How do the chemical compounds within steroids affect the body's performance?

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Abstract

In recent years, the fitness industry has seen a dramatic increase in hormone supplementation as a result of the growth of social media fitness influencers. Although the pursuit of aesthetics and strength has become more prevalent in today's society, the morals and health risks behind supplementation are questionable. Here we review current studies of detrimental health risks as a result of supplementation and various other issues that may arise. Steroids have negative consequences on the balance of hormones in our bodies and our reproductive system.Steroids significantly affect the cardiovascular system, increasing the risk of heart disease by causing blood thickening, influencing cholesterol levels, and promoting the growth of coronary artery disease and atherosclerosis. Despite known health risks, many bodybuilders use steroids for their ability to enhance muscle growth and recovery, driven by the desire for rapid gains in muscle mass and strength. Additionally, Steroid use severely impacts reproductive health, causing lasting hormonal imbalances, hypogonadism, and various reproductive issues, highlighting the need for education on the risks. Furthermore, steroid usage can alter brain structure and function, as seen in experienced male weightlifters who show changes in amygdala size, brain connectivity, and cognitive performance, as well as leading to severe liver damage, indicated by elevated liver enzymes, cholestatic jaundice, liver tumors, and peliosis hepatis, emphasizing the need for regulations and education on steroid misuse. The pursuit of an ideal physique in bodybuilding is often intertwined with the use of performance-enhancing drugs, particularly anabolic steroids, which offer rapid gains but pose significant long-term health risks, such as cardiovascular issues and organ damage. Despite these dangers, many bodybuilders continue to use steroids, highlighting the need for a cultural shift towards prioritizing holistic health and sustainable methods for achieving physical fitness goals.

Introduction

As bodybuilding and the pursuit of physique becomes a staple within our modern day appearance based society, the question of health risks arise as a result of increased physique enhancing drugs. One drug that enhances both physique and performance would be the genre of anabolic androgenic steroids (referred to simply as "steroids" or "anabolic steroids" for the rest of this paper). Generally, anabolic steroids used for bodybuilding are derivatives of the natural hormone testosterone, and work by increasing the production of other naturally occurring hormones that increase muscle growth and recovery. From a historical perspective of steroid use, it first began as a treatment for depression and various physical ailments. However, by the 1950's and 60's the world began to see testosterone gradually spreading towards a more sports oriented area of usage. In 1954, the world weightlifting Olympics saw the first known uses of

synthetic testosterone among Russian athletes. As bodybuilding gradually became more widespread, body dysmorphic disorder (BDD) has also experienced a spike in people who feel their physique is lacking. Especially in our modern age filled with cellphones and social media, it becomes much easier to compare oneself to others and feel inadequate. Common performance enhancing drugs used by bodybuilders are called steroids; which enhance muscle growth and strength at the cost of future health risks. Studies have shown that steroids have had a negative impact on health, including one's lifespan. Steroids are a significant cause for failure in various organs such as the heart, lungs, and the reproductive system.

Methodology:

To investigate the impact of chemical compounds within steroids on aging body performance, a comprehensive research approach will be adopted. First, a thorough literature review will be conducted, encompassing academic papers, medical journals, and relevant studies focusing on the physiological effects of steroids. This review will identify gaps in existing knowledge and inform the development of research questions and hypotheses. Terms used to find literature on PubMed and Google Scholar include [Anabolic Androgenic Steroids, Effects of changes in Testosterone, and Social effects on Steroid Usage.] Proper citation of relevant research studies and sources will be maintained in adherence to academic integrity standards. The study's findings will be synthesized and discussed in light of existing literature, emphasizing the implications for bodybuilders and individuals considering steroid use. Recommendations will be provided, encouraging individuals to weigh the short-term gains against long-term health consequences and seek safer, holistic approaches to achieving their desired physique. This methodology ensures a rigorous and balanced investigation into the complex relationship between steroid compounds and aging body performance.

