

Exercise and libido in healthy men

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Abstract : The effect of exercise on the psychological aspect as libido (sexual desire) in healthy men is not examined as much as the evidence of physiological sexual functional changes after exercise. In this review in order to elucidate the relationship between libido and exercise, we introduce sexual desire, sex hormone, methods to clarify and measure libido, effects of aerobic exercise and anaerobic exercise on libido, and effects of exercise on sex hormone. Sexual desire is difficult to define so that it is explained in many ways. Testosterone is male sex hormone and is produced by hypothalamic-pituitary-gonadal axis activation. Male athletes under high intensity and high volume aerobic training show the symptom called “Exercise Hypogonadal Male Condition”. In this condition, testosterone, luteinizing hormone and libido decrease. On the other hand, anaerobic exercise has not been examined to elucidate libido change in healthy men. Testosterone secretion increases after acute aerobic and anaerobic exercise. Chronic fatigue because of high volume and intensity aerobic training leads to decrease testosterone concentration base line. Testosterone administration to supra physiological level used as doping by bodybuilders increases sexual desire and activity. It seems difficult to increase libido by exercise and too much aerobic exercise can decrease libido in normal man.

Key words : sexual desire, testosterone, exercise

キーワード : 性欲, 運動, テストステロン

I Introduction

It is well known that female athletes who have been doing high intensity and volume training have more risk for irregular menstruation and infertility. Sometimes, those athletes fall into the situation called athletic amenorrhea¹⁾. This seem to be because of mal function of hypothalamic-pituitary-gonadal axis. On the other hand, male athletes under high intensity and high volume training also shows the symptom "exercise hypogonadal male condition" (EHMC). In this condition testosterone and luteinizing hormone secretions decrease. As just described, physiological and biochemical changes of sexual functions during and after exercise are well documented. Exercises are often recommended to men with aging, hypogonadal, obese, hypertension, and metabolic syndrome, who have problems of penal functions and sexual desire. However, is libido affected by exercise in healthy men?

The effect of exercise on the psychological aspect as libido (sexual desire) is not examined as much as the evidence of physical sexual functions change. In this review in order to elucidate the relationship of libido and exercise in healthy men, we introduce sex hormone, the methods to clarify libido, effects of aerobic exercise and anaerobic exercise on libido, and effects of exercise on sex hormone.

II Sexual desire

It is difficult to define sexual desire since it is a complex component²⁾. And sexual desire is explained in various ways as follows. It is the sensations that motivate individuals to initiate or be receptive to sexual stimulation³⁾. It is "a psychological state subjectively experienced by the individual as an awareness that he or she wants or wishes to attain a (presumably pleasurable) sexual goal that is currently unattainable"⁴⁾. It is the "sum of the forces that lean us toward and away from sexual behavior"⁵⁾. It is the motivation to participate in sexual activity⁶⁾, whether with or without a partner⁷⁾, triggered by both internal and external stimulation⁸⁾. It is an "interest in sexual activity, which can be measured by amount and strength of thought directed toward sexual stimuli"⁹⁾.

III Sex hormones

Sex hormones are the hormones responsible for the sexual characteristics of men and women. Testosterone is the male hormone, and progesterone and estrogen are the female hormones. Testosterone influences masculinization, such as body hair and larynx, muscle hypertrophy and strength development, and the development of reproductive organs such as the prostate and testes. Testosterone is produced from cholesterol primarily in the testes. It is a compound whose basic structure is a steroid skeleton consisting of three five-membered rings and one six-membered ring. This structure allows it to pass through the cell membrane without the need for receptors

or channels. It binds to receptors in the cytoplasm and migrates into the nucleus where it binds to DNA as a transcription factor. It also binds to membrane androgen receptors and rapidly activates the lower cascades. The signaling stimulates transcription of target genes and translation of proteins.

The amount of testosterone synthesis is regulated by the hypothalamus-pituitary-gonadal (testes) axis. When testosterone levels are low, the hypothalamus releases gonadotropin-releasing hormone, which stimulates the pituitary gland to release follicle stimulating hormone and luteinizing hormone. These two hormones stimulate the testes to synthesize testosterone.

