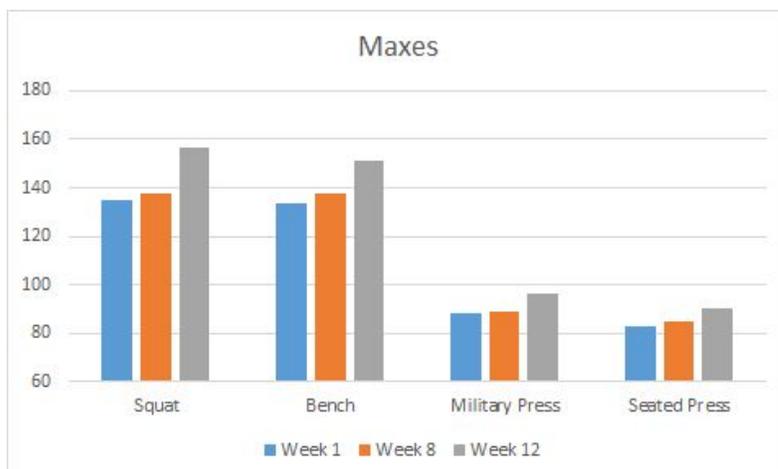
¹⁴ http://highered.mheducation.com/sites/0072495855/student_view0/chapter10/animation_myofilament_contraction.html

and frees itself from the actin using energy from ATP. Once free, the myosin head may bind to another site on the actin filament and repeat the process as if it were walking along the actin.

An interesting, yet important fact about steroids is the fact that it works psychologically just as well as they do physically as noted by two studies examining the degree to which the placebo effect can have on strength gains. The first study, published in *Medicine and Science and Sports* in 1972, consisted of 15 athletes with max squats and benches at around 300 pounds and max military presses a little under 200 pounds.¹⁵ The athletes trained for about seven weeks with the promise that those who made the most strength gains would be given free and legal steroids.

Over that seven week period, these lifters added a total of about 22 pounds to their four main lifts (bench press, military press, seated press, squat). Subsequently, six participants were randomly selected and given a “dosage” of 10 mg of Dianabol per day when in reality, they were just given

a placebo pill. After training four weeks on the placebo pill, the six athletes added an average of 100 pounds for all four lifts combined. As one can see, the testees added MORE weight to their lifts in LESS time, and while there are many factors that could have affected their training, one can properly attribute that this drastic increase

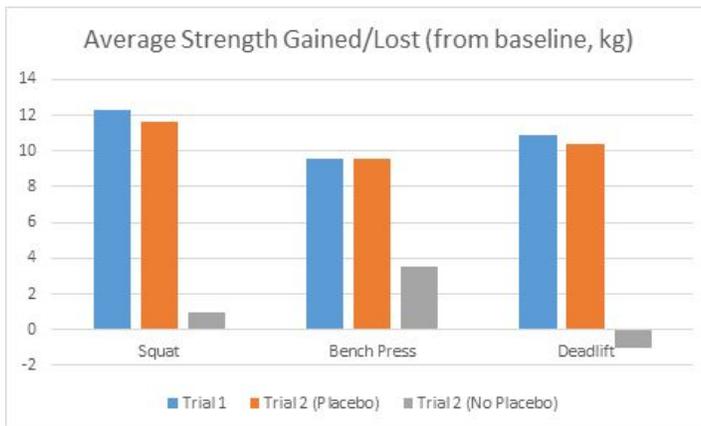


in strength to the fact that the athletes thought that they were on steroids.

¹⁵ <http://www.arielnet.com/articles/show/adi-pub-01242/anabolic-steroids-the-physiological-effects-of-placebos>

