Observations on serum androgen response to short term resistive training in middle age sedentary males

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While serum androgen concentration is known to rise in response to intense exercise (7, 21), training effects on resting androgen level are largely unknown. ABBO (1) and Lamb (11) suggest that training may increase androgen concentration. However, Stromme, Meen and Aakvaag (21) report that eight weeks of weight training did not significantly affect resting serum testosterone concentration in young men. Young and Ismail (26) suggest that aerobic training may bring about slight increases in resting testosterone levels in older men with low testosterone and low fitness levels but not in older men with high resting testosterone and high fitness levels.

Androgens have been associated with protein anabolism, spermatogenesis, and a number of psychosocial aspects including aggressiveness and libido (17, 20, 21, 23, 24, 25, 26). Furthermore, some relationship between androgens and cardiovascular disease (CVD) may exist (6, 13, 14, 15). Recent research suggests that CVD may be associated with low testosterone and high estrogen levels. Studies of androgen response to training may contribute to the understanding of a variety of psychological and physiological phenomena. The purpose of this study was to observe the short term effects (12 wks) of resistive training on serum testosterone in middle age sedentary men. This study represents additional information and data relating to a previous study reported in the **NSCA Journal** (19).

Materials and methods

The subjects were obtained from a group of volunteers consisting of faculty and staff at Louisiana State University. Their average age was 42 yrs. $\pm$ 12. Fourteen subjects made up the experimental group (G_1) and trained with resistive exercises for 12 weeks. Nine of the volunteers had been previously participating in jogging programs (about 10 km/wk) and agreed not to alter their workload (training load) for the duration of the experiment (G_2). A sedentary control group (G_3) consisted of eight subjects who maintained their normal life style.

The weight training schedule is reported elsewhere (19). The subjects (G_1) trained three days per week (at noon) and progressed at their own rate. Methods of measuring strength, body composition, and cardiovascular fitness are reported elsewhere (19). Each of these variables were measured at the beginning (T_1), at six weeks (T_2), and after 12 weeks (T_3).

Serum testosterone concentrations were determined by radioimmunoassay (RIA) (18). Testosterone antibody was obtained from Radioassay Systems Laboratories (Carson, California). Blood was drawn from the antecubital vein and placed in heparinized tubes. They were kept chilled for no longer than two hours. The blood was centrifuged at 3000 rpms for 30 min., and the plasma was withdrawn for RIA. Blood was drawn on August 25, 28, and 31 (T_1), on October 19 and 21 (T_2), and on November 30 and December 1 (T_3). Blood was collected between 7:00 and 8:30 A.M. after a 12 hour fast. The (duplicates) plasma concentrations of testosterone were averaged for each testing period giving a three-day mean for T_1, a two-day mean for T_2, and a two-day mean for T_3.

Data analysis

The data were analyzed using a Group X trials ANOVA. Differences between groups, across time, were found with the Orthogonal Contrast Method. Correlations between variables were done with the Pearson Product Moment Method. The alpha level was set at $P \leq 0.01$.

Results

The results of the changes in strength, body composition, serum lipids, and

cardiovascular fitness are reported elsewhere (19). No significant correlations were found between testosterone and any other variable. The changes in testosterone are shown in **Figure 1**; all measures were within normal ranges (4, 12, 16). Group 1 showed a significant increase, P = 0.0004. Group 2 (sedentary) showed near significance P = 0.03. No significant change was found for G_3 (runners). No other significant differences were found.

Discussion

It has been generally assumed that androgen level is related to muscle mass (8, 20, 22, 24, 25). This assumption has largely been based on the effects of castration of immature and mature male animals (9, 10), androgen replacement therapy (3, 27), and androgen and muscle mass differences between males and females. As previously reported (19), G_1 (weight-training) realized a significant increase in lean body mass (LBM) and a significant decrease in % fat. The lack of significant relationships between testosterone and body composition do not necessarily preclude the assumption that testosterone levels are related (or other variables such as serum lipids). It is possible that post exercise surges of androgens observed after very intense exercise (7, 22) may produce some type of long term effect resulting in body composition changes, especially if the exercise is repeated at regular intervals.

Exercise and training may also a) induce alterations in cellular uptake of testosterone (11) and/or b) cause changes in the conversion rate of testosterone to dihydrotestosterone or estrogen. Frey *et al.* (6) have observed increased total estrogen levels in middle-aged men after aerobic training with a concomitant decrease in testosterone. Recent research suggests that testosterone and HDL-C are positively related to each other and inversely related to triglyceride in males (13, 14). In this study no significant relationships were realized in any group, although HDL-C did show an increase in G_1 (19).