Moderate exercise increases testosterone and progesterone secretion. However, women who engage in high-intensity exercise training may exhibit "exercise amenorrhea," especially due to hypothalamic-pituitary-gonadal disturbances¹⁰⁾. Men who exercise at too high intensity or volume may develop a condition called "exercise hypogonadal male condition" (EHMC). Men under EHMC can not produce testosterone as much as healthy men. EHMC is thought to be caused by the combined effects of volume and intensity of endurance exercise training which leads to low testosterone concentration¹¹⁾.

IV Survey Methods of Sexual Desire Questionnaire

Sexual desire is defined variously. But in practice, some kinds of questionnaires are often used to investigate the effects of sports on sexual desire. The Androgen Deficiency in Aging Males (ADSM) and The Aging Males' Symptoms questionnaire (AMS) are representative questionnaires of sexual desire. Both are related to male menopausal symptoms. However, these have been applied to sportsmen¹²⁾. For example, the ADSM asks questions such as "Do you have a decrease in libido (sex drive)?" In the AMS, the questions are dealing about Decrease in ability/frequency to perform sexually, Decrease in the number of morning erections, and Decrease in sexual desire/libido on a 5-point scale of none, mild, moderate, severe, and extremely severe. Thus, psychological factors such as desire and libido and physical factors such as erection and sex are surveyed, scored, and evaluated.

The Measurement of a Person's Habitual Physical Activity is also used as a physical activity survey, since the amount of physical activity may influence sexual desire and sex life¹²⁾. This scores the amount of activity related to work, sports, and leisure time based on frequency, duration, and intensity. This would be specific to the individual, taking into account both genetic and lifestyle factors including nutrition, stress, sleep, training experience, job-related duties, etc.

Leam-Q is used to investigate low energy availability by fatigue from sports and exercises. Because it can be the cause for the decreased libido in which state is called Relative Energy Deficiency in Sports (RED-S). For sex

drive, the questions are as follows Your sex drive can be a marker of the balance between exercise, rest and recovery. a) I would describe my general sex drive as: high, moderate, low, sex is not that interesting b) My sex drive in the last month has been: stronger than usual, as usual, a little less than usual, a lot less than usual. For physical aspects, it is common to have an erection when you wake up in the morning. a) Over the last month you have experienced this: 5-7 times per week, 3-4 times per week, 1-2 per week, rarely/almost b) Compared to what you consider normal for you, this is: more often than usual, about the same often, a little less often than usual, a lot less often than usual

The Sexual desire inventory (SDI)¹²⁾ consists of 14 items that measure two dimensions: (i) dyadic sexual desire (items 1-9), and (ii) solitary sexual desire (items 10-13). Here, desire means interest in and wish for sexual activity. For examples of sexual desire question, during this last month, how often would you have liked to engage in sexual activity with a partner (for example, touching each other's genitals, giving or receiving oral stimulation, intercourse, etc.)? And for solitary sexual desire question, how strong is your desire to engage in sexual behavior by yourself? The 14th item refers to the length of time that the subject can feel comfortable without having sexual activity of any kind. Subject answer the degree out of eight or nine depending question.

The Psychological Excitement Scale² (SES 2)¹³⁾ is a measure of the degree to which one seeks or tolerates, as opposed to avoids, imaginary or audiovisual sexual stimulation. Lower scores indicate a higher tolerance of sexual stimulation or a higher degree of psychological arousal. Higher scores suggest avoidance or rejection of such stimulation. There are three subscales: IS (interpersonal sexual attraction), EE (exposure to erotic imagery), and AE (arousal by erotic imagery).

The Sexual Motivation Scale³ (SES 3)¹³⁾ refers to sexual interaction with one's usual partner. This scale examines the degree of sexual response experienced, including the practical frequency and preference for intercourse, the occurrence and frequency of specific emotional responses in foreplay, copulation, and orgasm, and the degree of reproduction of sexual sensations. The subscales are EP (enjoyment potential of sexual interaction), FI (preferred frequency of intercourse), OE (frequency of orgasm during intercourse and its evaluation), SI (sexual inhibition), and LF (length of foreplay). Specific questions were also asked about the frequency of morning erections and erectile dysfunction during intercourse.