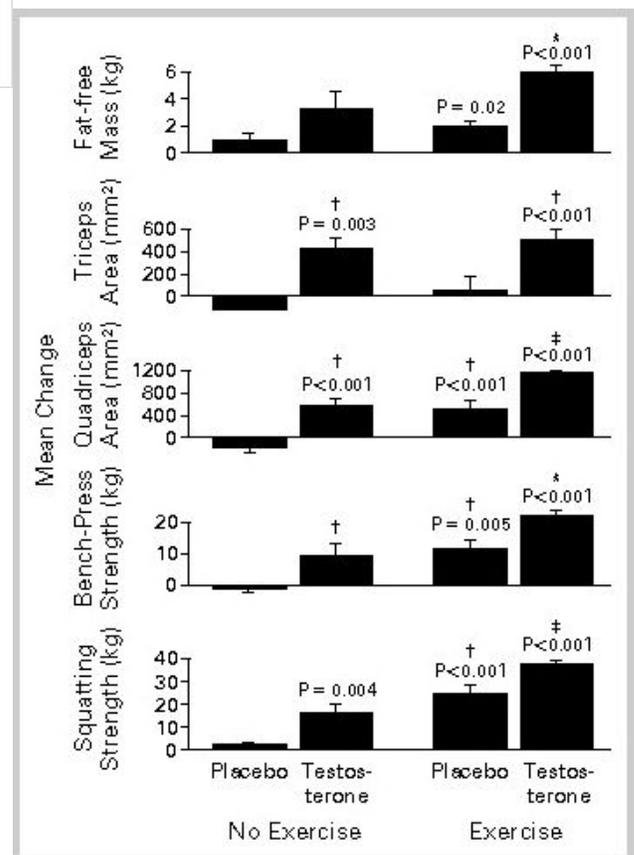
The second experiment, published in *Human Kinetics* in 2007, a powerlifting coach giving his team of 11 members “fast-acting” steroids that were just saccharine pills.¹⁶ After the team members took the pills, they all immediately hit personal records on their three main lifts squat, deadlift, and bench press, raising the average total weight of these three lifts from 1597 pounds to 1670 pounds. Further, after taking these pills for about two weeks, the lifters reported that they were lifting heavier weights for more reps and were having better training sessions.

Then came a twist: five lifters were told that they were taking a placebo pill, while the other six continued to be deceived. After receiving this news, the five who had been taken off the



placebo tanked, declined in strength with all of their lifts returning to their pre-placebo maxes while the six still on the placebo, despite a few minor

regressions and PR's, stayed at generally the same weight for their four lifts (1670 pounds). So, one can clearly see from these studies that part of the reason steroids work so well is that users expect them to work well. In other words, when you think you will get stronger, you will indeed become stronger.



¹⁶ <https://e-space.mmu.ac.uk/13266/>

At the same time, there are experiments that demonstrate that steroids do indeed work biologically as well. In a 1996 study published by *The New England Journal of Medicine*, testees were broken into four groups: placebo and no exercise; testosterone and no exercise; placebo with exercise; testosterone with exercise, all of whom had their one rep maxes on bench press and squat recorded at the beginning and end of the study.¹⁷ As shown by the diagram below, those who trained for two weeks with a placebo pills were only slightly stronger than those who took testosterone but did not train. In addition, those who took testosterone with no exercise gained slightly MORE muscle than those who trained with a placebo, which is very compelling considering the fact that the lifters were given a fairly basic dose of steroids with just 600 mg of testosterone per week with nothing else mixed in or stacked. Overall, this study exhibits the sheer power of steroids, as it demonstrates that those who take steroids without training can gain more muscle than those who train and nearly as much without. Steroids overall give an unfair advantage.

Typical Steroids Dosages and Cycles

Steroid users often take their hormones in cycles mainly because one can maximize the benefit of the drugs by taking them in a logical sequence and under specific dosages.¹⁸

Name	Weeks	Dosage	Frequency	Remarks
Depo Test 250	1-12	500mg	EW	Mon 250mg & Thurs 250mg
Proviron	1-12	50mg	ED	NA
Stanozolol	8-12	75mg	ED	NA

Name	Weeks	Dosage	Frequency	Remarks
Nolvadex-D	14-15	40mg	ED	Post Cycle Therapy
Nolvadex-D	16-17	20mg	ED	Post Cycle Therapy