Effect of Steroids on the Cardiovascular System

Steroids also have a substantial effect on the cardiovascular system and promote heart disease. While anabolic steroids affect numerous areas of the body, one of the organs most at risk through usage of anabolic steroids are the blood vessels at risk of erythrocytosis: an increase in blood cells that causes blood to thicken and move more sluggishly throughout the veins of the body. As a result of thickened blood, hematocrit levels increase up to 44% of the baseline hematocrit. Studies have shown that continued steroid usage will influence the cholesterol levels found within the body. An imbalance in cholesterol levels is found to lead to cases of heart disease in various patients. While erythrocytosis is a notable side effect of anabolic steroids, studies have also shown that steroids can rapidly influence the growth of coronary artery disease and atherosclerosis, which is a thickening or hardening of arteries due to a buildup of plaque found within the inner lining of the artery. Additionally, when this atherosclerosis spreads towards the coronary arteries, it can cause an influx of coronary artery disease leading to potential heart attacks and shortness of breath.

How Steroids Cause Muscle Gain and Testosterone Increase

By increasing the natural production of testosterone and other naturally occurring hormones in the body, steroids effectively speed up growth and recovery. This process occurs by inducing the genetic machinery in muscle cells to synthesize more protein which makes the muscle bigger as a whole. During this process, steroid receptors on the muscles bind with the steroids injected into the site. The cells that receive the steroids will then create larger amounts of myofibril proteins that make those muscle cells larger and stronger as a result. Despite the wealth of studies underscoring the dangers of testosterone supplementation through anabolic steroids, a substantial number of bodybuilders persist in embracing these compounds for their unparalleled ability to enhance muscle protein synthesis and stimulate muscle growth, often disregarding the potential toll on their health. This attests to the allure of rapidly achieving impressive gains in muscle mass and strength, seemingly outweighing the health risks for some individuals in the pursuit of their ideal physique.

Effect of Steroids on Reproductive Health and other Hormones

In addition to the pursuit of physique in bodybuilding, steroids significantly impact reproductive health according to a study on the reproductive system of steroid users. The systematic review and meta-analysis conducted in highlight the significant and lasting impact of anabolic androgenic steroids (AAS) on the reproductive system of athletes and recreational users. AAS use led to profound disruptions in the endocrine system, with considerable reductions in serum gonadotropin (luteinizing hormone and follicle-stimulating hormone) and endogenous testosterone levels during AAS intake. Moreover, these hormonal imbalances persist even after AAS discontinuation, with gonadotropin levels gradually returning to baseline values within 13-24 weeks, while serum testosterone levels remain persistently lower. These findings underscore the prevalence of hypogonadism, among AAS users and its persistent effects on hormone levels, lasting for several weeks to months post-AAS withdrawal. These imbalances lead to negative consequences for the reproductive system. For example, structural and functional changes in sperm, reduced testicular volume, gynecomastia, and, in female athletes, clitoromegaly, menstrual irregularities, and subfertility. Consequently, the study emphasizes the significant and potentially irreversible consequences of AAS use on the reproductive health of athletes and recreational users, underscoring the importance of comprehensive education and awareness programs regarding the associated risks. (Christou et al., 2017) If the potential health risks and numerous disruptions on the body proves too much for the user to handle, steroid users may choose to stop taking those hormones. Possible treatments that can alleviate the negative health effects caused by steroids include

simply stopping the treatment for a year, as a study finds that the reversibility in damage to cholesterol and liver function is high after just a year of stopping previous abusers, even without medication.

Effect of Steroids on Cognitive Health

Another area influenced by the usage of anabolic steroids is the brain and potential cognition abnormalities supplementation may cause. A study on 150 experienced male weightlifters found to be using anabolic steroids was conducted by comparing sizes of the amygdala and visual cortical areas. In summary, a study revealed that individuals using anabolic-androgenic steroids (AAS) had larger right amygdala volumes compared to nonusers, along with reduced connectivity between the right amygdala and various brain regions. Although slight differences were observed in the left amygdala volumes, there were no significant group disparities in connectivity (Kaufman et al., 2015). AAS users also showed lower dACC scyllo-inositol levels and higher glutamine/glutamate ratios, suggesting heightened glutamate turnover. Furthermore, AAS users exhibited poorer performance in a visuospatial cognitive task compared to nonusers, with the difference approaching significance. Additionally, it was found that there was a significant (p value = 0.036) correlation between AAS usage and visuospatial performance with AAS users performing almost an entire standard deviation lower than the normative population scores (Gen Kanayama et al., 2012). Studies also seem to indicate that the damage dealt to cognitive function as a result of steroids is irreversible with permanent effects on visual impairment.