International Index of Erectile Function (IIEF) Questionnaire deals with the erectile function, satisfaction with intercourse, orgasmic function, sexual desire, overall sexual satisfaction, and erectile function by 15 questions. In this context, sexual desire is defined as a feeling that may include wanting to have a sexual experience (for example masturbation or sexual intercourse), thinking about having sex, or feeling frustrated due to lack of sex. IIEF quantifies and evaluates the score of the answers

from 5 choices.

In addition, IIEF-5 is composed of 5 questions especially about erectile function¹⁴⁾. The questions are as follows, how do you rate your confidence that you could get and keep an erection? When you had erections with sexual stimulation, how often were your erections hard enough for penetration? During sexual intercourse, how often were you able to maintain your erection after you had penetrated (entered) your partner? During sexual intercourse, how difficult was it to maintain your erection to completion of intercourse? When you attempted sexual intercourse, how often was it satisfactory for you? The subjects respond with the degree from 1 to 5.

It should be considered that those data of questionnaires depend on the honesty of the participants.

V Aerobic exercise on libido in men

We introduce the study which examined the effects of aerobic exercise (running, swimming, and biking) on sexual desire through a questionnaire survey¹²⁾. The subjects were 1077 North American males aged 18 years and older who regularly engage in endurance exercise.

The questionnaire items were divided into three main categories: 1. gender (cultural differences) and history, 2. exercise, and 3. sexual desire. The items related to exercise are as follows frequency (days/week), amount (hours), and intensity, competition experience of marathon, swimming, or bicycling, years of training and continuity, and purpose of training. Items related to sexual desire included frequency of sexual activity, arousal, desire, sexual fantasies, fulfillment, and intimacy needs and infertility issues (azoospermia, impotence, etc.). The libido-related questions were based on items within the Androgen Deficiency in the Aging Male Questionnaire, the Sexual Desire Inventory 2, and the Aging Males' Symptoms Scale. Each question was evaluated and scored. The results of the survey categorized the examinees into low, middle, and high for each item. The results showed that the higher the frequency, duration, and intensity of endurance training, the lower the sex drive. Furthermore, subjects with intermediate or low frequency, duration, and intensity tended to have higher libido than those with high frequency, duration, and intensity, even when age was taken into account. High in intensity, as inferred from this questionnaire, refers to a maximal oxygen uptake of 70% or more. The high frequency was 7 times or more per week, and the high duration was 10 hours or more per week. The results of the questionnaire revealed that there is a negative correlation between frequency, duration, and intensity of exercise and sexual desire (Fig-1-A,B,C). However, this study did not examine why strenuous exercise decreases libido.

The research group further figured out that endurance training for a standard marathon had a more influence on male libido than more generalized endurance training¹⁵⁾. Men who were conducting marathon-specific training

had lower libido scores than those who were not engaged in marathon training. Also the factors most associated negatively with the libido score were the number of years in training (duration of exposure), and the proportion of high-intensity effort (low vs. moderate vs high exertion) at which that training was performed (Fig.1-D).

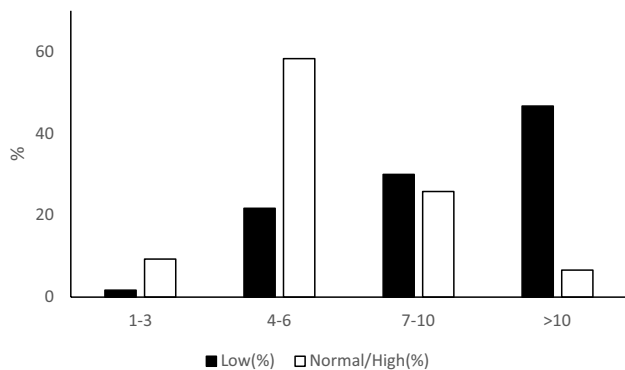


Fig. 1-A

Frequency exercise per week and libido score group. As the frequency increases, the percentage of low libido score group increases.

