Chronic Low Testosterone Levels in Endurance Trained Men: The Exercise-Hypogonadal Male Condition

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Introduction

Sportsmen and women who participate in endurance events perform a tremendous amount of exercise training [1]. For instance, it is not uncommon for a marathon or ultra-distance runner to perform 150 to 200 kilometers of intensive running per week as part of their regular training. Chronic exercise training to this extent results in positive physiological adaptations that are highly advantageous to the human body. For example, there is an enhancement of the maximal cardiac stroke volume, maximal cardiac output, maximal arterial-venous oxygen differential, increased erythrocyte number, decreased levels of stored adiposity and increased skeletal muscle mitochondrial density [1,2]. Such physiological changes result in an increased human performance capacity. Yet exercise training to this extent can also place an incredible amount of stress and strain on the athlete’s body and result in unwanted physiological responses and health problems. Some of the common unwanted consequences of high volume training include development of the “Overtraining Syndrome” condition, which can completely compromise the ability of an athlete to perform, or lead to musculo-skeletal trauma and injury (i.e., “pulled muscles”) [3].

One of the body’s physiological systems that is extremely sensitive to the stress of exercise training is the endocrine system. This is particularly true for the components of the endocrine system associated with the control and regulation of reproductive function. Over the last several decades, an increasing number of research studies have pointed to how chronic exposure to endurance exercise training results in the development of endocrine dysfunction, which may subsequently compromise normal reproductive processes [4,5]. The majority of the research on this topic has concentrated upon women athletes [4]; that is, specifically the study of “athletic amenorrhea” and the “Female Athlete Triad”. Researchers, however, have recently begun to address the question of how exercise training affects the reproductive endocrine system in men too. Unfortunately, the number of findings on this latter topic is still relatively sparse as compared to the number of women-based studies, but initial insights revealed that similarities exist for the effect of exercise on aspects of the reproductive system within the genders.

Research studies on men show the existence of a select group who, through their exposure to chronic endurance exercise training, have developed alterations in their reproductive hormonal profile - principally, low resting testosterone levels. The majority of these men display clinically “normal” levels of testosterone, but the levels are at the very low end of normal, and in some cases reach a sub-clinical status (i.e., “testosterone deficiency”). Such hormonal changes may result in diminished bone mineral content and spermatogenesis, as well as male infertility problems. The prevalence of the problems seems low (~15 to 25% of men doing chronic endurance training), but as noted the research studies examining this condition and its consequences are few in the literature. Hence, more research is needed, especially prospective studies as most information is based upon cross-sectional research designs [1,3].

The terminology to refer to these endurance-trained men with low resting testosterone had not been universally standardized, but in 2005 researchers from our laboratory group proposed the use of the phrase the “exercise-hypogonadal male” as a name to refer to this condition [6]. This is the terminology we and other investigators have chosen to use in our research discussions on the topic [5-8]. Men with this condition have certain characteristics and traits in common. These are summarized in Table 1.

The exact physiological mechanism(s) responsible for the reduction of testosterone is currently unclear, but is postulated to be a dysfunction or disruption within the hypothalamic-pituitary-testicular regulatory axis conceivably related to energy availability as is seen in women with the Female Athlete Triad [4]. It may also perhaps reflect a lowering of the set-point (i.e., readjustment) of the axis for what is deemed a necessary minimal amount of circulating testosterone for proper physiological function (i.e., endurance athletes have reduced amounts of muscle mass compared to many other athletes). The time course for the development of the exercise-hypogonadal male condition (EHMC) or the threshold of exercise training necessary to induce the condition remains unresolved, but preliminary evidence from our laboratory group suggest an extended window of time (i.e., years) may be necessary for its development. Much further scientific work, however, is necessary to address these latter points so exact mechanisms and timelines can be elucidated [8].

The potential exists for the reduced testosterone within these exercise-hypogonadal men to disrupt some anabolic or androgenic testosterone-dependent physiological processes such as muscle enzymatic or contractile protein synthesis. Unfortunately, a very limited number of studies have addressed whether such processes are affected, and thus findings are currently inconclusive on this issue. Conversely, the alterations in testosterone levels brought about by endurance training could have positive body composition effects (i.e., reduction in unnecessary muscle mass and overall body mass) and thus be beneficial to the physical performance of these men.

It is recommended that clinicians and researchers be mindful of the fact that patients or research study subjects who have extensive endurance exercise training backgrounds may have potential alterations in their resting testosterone and display EHMC. Thus, standard clinical reference norms and ranges for the hormonal assessment of testosterone may not be entirely appropriate for this population; although healthcare providers should make their own
I Low resting basal testosterone levels, typically only 50-75% that of normal, healthy, age-matched sedentary men.

II Low testosterone levels do not appear to be a transient phenomenon related to the acute stress of exercise training.

III In many cases, it appears an adjustment in the regulatory axis has occurred (to allow a new lower set-point for circulating testosterone). That is, gonadotropins also display lower compensatory levels (5).

IV A history of early involvement in organized sport and exercise training exist. This has resulted in these men having many years of almost daily exposure to physical activity.

V The type of exercise training most frequently seen in these men is prolonged, endurance-based activities such as: distance running, cycling, race walking, and the triathlon training.

Table 1: The table contains the common characteristics and traits of men displaying the “Exercise-Hypogonadal Male Condition” (EHMC) [8].

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decisions on this issue. Ultimately, additional research is needed in this area as chronic low testosterone has critical implications for fertility and bone health in exercising men [9].

References