Effect of Physical Exercise on Levels of Sex Hormones in Smoker Students

Samra S. J. Fernands and Noor S. Al-Taee

Department of Biology, Faculty of Science and Health, Koya University, Kurdistan Region – Iraq

***Abstract*—Smoking has multiple effects on sex hormones, some of which are associated with important clinical implications. This research included a study of the effect of exercise on the male hormones among smoker students. The study included 60 students of physical education students and medical microbiology students; their ages were between 18 and 25 years. The students were divided into two groups (30 students/group). The first group (non-athletes group) was divided into two subgroups: Smokers and non-smokers. The second group (athletes group) was also divided into two subgroups: Smokers and non-smokers. The result shows no significant difference ($P > 0.05$) in the level of luteinizing hormone, follicle-stimulating hormone, and testosterone hormones between non-athletes smokers and athletes smokers.**

***Index Terms*–Cigarette smoking, Male hormones, Physical exercise, Young smokers.**

I. Introduction

According to the World Health Organization (2002), approximately one-third of the world's male adult population (above 15 years of age) smoke. The combustion of tobacco yields about 4000 chemical compounds, some of which are deadly toxic. Given that, cigarette smoke contains more than 30 compounds known to be mutagens or carcinogens such as "radioactive polonium, benzo(a)pyrine, dimethylbenz(a) anthracene, dimethylnitrosamine, naphthalene, and methylnaphthalene" which have a direct deleterious effects on human embryos and female and male germ cells are probable [1].

Other chemical compounds in tobacco include nicotine and its metabolite cotinine which may lead to poor semen function and resultant infertility [2]. Cigarette smoke also contains carbon monoxide which may affect male reproduction through direct effect on the testicular function and spermatogenesis; this mechanism may involve the hormonal control of spermatogenesis or through direct effect on the germ cells and Sertoli cells of the seminiferous epithelium. Such alterations may lead to infertility and/or production of mutated spermatozoa which may subsequently cause an adverse pregnancy outcome if the mutated spermatozoa were to fertilize an egg [3]. In males, cigarette smoking is associated with reduced libido, premature ejaculation, erectile dysfunction, and impotence [4]. Destruction of sperm cells, decreased sperm motility, and relative infertility are also consequences of tobacco use, smoking being the most predisposing risk factor [5].

It is believed also that smoking affects some male reproductive hormones such as luteinizing hormone (LH), follicle-stimulating hormone (FSH), prolactin, and testosterone. Controversial, however, is the actual effect of smoking on these hormones. While some authors report that smoking increase serum testosterone levels [6], others have reported that testosterone levels unaffected [7]; while another group reported that serum testosterone levels in smokers was decrease [8]. Bakheet and Amarshad [9] and Mitra, *et al*. [10] have reported increased serum levels of LH and FSH in the studies on smokers, whereas Pasqualotto, *et al*. [11] reported no significant differences in levels of FSH, LH, and total testosterone in smokers. The effect of long-term, moderate-intensity, aerobic exercise on hormone levels in men has not been well studied, yet it may be important to differentiate between the acute and chronic effects of exercise, as acute changes may relate more to muscle growth and tissue remodeling, whereas chronic changes may mediate exercise effects on long-term health [12,13]. Some cross-sectional studies conducted in middle-aged and older men indicate that circulating testosterone concentrations may be higher in men who regularly exercise [14,15]. Prospective, nonrandomized studies of resistance exercise over a few weeks either increased testosterone [16] or not [17], whereas one study of daily aerobic exercises together with a low-fat diet increased SHBG, which could counteract the biological activity of testosterone [18]. To our knowledge, no randomized clinical trials have been published which have tested the chronic effects of aerobic exercise on a comprehensive panel of sex hormones in middle-aged to older men. Thus, there is no consensus regarding the physiologic role of long-term exercise to alter hormone levels in men and, in turn, impact age-related diseases.

The aim of this study is to evaluate the effects of physical exercise on the LH, FSH, and testosterone levels in healthy men smokers.

Pure and Applied Science Conference | Koya University
Paper ID: ICPAS2018.BPH81, 3 pages
DOI: 10.14500/icpas2018.bph81
Received 12 March 2018; Accepted 29 April 2018
Conference paper: Published 01 August 2018
Conference track: Biotechnology and Physiology (BPH)
Corresponding author's, e-mail: samra.samir@koyauniversity.org

II. Materials and Methods

Sixty blood samples collected from physical education healthy students and students of Medical Department of Microbiology, Faculty of Science and Health, Koya University-Iraq's Kurdistan region, at aged 18–25 years and with good health. Samples divided into two main groups as follows:

- First group (non-athletes group) - 30 students were divided into two subgroups: 15 smokers and 15 non-smokers.
- Second group (athletes group) - 30 students were divided into two subgroups: 15 smokers and 15 non-smokers.