ED = Everyday
EW = Every Week
EOD = Every Other Day

Chart of a typical long-term steroid cycle

¹⁷ <http://www.nejm.org/doi/full/10.1056/NEJM199607043350101#t=articleTop>

¹⁸ <http://www.anabolicsteroids.net/steroid-cycles.php>

Some users “stack” steroids, meaning that they take multiple types of steroids at the same time, a powerful strategy usually used by experienced users only. At the foundation of any steroid stack is a member of the testosterone family (formats, blends, and ester variants of pure testosterone), which includes testosterone enanthate, testosterone cypionate, testosterone propionate, and testosterone suspension, and sustanon 250. All of these testosterone derivatives are esterified, meaning that there is a carboxylic acid attached to the 17th carbon atom via an ester linkage that extends the steroid’s half life and therefore its effectiveness. Other anabolic steroids that can be stacked with testosterone include dianabol (methandrostenolone), winstrol (stanozolol), trenbolone, nandrolone (deca-durabolin), all of which are taken for specific purposes and intentions. Dianabol and winstrol are often taken in pill form, as oral steroids are often regarded as supplements to a solid base of injectable steroids. Dianabol often used to increase muscle size and mass and to furthermore gain weight by allowing one to retain water weight, which is a common goal of bodybuilders trying to “bulk.” Winstrol is taken by bodybuilders who want to put on lean mass without added muscle thickness or water retention. It gives one’s body a chiseled, shredded look, which is why it is often used before bodybuilding competitions when contestants are trying to “cut.” Unlike dianabol and winstrol, nandrolone and trenbolone are injectable compounds taken to supplement testosterone. Nandrolone is used when one is trying to gain muscle and strength and do so in a steady-paced, gradual fashion, which is possible due to Nandrolone’s long half life. Nandrolone is also preferable to novice steroid users who do not want to stack anything too potent with testosterone. Trenbolone is exact opposite of Nandrolone in the sense that it is incredibly strong and is only used by advanced steroids stackers

who have experimented with many other compounds. While it does not promote water retention like Nandrolone, Trenbolone can help one add lean muscle at an extremely rapid pace

All of the steroids mentioned above are referred to as “bodybuilder” steroids, as they are most commonly used by those looking to enhance their aesthetics and physique. Professional athletes on the other hand tend to be more selective regarding the steroids they use; for example, sprinters and runners would not take doses of testosterone that are larger than 300 mg per week, and would avoid supplemental compounds like Dianabol and Anadrol due to their water retention. Athletes would instead opt for drugs such as Winstrol, Masteron, and other similar compounds that can improve one’s endurance.

How to tell if someone is using steroids

Michael Scally, M.D., a researcher who has worked with thousands of steroid users once said: “Of all the people I’ve seen who admit using steroids, I’d say 90 percent don’t even look like bodybuilders,” and further noted “They aren’t 6 to 8 percent body fat. They aren’t huge. They look like 20-, 30-, 40-year-old men. They’re just using steroids to try to get in shape faster.”¹⁹ Scally, through years of extensive research, can confirm the fact that it is difficult to detect steroid use in most users, but that being said, it is easy to detect steroid usage if one is doing so successfully. Harrison Pope, a professor of psychiatry at Harvard University, developed a fat free mass index (FFMI), which utilizes one’s height, weight, and body fat percentage to give others an idea of how close that person is to his physiological ceiling. Below is a chart taken from the calculator.co of FFMI scores and what those scores signify:²⁰

¹⁹ <http://www.menshealth.com/fitness/signs-steroid-use>

²⁰ [https://www.thecalculator.co/health/Fat-Free-Mass-Index-\(FFMI\)-Calculator-794.html](https://www.thecalculator.co/health/Fat-Free-Mass-Index-(FFMI)-Calculator-794.html)

FFMI	Score Consideration
16-17	Below Average
18-19	Average
20-21	Above Averagea
22	Excellent
23-25	Superior
26-27	Scores considered suspicious but is still attainable naturally
28-30	Highly unlikely scores to be obtained naturally without steroid usage

There have been many experiments performed that confirm the FFMI score considerations seen above, with the most notable one being a 1995 study where researchers calculated the FFMI's of 156 men who lifted regularly.²¹ Of that group, the average FFMI of the natural lifters was 21.8 and maximum FFMI was 25; the average FFMI of steroid users that outstanding 24.8, and many of these testees had FFMI's that were well into the 30's. To put this into perspective, the average FFMI of all natural Mr. America winners from 1930-1959—all of

²¹ <https://www.ncbi.nlm.nih.gov/pubmed/7496846>

whom were natural because this was the pre-steroid era of bodybuilding—was 25.4, meaning these average steroid users were not far off from some of the best physiques in the world from the mid-20th century.

