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Role of Life Style Factors in Male Reproductive Functions: A Review

Amrit Kaur Bansal[1]* and Ranjna S Cheema[2]

[1]Department of Zoology, Mata Ganga Khalsa College for Girls, Manji Sahib, Kottan, Ludhiana-141402, Punjab, India
[2]Department of Veterinary Gynaecology and Obstetrics, GADVASU, Ludhiana, Punjab, India

*Corresponding author: bansal2amrit@gmail.com

ABSTRACT

The prevalence of male and female infertility is being increased in many nations and has emerged as a serious problem. Many life style factors and occupational exposures can have substantial effects on fertility problems. Life style factors such as smoking, illicit drug (cocaine, cannabis),alcohol and caffeine consumption, exposure to extreme heat etc. have negative effects on functions of male reproductive system. In recent years, increase in disorders of male reproductive system may be associated at least some extent with these factors; which are enhanced by some of new emergent life style habits. A detailed study is required based on the data i.e., excess use of mobile phones and impact of mental stress on male reproductive health. This review highlights the role of various life style factors, environmental stresses and occupational exposures in male reproductive functions and their negative feedback in declining semen quality, increased oxidative stress as well as sperm DNA damages in male.

Keywords: Life style factors, male infertility, sperm

A male infertility factor is correlated with abnormal semen parameters (Ilacqua *et al.* 2018) at least in 50 % of involuntary childless couples. There are many factors which influence male infertility such as environmental and/ or occupational factors which deteriorates the quality of semen and spermatozoa (Jurewicz *et al.* 2014; Knez 2013; Bonde 2013; Sharma 2013).

Infertility problems in a population has important demographic and health implications (Aflatoonian *et al.* 2009). The prevalence of infertility disorders are reported more in developing countries than in developed ones because of shortage of resources for investigation and treatment of such problems in the former (Ahmed *et al.* 2012). Many life style factors which we adopt in our daily life can be altered in order to increase the welfare. It is observed that these factors are under our own will/control and they play an important role in assessing our reproductive health. These factors may include age of paternity, nutrients, physical exercise and obesity. Thus, they can impact the sperm membranes, semen parameters, DNA damages, oxidative stress caused by reactive oxygen species (ROS, Sharma *et al.* 2013).

The present article highlights the available evidences regarding the potential effects of life style factors, environmental issues and occupational stresses on male reproductive health. Life style factors which are associated with male infertility problems are smoking, alcohol intake, recreational drugs, obesity, psychological stress, occupational exposure and diet. Other factors such as exercise, electromagnetic radiations from mobile phones, acupuncture, mind body practices and air pollution are briefly touched upon.

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Smoking

Cigarette smoke contains highly toxic and carcinogenic nitrosoamines [e.g., 4-(Methyl nitrosoamino) -1-(3-pyridine) -1 butanone and N-nitrosonornicotine], polycyclic aromatic hydrocarbons (e.g., benzo(a) pyrene) as well as cadmium (Sobinoff *et al.* 2014). Offspring bear genetic defects due to paternal smoking. It is caused by epigenetic modification transferred through spermatozoa. Jenkin *et al.* (2017) observed that a decline in germ cell population, an increase in germ cell DNA damages and many defects in spermatozoa of male offspring are observed, if female gets continuously expose to cigarette smoke during gestation and weaning period. Maternal smoking during pregnancy and lactation period also adversely affect the fertility of male fetus. (Sobinoff *et al.* 2014). A decrease is reported in the percentage of total sperm count, viable and morphologically normal spermatozoa of mal fetus due to maternal smoking. Smoking lead to increase in ROS in the sperm plasma membranes, which lead to oxidative stress and causes oxidative damages in spermatozoa (Naseem *et al.* 2012). It is recommended that smoking should be ceased by couples who are trying to conceive (Durairajanayagam, 2017).

Alcohol

It has been reported that alcohol has substantial effects on semen volume and sperm morphology (Li *et al.* 2011). With the increase in doses of alcohol, harmful effects on sperm motility and morphology are seen (Muthusami and Chinnaswamy, 2005). Alcohol appears to interfere with the production of GnRH, FSH, LH and testosterone as well as impair the function of Leydig cell and Sertoli cells. As a result production, morphological development and maturation of spermatozoa could be impaired (Emanuele and Emanuele, 1998). In comparison to non-drinkers, a partial or complete spermatogenic arrest and Sertoli cell syndrome was observed in heavy drinkers (Pajarinen and Karhunen, 1994). With the increase in intake of heavy doses of alcohol, spermatogenesis gradually decline; severe oligozoospermia and obstructive azoospermia was observed in men (Zhang *et al.* 2012). Chronic alcohol intake was found to have detrimental effects on both semen quality and level of male reproductive hormones (Muthusami and Chinnaswamy, 2005). Heavy chronic alcohol intoxication led to teratospermia, oligoasthenoteratospermia, cryptozoospermia and ultimately azoospermia in men (Martini *et al.* 2004).