While all measures of testosterone were within normal ranges, it has been shown that cyclical variations, perhaps seasonal, occur in normal males (4, 16). The results of this study suggest that G_1 and G_2 may have been experiencing a normal cyclical (seasonal?) variation in testosterone, G_1 realizing a somewhat higher peak (**Figure 1**). It is doubtful that the responses of G_1 and G_2 represent biological difference. The testosterone levels of G_3 (aerobic training) did not show the increases seen in the other two groups. It is possible that G_3's response represents a suppression of a normal cyclical variation of testosterone levels. The suppression of testosterone levels by aerobic training is supported by animal (2, 5) and human (6) studies.

Summary

Within the confines of the experimental design of this study, the results suggest that aerobic training may suppress testosterone concentrations in normal middle-aged men. The mechanism of this change is unknown. •

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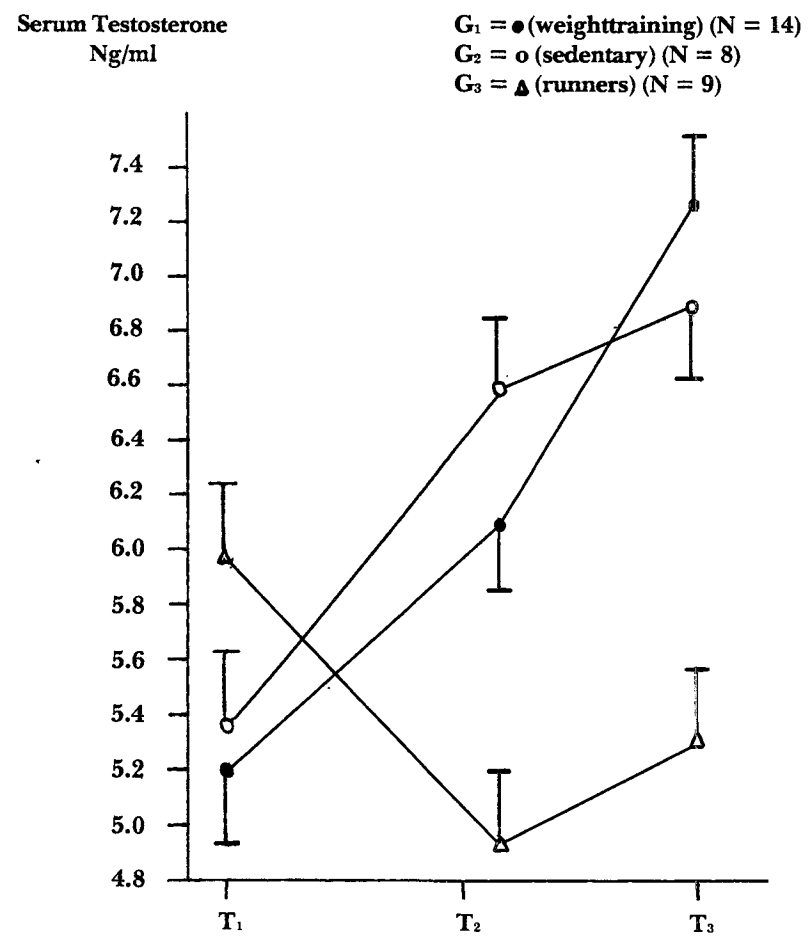

Figure 1: Serum Testosterone (means + SE) Orthogonal contrast shows a significant increase for G_1 (P = 0.0004).

Blood Pressure

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Serum Androgen Response

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Yessis:

1. Specific differentiation of running technique in the sprints through all of the running events. Soviet and all foreign research indicates a major difference in running technique in all events. But, yet, most U.S. research says that all running styles are the same; which is it?

2. Modeling of "ideal" running technique in relation to specialized strength and power training programs.

3. The exact role of the muscles in the entire running stride, i.e., which muscles are used when and how and what is the intensity of their contractions in relation to specific technique? With this information, we can develop more specialized exercises for individual runners.

Brittenham:

I would like to see the following questions addressed:

What part does blocking play in sprinting?

Would unlocking the arms from 160° to 180° both in front and back create more force to create a longer stride?

What would need to be done to run with a 10' stride?

Are speed and quickness the same thing? •

Androgen

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