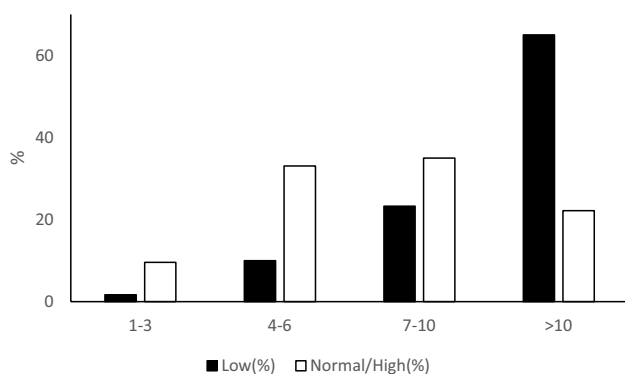


Fig. 1-B

Hours of exercise per week and libido score group. As the hours of exercise increases, the percentage of low libido score group increases.

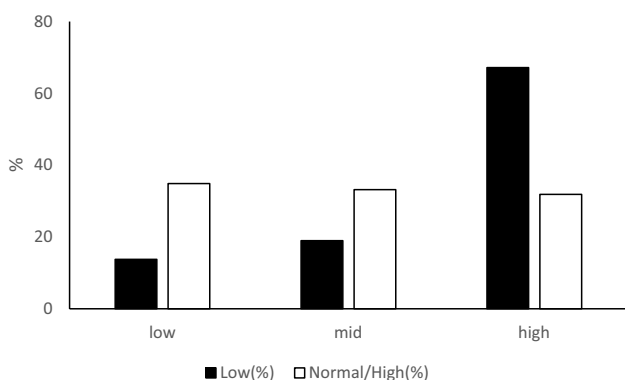


Fig. 1-C

Total intensity session hours per week and libido score group. As the intensity session hours increases, the percentage of low libido group increases.

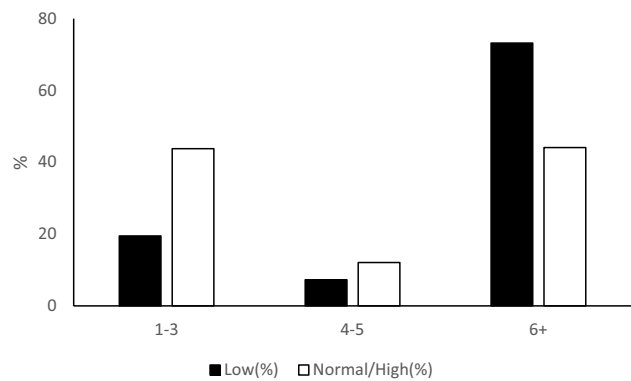


Fig. 1-D

Number of marathons completed and libido score group. In all figures statistically significant association with libido groups (low vs normal/high). Based on the data from Hackney et al., 2017¹²⁾ and 2022¹⁵⁾.

VI Anaerobic exercise on libido in men

A typical example of anaerobic exercise that is often handled is resistance training. Although it is known that resistance training increases testosterone levels in healthy, disease-free men, the relationship between weight training and sexual desire in healthy men has not been well investigated.

VII Aerobic and anerobic exercise on testosterone in men

Since testosterone is the most potent naturally secreted anabolic and androgenic steroid hormone and induces muscle growth and neuromuscular adaptation, the change of its concentration after exercise is well studied. Furthermore, testosterone could administer the fertility and the production of sperm and is also thought to enhance libido. Yet, the change of libido related to testosterone after exercise in healthy eugonadal men has not been examined.

This research was done to investigate the acute response of testosterone after endurance exercise¹⁶⁾. 12 healthy male volunteers were recruited for this study. Serum testosterone was evaluated before and after a 30-min sub-maximal exercise on cycle ergometer at individual anaerobic threshold (IAT) and a maximal exercise (Max) until exhaustion. Blood samples were collected before exercise (30, 15 min and immediately before), immediately after and at different time points during recovery (after 15, 30 and 60 min) for hormones assays. Testosterone acutely increased in all volunteers after both exercises for 60 minutes (Fig.2.-A).

In athletes who are under aerobic endurance training, the testosterone concentration was significantly lower than in sedentary untrained men in resting state¹⁷⁾. The subjects who were under endurance training for more than 5 years and sedentary followed similar diets and kept from sexual activities for 36 hours before the experiment. The blood

were sampled every 60 minutes for 4 hours to elucidate the minor change of the concentration during the day. The concentration was lower in the trained subjects, which was 68% of untrained group. And there was no significant changes over time for each group.

