

Fat-Free Mass Index in Users and NonUsers of Anabolic-Androgenic Steroids – Research Review

August 25, 2009 by [lylemcd](#) - [39 Comments](#)

Title and Abstract

Kouri EM, et. al. Fat-free mass index in users and nonusers of anabolic-androgenic steroids. Clin J Sport Med. (1995) 5(4):223-8.

We calculated fat-free mass index (FFMI) in a sample of 157 male athletes, comprising 83 users of anabolic-androgenic steroids and 74 nonusers. FFMI is defined by the formula (fat-free body mass in kg) x (height in meters)⁻². We then added a slight correction of 6.3 x (1.80 m – height) to normalize these values to the height of a 1.8-m man. The normalized FFMI values of athletes who had not used steroids extended up to a well-defined limit of 25.0. Similarly, a sample of 20 Mr. America winners from the presteroid era (1939-1959), for whom we estimated the normalized FFMI, had a mean FFMI of 25.4. By contrast, the FFMI of many of the steroid users in our sample easily exceeded 25.0, and that of some even exceeded 30. Thus, although these findings must be regarded as preliminary, it appears that FFMI may represent a useful initial measure to screen for possible steroid abuse, especially in athletic, medical, or forensic situations in which individuals may attempt to deny such behavior.

Background

Last Thursday, I published a guest article by Alan Aragon entitled [Supplement Marketing on Steroids](#), which was a scientific and technical analysis of recent claims regarding rates of muscle mass gain and potential maximum size by the website [Testosterone.nation](#). In a different context, this topic was previously covered on this site in the article [What Is my Genetic Muscular Potential?](#)

As expected, this caused quite an uproar as can be seen in the comments section of that article.

Of course, similar discussion has gone on on the T-nation site itself although, I should note that the term 'discussion' is debatable at best. The moderators at T-nation are very censorship heavy, controlling information flow with an iron fist. They ensure that only certain responses will be seen to keep their readers from the truth of their nonsensical claims. My friend Matt Perryman made two posts to his site [AmpedTraining](#) which are worth reading in this regards:

[Monday Morning Censorship Protest Real T-Men Speak Out](#)

[Real T-Men Speak Out Part 2](#)

But I'm getting a bit off topic.

In the article [What Is my Genetic Muscular Potential](#), one of the models presented is that of Casey Butt, who did an analysis of top bodybuilders over many years to develop an equation that predicts maximum potential for muscle growth. There are several assumptions inherent in his model including that the bodybuilders are natural, along with the idea that bodybuilders represent the pinnacle of muscle building potential.

I'd note that Casey's model lined up quite well with the models presented by myself, Alan Aragon and Martin Berkhan. We all approached it from a slightly different direction but, based on our combined experience over the years, all ended up at basically the same place.

But among other gems of argument on T-nation was criticism that Casey's model was inaccurate because it only examined bodybuilders from ages past (another was that athletes with better muscular potential would go into sports that weren't bodybuilding).

That is, that current improvements in nutrition and training will have improved the muscular potential for natural bodybuilders beyond what Casey's analysis shows. Never mind that the three other models presented by myself, Alan and Martin and that includes top natural bodybuilding competitors completely line up with it perfectly as well.

Which brings us to today's paper.

As another piece of background, I assume that readers are familiar with the concept of the Body Mass Index (BMI). BMI gives a relationship of weight to height and is often used to determine things like under-, normal and over-weight. With certain caveats, discussed in [Body Composition Methods Part 1](#) BMI can be a reasonably accurate measure but it suffers from a major problem for athletes: it doesn't distinguish between fat mass and lean body mass.

Towards this goal, researchers have tried to develop what they call a Fat-Free Mass Index (FFMI) conceptually similar to the BMI but a measure of fat free mass (another term for lean body mass) relative to height. Which is what this study looked at...in both users and non-users of steroids. They wanted to see if there were any fundamental differences in the FFMI that either occurred or were achievable between users of steroids and nonusers. Clearly this ties in to the current debate over genetic maximums along with rates of muscle gain.

Just for completeness FFMI is defined as fat free mass / height squared.

Where fat free mass is in kg and height is in meters.

If you want to calculate your current FFMI (for example, to compare it to the values I'm going to discuss below), there is an easy to use online

[FFMI Calculator](#).

The Study

The researchers recruited 156 men, athletes, from gyms in the Boston and Los Angeles area, of those 156 men 134 data points were used. A full physical examination was given including measurements of height, weight and body fat, the latter computed from the sum of 6 skinfold measurements and the Jackson and Pollock equation. A history of previous steroid use was obtained by personal interview along with urine testing. Now we might quibble with this as athletes are known to lie about drug use.

But as the researchers state:

Briefly, no evidence suggested that any athlete had deliberately misrepresented his steroid use, nor did any urine test contradict an athlete's verbal report.

Of course, that still doesn't prove anything, athletes have been beating drug tests for years. But within the context of this paper, that's as good as it's going to

get.

To the above data set of 156 men, an additional 23 men were recruited from a separate study examining the impact of testosterone cypionate, the same measurements were given to them. So of the total 157 individuals (134 from the first group, 23 from the second group), 74 (47%) had never used steroids and 83 (53%) had used steroids. Fifty-two of the subjects had used steroids within the past year.