The method for calculating FFMI is broken down into three formulas:

First, one must calculate the suspected user's lean muscle mass: $\text{Weight in kg} \times (1.0 - (\text{Body fat \%} / 100.0))$

Second, one will calculate the FFMI: $(\text{Lean} / 2.2) / ((\text{Height in ft} \times 12.0 + \text{in}) \times 0.0254)^2 \times 2.20462$

Third, one shall calculate the Adjusted FFMI, which is the FFMI that is often reported in tests. FFMI must be adjusted with height because the amount of muscle one has is not directly related to his height. In other words, an unadjusted FFMI overestimates that amount of muscle a tall person can have: $\text{FFMI} + (6.1 \times (1.8 - ((\text{Height in ft} \times 12.0 + \text{in}) \times 0.0254)))$

As noted above, FFMI interpretations are not clear-cut, as most steroid users do not look like gifted bodybuilders and may have FFMI's in the low 20's. At the same time, there are many genetically gifted, natural athletes with FFMI's in the mid to high 20's as well. Putting this formula into action, one can make an educated guess on to the status of many famous lifters who claim to be natural. For example, many skeptics claim that David Laid, a well-known 19-year-old in the Youtube fitness community, is on steroids mainly because he has made such noticeable strength and muscle gains in a very efficient manner, as not too long ago he was an incredibly skinny adolescent. Weighing in at 85kg and standing 6'2 with an 8.2% body fat, he calculations with David Laid are as follows:²²

²² <https://bodywhat.com/?v=dgf68sx9>

$$\text{Lean Mass} = 85 * (1 - (8.2/100)) = 78.03\text{kg}$$

$$\text{FFMI} = ((78.03 / 2.2) / ((74 \text{ in} \times .0254)^2)) \times 2.20462 = \mathbf{22.13}$$

$$\text{Adjusted FFMI} = 22.13 + (6.1 * ((1.8 - (74 * .0254)))) = \mathbf{21.64}$$

As one can see, Mr. Laid's FFMI is at a perfectly attainable 22.1, and because David has been training frequently and diligently for about 5 years, one can safely assume that he is not taking hormonal substances.

On another note, there are more objective ways to determine if someone is using steroids: blood and urine tests. Steroids tests, as opposed to that of street drugs like cocaine and marijuana, are very specific and require advanced technology mostly because the hormones released by steroids are native to the human body—or synthetic versions of hormones already in the human body—whereas the compounds in other drugs are foreign to the body. In addition, anabolic steroid testing requires examining liquid samples for *all* known anabolic steroids until doctors can further narrow it down to a specific type of steroid.

The most popular type of steroid testing is urine drug testing (UDT), which utilize immunoassay, the process of analyzing urine for specific metabolites that are released in response one's metabolism breaking down specific substances. Metabolized forms of testosterone include Epitestosterone, Dihydrotestosterone, and Estrogen. Blood tests can also be used to detect steroid use but are not preferable because steroids are metabolized in the pathways of the liver and kidney and as a result rarely stay in the bloodstream.

How harmful can steroids be for the the body?

It is no surprise that there are many potential detrimental effects to taking steroids. Nonetheless, the one problem that arises when trying to examine steroid's side effects is the

difficulty of organizing real life human experiments. For instance, one cannot design an experiment where testees are given steroids for a long period of time—20 years for example—mainly because it would be immoral give a large group of lifters potentially toxic and lethal substances. As a result, much of the information researchers currently have regarding steroid's side effects comes from isolated, random cases that each have their own set of circumstances. For example, if a 300-pound avid steroid user were to drop dead due to heart failure, there are many factors one must take into consideration—such as the person's use of street drugs (cocaine, marijuana), alcohol consumption, family history of heart problems, and everyday diet—before attributing the death solely to alcohol.

Only some steroids users will experience negative side effects, and the severity and type of effects will vary from person to person due to a variety of factors, including age, gender, and overall bodily health. Regarding age, side effects may be less apparent in those who are young (less than 25) as the person's hormonal balances will still be changing. Men and women experience different problems as well, as women, due to increased testosterone levels, can undergo deepening of their voice, growth of facial hair, reduction of breast size while men, due to increased estrogen levels, can suffer from enlargement of the breasts. The user's preexisting medical health can also come into play, as those with existing psychological problems are more susceptible to developing mood swings, roid rages, and emotional issues.

Regarding liver problems, in general, it is believed that prolonged use of anabolic steroids makes one more susceptible to developing hepatotoxicity and cholestasis, but a report from the National Library of Medicine (NLM) stated that the development cholestasis is solely dependent upon the dosage and the specific types of steroids that one ingests.