The response of testosterone to weight training has been extensively studied¹⁸⁾. It is known that baseline concentrations of testosterone in resting muscle and blood are virtually unchanged, and that testosterone concentrations in muscle and blood increase significantly in the 30 minutes following the end of training¹⁹⁾ (Fig.2.-B).

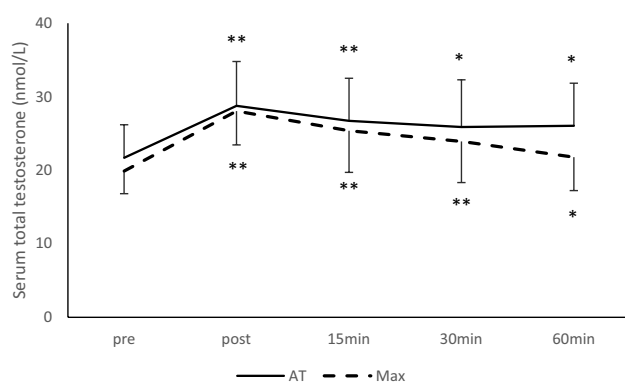


Fig. 2-A

Serum testosterone concentrations after a sub-maximal individual anaerobic threshold (IAT) and a maximal exercise test until exhaustion (Max) on cycle ergometer. * $p < 0.05$, ** $p < 0.01$ vs. respective pre. Based on the data from Sgro et al., 2014¹⁶⁾.

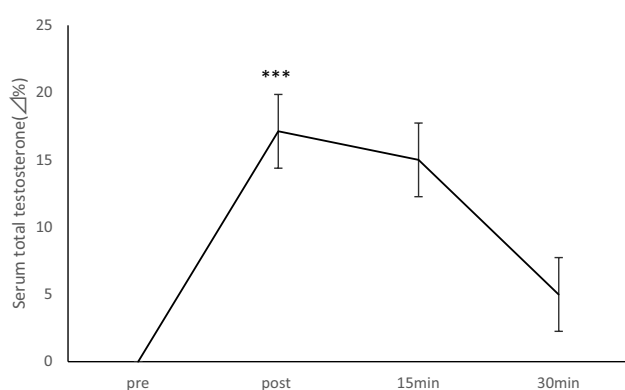


Fig. 2-B

Relative changes in serum testosterone concentrations after the heavy resistance exercise. *** $p < 0.001$ vs. pre. Based on the data from Ahtiainen et al., 2010¹⁹⁾

The magnitude of this acute response is thought to be influenced by many factors, including training protocol, nutritional intake, and training experience. With regard to training regimens, testosterone concentrations appear to increase in training that uses large muscle groups as squats, deadlifts, and Olympic lifts with high volume, from moderate to high intensity, and short intervals between sets.

VIII Effects of testosterone administration on libido in healthy eugonadal men

The effects of testosterone administration above physiological levels on sexual behavior in normal men were examined in some research. One of them was in a single-blind, placebo-controlled group of 31 healthy men aged 21-41 years, 200 mg of testosterone enanthate (TE) by weekly intramuscular injection for 8 weeks (Testosterone Only group), and the other group received weekly placebo injections for the first 4 weeks and weekly TE 200 mg for the following 4 weeks (Placebo/Testosterone group). Testosterone administration resulted in an 80% increase in plasma testosterone trough levels and peak testosterone levels 400-500% above baseline; at the end of each 4-week period, various aspects of sexuality were assessed using the Sexual Experience Scale (SES) questionnaire, and sexual activity was recorded in a daily logbook and self-rating scale were used to record the results. Both groups showed significant increases in Psychosexual Stimulation Scale (i.e., SES 2) scores on the SES after testosterone treatment, but not placebo. There was no change in SES 3, which measures aspects of sexual interaction with a partner. Both groups showed no change in frequency of sexual intercourse, masturbation, penile erection upon waking, or reported mood. In the placebo/testosterone group, self-reported interest in sexual intercourse increased during testosterone treatment, but not with placebo; the results of SES 2 suggest that sexual awareness and arousal are enhanced by testosterone beyond physiological levels. However, these changes are not reflected in changes in overt sexual behavior and may be more determined by sexual relationship factors in healthy men with normal testosterone levels. This is in contrast to hypogonadal men in whom testosterone replacement apparently stimulates sexual behavior. It is concluded that testosterone above physiological levels maintained for up to 2 months can promote some aspects of sexual arousal without stimulating sexual activity in healthy men within stable heterosexual relationships or, either with a partner or as masturbation, but a significant increase in a measure of sexual interest independent of sexual interaction with the partner¹³⁾.