A. Sample Collection

5 ml venous blood sample was collected from smokers and nonsmokers and putted in plain tube. Blood samples left for a while without anticoagulant to allow blood to clot. Then, serum samples were obtained by centrifugation at room temperature at 3000 rpm/10 min and stored frozen at −20°C until a hormonal analysis.

B. Estimation of Hormones

The concentration of testosterone, LH, and FSH was measured in the blood serum using the Mini VIDAS device with kit ready-analysis of these hormones by following the instructions supplied with the kit for hormones.

C. Statistical Analysis

Data were subjected to analysis of version using SPSS program. The hormone values between smokers and non-smokers and athletes and non- athletes were compared using unpaired *t*-test. $P < 0.05$ was considered as statistically significance [19].

III. Results and Discussion

The direct toxic effect of environmental toxins presents in cigarette smoking which contains a lot of known toxins that may have detrimental effects on fertility in both sexes [20]. Some of chemicals in cigarette's smoke generate a large number of free radicals, which may be related to etiology of cancer and various diseases [6].

In non-athletes smokers have low levels of LH, FSH and testosterone hormones ($P > 0.05$) in compared with non-athletes non-smokers (Table I). These results are similar with these studies [6,21]. While inconsistent with [22] that observed a significantly high in the level of LH and FSH, and a significantly low testosterone hormones.

The reason for this may be that nicotine increases the concentration of 6β-hydroxylase, an enzyme responsible for the metabolism of plasma testosterone into excretory metabolites which leads to a decrease in circulating test levels [22]. The results also showed no significantly low in the level of LH, FSH, and testosterone hormones ($P > 0.05$) in athlete smokers compared with athlete non-smokers (Table II).

This contradiction was frequently encountered in literature among different population and may be related to different lifestyle and environment. Furthermore, the number of smoked cigarettes/day and duration of smoking had no significant effect on hormonal profile.

In conclusion, cigarette smoking affects fertility by its main negative impact on semen parameters rather than hormonal profile at least in our patients.

The results showed high in the level of LH and testosterone hormones and low in the level of FSH hormones ($P > 0.05$) in non-smokers athletes compared with non-smokers non-athletes (Table III).

While In smokers athletes compared with smokers non-athletes (Table IV), the results showed high in the level of LH and testosterone hormones and low in the level of FSH hormones ($P > 0.05$).

These results are similar with this study [23] which found no significantly difference in the level of testosterone hormones between athletes and non-Athletes.

When measured after a short-term, acute bout of exercise, testosterone levels typically increase transiently, though this finding is not universal [24]. In some studies, elevations in free testosterone, bioavailable testosterone, SHBG, and

Table I Effect of Smoking on Male Hormones in Non-athlete's Students

Parameters	Non-athlete non -smokers (*n*=15) Mean±SD	Non-athletes smokers (*n*=15) Mean±SD
LH (mIU/ml)	6.38±2.39	5.08±1.84
FSH (mIU/ml)	4.09±1.18	3.44±1.50
Testosterone (ng/ml)	6.43±2.39	4.30±2.03

*Significant, **High significant. LH: Luteinizing hormone, FSH: Follicle-stimulating hormone, SD: Standard deviation

Table II Effect of Smoking on Male Hormones in Athlete's Students

Parameters	Athletes non-smokers (*n*=15) Mean±SD	Athletes smokers (*n*=15) Mean±SD
LH (mIU/ml)	7.99±1.92	6.52±1.05
FSH (mIU/ml)	3.07±1.69	2.44±0.96
Testosterone (ng/ml)	7.13±2.66	5.81±1.78

Significant, **High significant. LH: Luteinizing hormone, FSH: Follicle-stimulating hormone, SD: Standard deviation

Table III Effect of Sport Exercise on Male Hormones in Non-smoker's Students

Parameters	Non-smokers non-athletes (*n*=15) Mean±SD	Non-smokers athletes (*n*=15) Mean±SD
LH (mIU/ml)	6.38±2.39	7.99±1.92
FSH (mIU/ml)	4.09±1.18	3.07±1.69
Testosterone (ng/ml)	6.43±2.39	7.13±2.66

Significant, **High significant. LH: Luteinizing hormone, FSH: Follicle-stimulating hormone, SD: Standard deviation