In terms of cardiovascular complications, steroids can be detrimental to one's lipid metabolism by increasing LDL levels and decreasing HDL levels. LDL is low-density lipoprotein cholesterol and is often referred to as "bad" cholesterol due to the fact that it can lead to plaque build up in one's arteries, which increases one's chances of experiencing heart attacks and strokes.²³ HDL is high-density lipoprotein cholesterol and is referred to as "good" cholesterol as it carries LDL from the arteries back to the liver where it can be broken down and passed out of the body. Steroids are likely to cause LDL and HDL imbalances if the user already had existing cardiovascular complications or if the user takes questionable doses, but luckily there are no studies suggesting that steroids directly lead to life threatening arrhythmia. Heart enlargement is also often attributed to steroids, but since cardiac tissues only expand when one is performing intense physical activity while on steroids, so it would be inaccurate to say that steroids alone enlarges one's heart. More importantly there is no scientific research that backs up the hypothesis for heart enlargement, which can easily be reversed. Steroids have also been found to exacerbate hypertension, due to water retention in one's blood that is caused by increased estrogen levels, but these fluctuations are usually minimal. Nevertheless, this can be easily prevented by taking an aromatase inhibitor (a type of drug used to treat gynecomastia in men) or using steroids with lower levels of estrogen.

It is also believed that steroids have detrimental effect on one's psychological state by affecting the central nervous system, as steroid-induced aggressive behavior exhibited by users is commonly referred to as "roid rage." One experiment that wished to explore these psychological effects examined how Nandrolone decanoate affects the dopaminergic and serotonergic parts of

²³

http://www.heart.org/HEARTORG/Conditions/Cholesterol/HDLTriglycerides/HDL-Good-LDL-Bad-Cholesterol-and-Triglycerides_UCM_305561_Article.jsp#.WXqpmtMrKAw

the brain. Dopaminergic part of the brain that emits dopamine, which is released when one experiences pleasure and reward, while the serotonergic portion emits serotonin, a hormone that fights depression and anxiety. The test found Nandrolone decanoate temporarily blocks the release of dopamine and serotonin, which decrease the effectiveness of these parts of the brain. However, damages made to the central nervous systems can be easily reversed provided enough time was taken in between steroid cycles (5 times the duration of the cycle for dopamine and 6 times for serotonin). Nonetheless, at the end of the day, only about 21% of anabolic steroid users have reported from suffering psychological effects. More importantly, there are many more cases of alcohol and other drug-induced anger episodes than that of anabolic steroids.

One of the most noticeable side effects of steroids is increased acne on one's chest, face, and back, as steroids cause increased activity in the sebaceous glands by binding to androgen receptors.²⁴ The sebaceous glands produce and release sebum, which is responsible for moisturizing skin and hair, but excess of sebum can lead to acne. The acne is also fairly severe due to the fact that steroids further exacerbate the problem by increasing the size of the sebaceous glands. Luckily, acne can be treated with topical androgens and is often eliminated once steroid use is ceased.

Gynecomastia (breast enlargement) is also a very evident effect of steroids. Gynecomastia—which is Greek for “woman breast”—is an endocrine disorder whereby a male's chest begins to take the shape of that of a woman due to increased estrogen levels and overall hormonal imbalances. While it may not be physically lethal or dangerous—in fact, if it is detected an early stage it can be reversed, if not surgery is needed for removal—gynecomastia can take a

²⁴ <http://thescienceofacne.com/anabolic-steroids-and-acne/>

toll on one's psychological state and self-confidence due to the fact that it is aesthetically unpleasing for a man.

One of the most feared bodily responses to steroids is testicular atrophy. Testicular atrophy is the shrinking of one's testicles due to the suppression of the Hypothalamic-Pituitary-Testicular Axis (HPTA), a system of glands—mainly the hypothalamus and pituitary gland—that produces testosterone. Testicular atrophy is the product of a negative feedback cycle, because when testosterone is being inserted into one's body, the pituitary gland will stop producing testosterone so that overall bodily testosterone levels will not rise above a certain limit (homeostasis). Luckily, testicular atrophy can be treated with Post Cycle Therapy, which involves ingesting a safe compound that stimulates testosterone production in the testicles.