Further studies of the effects of increasing circulating testosterone above a normal baseline by means of exogenous testosterone administration follows. Bagatell et al. (1994b), in eugonadal normal men, found no effects of 200mg/week administration of testosterone on frequency of sexual activity²⁰⁾. There was a trend toward increased arousal and spontaneous erections during testosterone administration, but this did not show statistical significance. Yates et al. (1999) reported that increasing testosterone into three groups from 100, 200 to 500mg per week, which is a dose of five times the normal physiologic level of testosterone, did not enhance daily measures of sexual interest²¹⁾. Subjects completed a diary including counts for all episodes of sexual orgasm. They also rated

their perceived interest in sexual activity on a daily basis. This measure was rated on a 100-mm visual analog scale with one end anchored at zero and identified as “no sexual thoughts” and the other end anchored at 100 and identified as “the most sexual thoughts I have ever had”. It is also apparent that, in adult eugonadal men, the level of testosterone in the blood circulation was substantially higher than required to maintain sexual arousability, suggesting that other effects of testosterone, most probably in the periphery tissues, may require higher levels than were needed in the central nervous system in order to increase physical sexual functions.

In addition, 231 bodybuilders who take anabolic steroids were measured for demographics and with IIEF-5¹⁴⁾. The majority administered weekly doses of more than 600 mg per week ranged from 75–1,550 mg/week. Increasing use of testosterone was associated with higher rates of preserved erectile function in men currently using doping. Furthermore, bodybuilders who are currently doping testosterone have more frequent sexual intercourse than natural or former dopers²²⁾. The structured clinical interview was administered by a certified nurse. The interview estimated the frequency of sexual behaviors including coitus, masturbation, morning erections, and number of sexual thoughts and the quality of sexual experience. Also those testosterone users reported a greater total number of orgasms from both coitus and masturbation than did controls and past users (Fig.3).

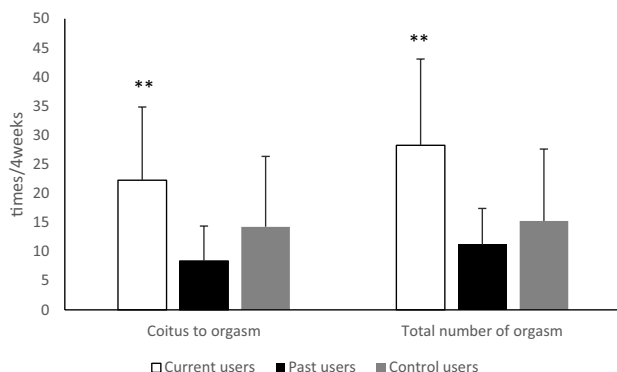


Fig. 3

Frequency of sexual activities between anabolic steroid users, past users and natural body builders. Current users showed higher frequency in coitus to orgasm and total number of orgasm in 4 weeks.

**p<0.01 Based on the data from Moss et al., 1993²²⁾

Testosterone dopers in this experiment self-administered doses of testosterone that are typically from 10 to 100 times more than those prescribed in standard medical protocol for hypogonadism. From the data it can support that anabolic steroids, if administered with supra-physiological dose, can enhance sexual desire.

IX Conclusion

We have looked at exercise and sex drive via sex hormones in healthy men. It appears that endurance aerobic training that fatigues to the point of low energy state decreases sex drive. Anaerobic training like resistance exercise do not have evidence to increase libido. Eugonadal men are not affected sexually by testosterone administration with clinical level. However, testosterone administration to supra-physiological level can increase libido as doping in power athletes and bodybuilders, but when administration is stopped, libido decreases.

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