Table IV Effect of Sport Exercise on Male Hormones in Smoker's Students

Parameters	Non-athletes smokers *n*=15(Mean±SD)	Athletes smokers *n*=15(Mean±SD)
LH (mIU/ml)	5.08±1.84	6.52±1.05
FSH (mIU/ml)	3.44±1.50	2.44±0.96
Testosterone (ng/ml)	4.30±2.03	5.81±1.79

Significant, **High significant. LH: Luteinizing hormone, FSH: Follicle-stimulating hormone, SD: Standard deviation

DOI: http://dx.doi.org/10.14500/icpas2018

other androgens such as dehydroepiandrosterone have also been observed, but the hormone changes are variable and may depend on the exercise paradigm (resistance vs. aerobic), the exercise intensity, and/or the study population (young vs. older men) [25-27]. When testosterone levels are compared cross-sectionaly between middle-aged and older men who have engaged in long-term exercise versus those who have not, testosterone levels are higher among regular exercisers [14,15], with similar findings for SHBG [28]. However, among highly trained endurance athletes, testosterone levels have also been found to be lower than. However, among highly trained endurance athletes, testosterone levels have also been found to be lower, introducing the possibility of exercise-related sex hormone dysfunction [29].

References

[1] M. T. Zenzes, "Smoking and reproduction: Gene damage to human gametes and embryos," *Human Reproduction*, vol. 6, pp. 122-131, 2000.

[2] M. Arabi and B. Shareghi, "Anti-fertility effect of nicotine," *Zhonghua Nan Ke Xue*, vol. 11, no. 5, pp. 323-330, 2005.

[3] J. P. Hanrahan, C. B. Sherman, E. A. Bresnitzf, K. M. Emmons and D. M. Manion, "Cigarette smoking and health," *American Journal of Respiratory and Critical Care Medicine,* vol. 153, pp. 861-865, 1996.

[4] R. C. Okoye, *Preventing Infertility and Early Sexual Weakness in Men.* Nigeria: Save a Life Foundation Publications, 2005.

[5] V. M. Brugh and L. I. Lipshultz, "Male factor infertility: Evaluation and management," *Medical Clinics of North America,* vol. 88, no. 2, pp. 367-378, 2004.

[6] K. M. English, P. J. Pugh, H. Parry, N. E. Scutt, K. S. Channer and T. H. Jones, "Effect of cigarette smoking on levels of bioavailable testosterone in healthy men," *Clinical Science*, vol. 100, pp. 661-665, 2001.

[7] G. Halmenschlager, S. Rosetto, G. M. Lara and E. L. Rhoden, "Evaluation of the effects of cigarette smoking on testosterone levels in adult men," *The Journal of Sexual Medicine*, vol. 6, no. 6, pp. 1743-1772.2009

[8] T. Funabashi and F. Kimura, "Nicotine inhibits pulsatile luteinizing hormone secretion in males," *The Journal of Clinical Endocrinology and Metabolism*, vol. 90, pp. 3908-3913, 2005.

[9] M. S. Bakheet and H. A. Almarshad, "Improving effect of zinc supplementation on pituitary gonadotrophins secretion in smokers," *African Journal of Pharmacy and Pharmacology,* vol. 8, no. 3, pp. 81-86, 2014.

[10] A. Mitra, B. Chakraborty, D. Mukopadhay, M. Pal, S. Mukherjee, S. Banerjee and K. Chaudhuri, "Effect of smoking on semen quality, FSH, testosterone level and CAG repeat length in androgen receptor gene of infertile men in an Indian city," *Systems Biology in Reproductive Medicine*, vol. 58, no. 5, pp. 255-262, 2012.

[11] F. F. Pasqualotto, B. P. Sobreiro, J. Hallak, E. B. Pasqualotto and A. M. Lucon, "Cigarette smoking is related to a decrease in semen volume in a population of fertile men," *BJU International,* vol. 97, no. 2, pp. 324-326, 2006.

[12] K. L. Herbst and S. Bhasin, "Testosterone action on skeletal muscle," *Current Opinion in Clinical Nutrition and Metabolic Care*, vol. 7, no. 3, pp. 271-277, 2004.

[13] W. J. Kraemer and N. A. Ratamess, "Hormonal responses and adaptations to resistance exercise and training," *Sports Medicine,* vol. 35, no. 4, pp. 339-361, 2005.