Adding to the validity of the data set, in the context of Alan's article and this debate, the researchers state (bold added for emphasis) that:

The nonusers included many dedicated bodybuilders. Several had competed successfully in "natural" bodybuilding contests, two held world records in strength events, and many others were recognized by their associates as highly successful weightlifters. Thus the nonuser group probably included individuals who **closely approached the maximum limits of muscularity that could be attained without drugs**

I'm quoting that bit in full so that people can't try to dismiss this in the comments section or on forums by trying to argue that these were recreational lifters or that they didn't train hard: these guys were near the top of the heap in terms of natural competitors.

Results

In any case, with this data set in tow, the researchers calculated the FFMi for both the steroid user and nonuser groups. I've reproduced the results in full in the table below; please note that I added the column for lean body mass which I simply calculated by taking weight in kg by body fat percentage (without the error bars).

Table 1: Characteristics of Steroid Users and Nonusers

	Steroid Users	Nonusers
Height (m)	1.79+ -0.0075	1.80 + -0.074
Weight (kg/pounds)	91.69+ -11.8/210+ -26	82.06+ -13/180+ -28.6
% Body Fat	12.8 + -4.8%	12.5+ -5.5%
Lean Body Mass (kg/pounds)	79.9kg/175 pounds	71kg/158 pounds
FFMI	24.8 + -2.2	21.8+ -1.8

Now, as the results above show, even with steroid use, the users were still considerably lighter on average than even the typical IFBB pro with only 175 pounds of lean body mass. Contest weights in the 200's are common nowadays; of course modern bodybuilders use far more than just anabolic steroids. Growth hormone, IGF-1 and all kinds of ancillaries are in use now.

And, again, look at the nonusers. An average lean body mass of 158 pounds. Of course, that's not taking into account the error bars. Some of the subjects in each group were larger than this and some smaller.

Just for the hell of it, let's see what the absolute best values we can get out of the above are.

I'll assume the heaviest body weight for both the steroid and non-steroid users and the lowest body fat percentage so it's an equal comparison; this calculation will show the absolute biggest guys in both groups in terms of how much lean body mass that they can carry.

All I've done is taken the average weight plus the error bar for weight and average body fat percentage minus the error bar for body fat percentage. I've shown the numbers in the table below.

Table 2: Maximum Lean Body Mass in the Sample Group

	Steroid User	Nonuser
Body Weight	236 pounds	208 pounds
% Body Fat	8% Body Fat	7% Body Fat
Lean Body Mass	219 pounds	193 pounds

Those are the two biggest guys in the sample size, again using the highest body weight and lowest body fat percentage. Notice anything, for example how the values line up if you go back and look at [Supplement Marketing on Steroids](#) or [What Is my Genetic Muscular Potential?](#)

In this MODERN sample of top level bodybuilders using drugs or not, the steroid users are about what Arnold was at his peak (average competition weight of 235). And not a single one of the nonusers exceeds the maximums set by my, Alan, Martin or Casey's model in [What Is my Genetic Muscular Potential](#).

This is despite being world record holders and top level competitors in natural bodybuilding. Presumably they are using every modern nutritional and training trick available. And they still can't break the model's predictions. Not a single one of them.

The researchers concluded, based on this that the upper limits of FFMi in non-steroid users is roughly 25 with an abrupt stopping point; steroid users can surpass this with FFMi values as high as 32 occurring in this study for the largest individual. But for nonusers, 25 is it.

In support of this, the researchers obtained other data, similar to Casey's original analysis. Using data on the Mr. American winners from the years of 1939-1959 (a time when presumably training and nutrition was improving) an estimated FFMi was done. With one or two outliers, none exceeded a FFMi of 25.

My Comments

Now the researchers were using this whole approach to basically try to find a way, more or less, to determine whether or not a given individual was on steroids. Basically, they found through their sample that, without drugs, there is simply a cap on how much fat free mass an individual can carry.

And a FFMi of roughly 25 represents the natural limit. And this value hasn't changed since 1930. Because human genetics haven't changed. And no amount of training or nutrition will EVER change that.

Of course that's not really why I choose to analyze this study. This paper represents a meticulously analyzed modern data set showing that, assertion by T-nation moderators to the contrary, the potential for muscular gain in natural athletes has not gone up or changed due to improvements in training, nutrition or anything else. Claims that 'We have naturals exceeding 230 pounds of lean body mass on our forums' are either delusion, lies, or both. Ok, not exactly.

In that context, it is worth noting a specific comment by the researchers which I will again quote in full:

Fourth, our formula may not be satisfactory for fat individuals. Because a gain in the fat component of the body is consistently accompanied by some gain in the lean component, it is possible that fat individuals might be able to exceed substantially an FFMi of 25 without steroids.

It is amusing to note that, invariably the pictures of T-nation members held up as 'proof' that LBM can go higher than what's in my, Alan, Martin or Casey's models are invariably carrying a tremendous amount of body fat. But the reality is that, dieted down, the loss of connective tissue, etc. that accompanied the

development of their frank obesity would bring them right back down to the numbers predicted by the various models. They wouldn't end up with more than 200 pounds LBM after the two plus years of dieting it would take to get the fat off.

And, while I'm sure this paper will do nothing to quell the claims of the T-nation moderators or the folks who want to believe that they are the lone exception, the evidence and research based facts speak for themselves. Natural limits exist and no amount of magic pills, powders or potions will let you exceed them unless those magic pills are anabolic steroids. That's reality folks, it may not be pretty or sexy but it is true.

Please not that, again, I've turned off moderation for this article to encourage discussion and meaningful debate (in direct contrast to the T-nation approach). Please keep it civil and I will be keeping an eye for outright trolling or what have you.

Comments

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