Effect of Steroids on Various Organs

One last area that comes under severe influence as a result of Anabolic Steroid usage is the liver. The widespread use of Anabolic Androgenic Steroids (AAS) among athletes has been implicated in a series of detrimental effects on various organs, notably the liver. A significant consequence associated with the misuse of AAS is the elevation of liver enzymes, indicating liver stress and potential damage. Cholestatic jaundice, a condition characterized by the obstruction of bile flow, can result from the use of anabolic steroids, leading to the characteristic yellowing of the skin and eyes. Furthermore, the development of liver tumors, both benign and malignant, has been linked to long-term AAS abuse, posing a serious health risk to individuals. Peliosis hepatis, another concerning complication, involves the formation of blood-filled cavities within the liver tissue, which can result in severe internal bleeding and further compromise liver function (Neri et al., 2011). These adverse effects underscore the critical need for stringent regulations and education on the potential risks associated with the misuse of anabolic steroids in athletic settings, emphasizing the importance of promoting safer and healthier performance-enhancing practices for athletes.

Conclusion and Discussion

In conclusion, the pursuit of an ideal physique through bodybuilding has become deeply intertwined with the use of performance-enhancing drugs, particularly anabolic steroids. While

these substances offer rapid gains in muscle mass and strength, they also pose significant risks to long-term health. The evidence is clear that the use of steroids can lead to a range of detrimental effects on various organs, including the heart, lungs, and reproductive system. Erythrocytosis, a thickening of the blood due to increased red blood cell production, presents a specific risk to the cardiovascular system. Moreover, the negative impact on lipid profiles and the accelerated development of coronary artery disease and atherosclerosis underline the potential for life-threatening cardiovascular events. Despite the well-documented health risks, a considerable number of bodybuilders continue to prioritize short-term gains over their long-term well-being. This highlights the complex interplay between the allure of achieving an enviable physique and the willingness to overlook potential health consequences.

It is crucial for individuals involved in bodybuilding to weigh these risks against their goals and aspirations, seeking out safer and more sustainable ways to achieve their desired results. Bodybuilders can spend years of their life building a physique naturally, but will still be far outshone in size and strength by a user of steroids with a fraction of the lifting experience the natural lifter has. Overall, it is fairly unrealistic for a natural lifter to reach the heights of an enhanced bodybuilder/powerlifter. As society places a growing emphasis on appearance, fostering a culture that prioritizes holistic health and wellness becomes imperative, encouraging individuals to embrace methods that promote both physical and physiological well-being. Only by recognizing the inherent trade-offs and making informed choices can individuals truly strike a balance between their aesthetic goals and their overall health.

Glossary:

Erythrocytosis - Having a higher concentration of red blood cells than normal
Hematocrit - A measurement that indicates the proportion of red blood cells in a person's blood.
Atherosclerosis - A medical condition in which the arteries of a person become hardened and narrowed due to plaque buildup inside of the arteries.
Testosterone Supplementation - Methods both natural and unnatural used to increase the amount of testosterone in the body, usually for the purpose of bodybuilding or strength training.

Serum Gonadotropin (Luteinizing Hormone and follicle stimulating Hormone) - Refers to the levels of Luteinizing hormone and Follicle Stimulating hormone found in the blood. Produced by the pituitary glands and are regulators of the reproductive system.
Protein Synthesis - Protein Synthesis is the biological process in which cells balance the loss of cellular proteins through the production of new ones.
Anabolic Androgenic Steroids - Synthetic substances that mimic the effects of the male hormone testosterone, usually used in bodybuilding to enhance performance and physicality. Resemble molecules within our bodies with slight differences, which bind to our natural steroid receptors.
Amygdala - The area of the brain controlling emotions, fear, and motivation.
dACC scyllo-inositol - dACC refers to the part of the brain known as the angular cingulate cortex, while scyllo-inositol
Cholestatic Jaundice - A condition in which jaundice occurs due to a blockage of bile flow to the liver.
Peliosis Hepatis - Peliosis hepatis is a vascular condition in which the sinusoids of the liver proliferate, resulting in engorgement of the capillary bed and cavities within the liver.
Myofibril Proteins - The structural and functional proteins that make up myofibrils.
Body Dysmorphic Disorder - A mental health condition where an individual becomes overly obsessed with the perceived flaws or defects of their own physical condition.

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