Conclusion

On the whole, one can easily see why steroids are portrayed in such a negative light by the mainstream media by reason of the many potential bodily dangers that come with these synthetic substances as well as—while not discussed in detail above—the way in which steroid use can compromise the integrity of professional sports. Nonetheless, at the same time, there also seems to be an unfair bias against steroids as opposed to more conventional drugs and alcohol. While steroids can be lethal, one would have to fervently abuse steroids for an extended period of time to severely suffer and die from them, similar to how one would have to ardently abuse marijuana, cocaine, whiskey, and vodka, all of which are consumed at a much higher rate than steroids. Moreover, like other drugs and alcohol, steroids, if taken safely, can provide minimal to no harm to one's body. So, by and large, while steroids, like other drugs, are a major risk to one's health—as their only upside would be to increase one's visible physique or enhance

one's performance in a sport—that should NEVER be taken, steroids should not be thought of as worse than everyday alcohol or street drugs as many claim them to be. Similarly, one should be more cautious before accusing others of steroid use because looks can be deceiving.

Works Cited

- "Acne Science." *Science of Acne*. Science of Acne, n.d. Web. 31 July 2017.
- "Anabolic Steroids." *NIDA*. NIDA, n.d. Web. 31 July 2017.
- Ariel, Gideon. "Article." *Ariel Dynamics*. Ariel Dynamics, 23 May 1972. Web. 31 July 2017.
- Bicêtre, Le Kremlin. "Home - PubMed - NCBI." *National Center for Biotechnology Information*. U.S. National Library of Medicine, n.d. Web. 31 July 2017.
- Boundless. "Steroids - Boundless Open Textbook." *Boundless*. Boundless, 26 May 2016. Web. 31 July 2017.
- Callahan, Christy. "Why Does Cholesterol Lower Membrane Permeability?" *LIVESTRONG.COM*. Leaf Group, 06 Jan. 2016. Web. 31 July 2017.
- Ciorniciuc, Viorel. "Fat Free Mass Index (FFMI) Calculator." <https://www.thecalculator.co>. The Calculator, n.d. Web. 31 July 2017.
- Cunningham, S. K., T. Loughlin, M. Culliton, and T. J. McKenna. "The Relationship between Sex Steroids and Sex-hormone-binding Globulin in Plasma in Physiological and Pathological Conditions." *Annals of Clinical Biochemistry*. U.S. National Library of Medicine, Sept. 1985. Web. 31 July 2017.
- Kouri, E. M., J. R. Pope, D. L. Katz, and P. Oliva. "Fat-free Mass Index in Users and Nonusers of Anabolic-androgenic Steroids." *Clinical Journal of Sport Medicine : Official Journal of the Canadian Academy of Sport Medicine*. U.S. National Library of Medicine, Oct. 1995. Web. 31 July 2017.
- "Male Hypogonadism." *Mayo Clinic*. Mayo Foundation for Medical Education and Research, 29 Sept. 2016. Web. 31 July 2017.

- Micevych, Paul, and Kevin Sinchak. "The Neurosteroid Progesterone Underlies Estrogen Positive Feedback of the LH Surge." *National Center for Biotechnology Information*. U.S. National Library of Medicine, n.d. Web. 31 July 2017.
- Nuckols, Greg. "The Science of Steroids • Stronger by Science." *Stronger by Science*. Stronger by Science, 17 Dec. 2016. Web. 31 July 2017.
- Peterson, Dan. "How Do Steroids Work?" *LiveScience*. Purch, 19 Feb. 2009. Web. 31 July 2017.
- Schuler, Lou. "How to Tell If Someone Is Using Steroids." *Men's Health*. Men's Health, 14 Aug. 2015. Web. 31 July 2017.
- "Steroid Cycles." *AnabolicSteroids.net*. AnabolicSteroids.net, n.d. Web. 31 July 2017.
- Steroid Detection Times." *Steroidal*. N.p., n.d. Web. 31 July 2017.
- "Test ID: TTFB Testosterone, Total, Bioavailable, and Free, Serum." *Mayo Clinic*. Mayo Clinic, n.d. Web. 31 July 2017. "Testosterone." *Lab Tests Online: Empower Your Health. Understand Your Tests. A Public Resource on Clinical Laboratory Testing*. AACC, n.d. Web. 31 July 2017.
- "The Effects of Supraphysiologic Doses of Testosterone on Muscle Size and Strength in Normal Men — NEJM." *New England Journal of Medicine*. New England Journal of Medicine, 4 July 1996. Web. 31 July 2017.
- "What Are Anabolic Steroids?" *NIDA*. NIDA, n.d. Web. 31 July 2017.