[14] Z. Ari, N. Kutlu, B. S. Uyanik, F. Taneli, G. Buyukyazi and T. Tavli, "Serum testosterone, growth hormone, and insulin-like growth factor-1 levels, mental reaction time, and maximal aerobic exercise in sedentary and long-term physically trained elderly males," *International Journal of Neuroscience*, vol. 114, no. 5, pp. 623-637, 2004.

[15] M. Muller, I. den Tonkelaar, J. H. Thijssen, D. E. Grobbee and Y. T. van der Schouw, "Endogenous sex hormones in men aged 40-80 years," *European Journal of Endocrinology,* vol. 149, no. 6, pp. 583-589, 2003.

[16] J. Sallinen, I. Hoglund, M. Engstrom, J. Lehtimäki, R. Virtanen and J. Sirviö, "Pharmacological characterization and CNS effects of a novel highly selective alpha2C-adrenoceptor antagonist JP-1302," *British Journal of Pharmacology,* vol. 150, no. 4, pp. 391-402, 2007.

[17] M. Izquierdo, K. Hakkinen, J. Ibanez, M. Garrues, A. Antón, A. Zúñiga, J. L. Larrión and E. M. Gorostiaga, "Effects of strength training on muscle power and serum hormones in middle-aged and older men," *Journal of Applied Physiology,* vol. 90, no. 4, pp. 1497-507, 2001.

[18] C. N. Tymchuk, S. B. Tessler, W. J. Aronson, R. J. Barnard, "Effects of diet and exercise on insulin, sex hormone-binding globulin, and prostate-specific antigen," *Nutrition and Cancer*, vol. 31, no. 2, pp. 127-131, 1998.

[19] B. Rosner, *Fundamentals of Biostatistics,* 5th ed. Pacific Grove, CA: Duxbury Press, 2000.

[20] J. Svartberg, M. Midtby, K. H. Bonaa, J. Sundsfjord, R. M. Joakimsen and R. Jorde, "The association of age, lifestyle factors and chronic disease with testosterone in men: The tromso study," *European Journal of Endocrinology*, vol. 149, pp. 145-152, 2003.

[21] L. H. A. Al-Azzawy, "The impact of cigarette smoking on levels of sex hormones and zinc in blood of smokers," *IBN Al-Haitham Journal for Pure and Applied Science,* vol. 24, no. 2, pp. 6-12, 2011.

[22] I. E. Bassey, O. E, Essien, R. M. Gali, "The effect of smoking on fertility hormones in male adult smokers in south-south Nigeria," *British Journal of Medicine and Medical Research*, vol. 9, no. 7, pp. 1-6, 2015.

[23] V. N. Hawkins, K. Foster-Schubert, J. Chubak, B. Sorensen, C. M. Ulrich, F. Z. Stancyzk, S. Plymate, J. Stanford, E. White, J. D. Potter and A. McTiernan, "Effect of exercise on serum sex hormones in men: A 12-month randomized clinical trial," *Medicine and Science in Sports and Exercise,* vol. 40, no. 2, pp. 223-233, 2008.

[24] D. S. Willoughby and L. Taylor, "Effects of sequential bouts of resistance exercise on androgen receptor expression," *Medicine and Science in Sports and Exercise,* vol. 36, no. 9, pp. 1499-506, 2004.

[25] M. S. Tremblay, J. L. Copeland and W. Van Helder, "Effect of training status and exercise mode on endogenous steroid hormones in men," *Journal of Applied Physiology,* vol. 96, no. 2, pp. 531-539, 2004.

[26] J. R. Baker, M. G. Bemben, M. A. Anderson and D. A. Bemben, "Effects of age on testosterone responses to resistance exercise and musculoskeletal variables in men," *The Journal of Strength & Conditioning Research*, vol. 20, no. 4, pp. 874-881, 2006.

[27] I. Smilios, T. Pilianidis, M. Karamouzis, A. Parlavantzas and S. P. Tokmakidis, "Hormonal responses after a strength endurance resistance exercise protocol in young and elderly males," *International Journal of Sports Medicine*, vol. 28, no. 5, pp. 401-406, 2007.

[28] C. S. Cooper, D. R. Taaffe, D. Guido, E. Packer, L. Holloway and R. Marcus, "Relationship of chronic endurance exercise to the somatotropic and sex hormone status of older men," *European Journal of Endocrinology*, vol. 138, no. 5, pp. 517-523, 1998.

[29] A. C. Hackney, "Endurance exercise training and reproductive endocrine dysfunction in men: Alterations in the hypothalamic-pituitary-testicular axis," *Current Pharmaceutical Design,* vol. 7, no. 4, pp. 261-273, 2001.

DOI: http://dx.doi.org/10.14500/icpas2018