RECREATIONAL DRUGS

Marijuana

Cocaine, anabolic–androgenic steroid (AAS), opiates (narcotics) and methamphetamines are example of illicit drug that exert a negative impact on male fertility (Fronezak *et al.* 2012). Regular intake of marijuana decreases the sperm concentration amongst young men and adversely affect the total sperm count if use along with other recreational drugs (Gundersen *et al.* 2015). Long term cocaine uses are associated with lower sperm concentration and motility and a high fraction of sperm with abnormal morphology (Bracken *et al.* 1990).

Obesity

Decrease in sperm motility and a greater risk of infertility problems are observed in overweight and obese men. Overweight of men increase higher percentage of sperm with DNA fragmentation, abnormal morphology and low mitochondrial membrane potential (MMP), all these lead to male infertility problems (Campbell *et al.* 2015). Sperm with high DNA fragmentation and low MMP are associated with high level of ROS (Lobascio *et al.* 2015). According to analysis, it is observed that obese men are more likely to be oligozoospermic or azoospermic as compared to men with a normal weight range (Sermondade *et al.* 2013). Excess of white adipose tissue in obese men cause increased

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conversion of testosterone to oestrogen, and affects hypothalamic gonadal axis (HPG) leading to reduction in gonadotropin release. These effects result in secondary hypogonadism and impaired spermatogenesis (Palmer *et al.* 2012). Men with basal metabolic rate (BMI) over 25 showed a significant decline in normal motile spermatozoa (Durairajanayagam *et al.* 2015).

It has been observed that elevated rates of oligospermia or azoospermia, and decreased ejaculate volume, sperm concentration(10^6/ml) and total sperm count are associated with obesity. But gradual weight loss through exercise and a progressive decrease in caloric intake led to improvement of sperm parameters. It is recommended that by good diet and exercise, chances of male factor infertility can be declined (Kahn and Brannigan, 2017).

Psychological stress

Psychological stress has detrimental effects on male reproductive potential. Stressed men have decreased level of testosterone, but increased level of LH and FSH hormones in comparison to normal men (Bhongade *et al.* 2015). It is observed that in healthy volunteers during stressful pre-examination period, oxidative stress level and SOD activity increased, whereas, sperm concentration and motility decreased in normal stressed period. However, catalase activity remained unchanged both in normal and/or stressed period. Psychological stress is correlated with reduced paternity and abnormal semen parameters, which is one of the causes of male infertility (Damayanthi, 2018). Stress activates the hypothalamus – pituitary –adrenal (HPA) axis. Both HPA axis and gonadotropin inhibiting hormone exert an inhibitory effect on HPG axis and testicular Leydig cells. The resulting inhibition of HPG axis reduces testosterone level. This lead to changes in sertoli cells and blood testes barrier, which ultimately causes spermatogenesis to be suppressed (Nargund, 2015).

Occupational exposure

Various types of anomalies like alteration in viscosity, liquefaction capacity, sperm count , sperm motility and proportion of sperm with normal morphology etc. are seen in males who are exposed at work to hydrocarbons like toluene, benzene and xylene (Ten *et al.* 2018).. Occupation in which workers are exposed to heat such as welding may reduce the quality and quantity of semen and sperm count. Men in agricultural fields /industries who are exposed to pesticides have damaging negatively affected reproduction (Queiroz and Waissmann, 2016). Oligospermia, and declined motility are observed in men who work in agricultural fields and greenhouse, where pesticide spray is common. Workers who are exposed to lead (in battery producing factories) have negative impact on reproductive capability and morphological abnormal spermatozoa (asthenozoospermia and teratospermia) (Queiroz and Waissmann, 2006).

Diet and exercise

Nutrition play significant role in semen quality. It has been observed that intake of healthy balanced diet could improve semen quality and fecundity rates amongst males (Salas-Huetos *et al.* 2017). Male showed good quality in semen parameters that take omega 3 fatty acids, antioxidants and vitamins and low saturated and trans- fatty acids. Processed red meat with fish has a positive impact on sperm count and morphology (Salas-Huetos *et al.* 2017). Vegetables, fruits, fish poultry and cereals rich diet is positively correlated with semen quality; whereas diet rich in coffee, sugar and sweetened beverages is associated with poor semen quality and lower fecundity rates. Men who consume three cups of tea daily have decreased fertility (Salas-Huetos *et al.* 2017). A diet rich in foliate, fiber, lycopene, fruits and vegetables correlates with improved semen quality. Antioxidants play important role by quenching ROS. ROS are a collection of free radical and non-radical

derivate of oxygen such as superoxide anion ($^{-}O_2$), hydrogen peroxide (H_2O_2), hydroxyl radical (.OH) (Damayanthi, 2018). Both long term exercise and resistant in exercise have deleterious effects on semen parameters and level of testosterone (Safarinejad *et al.* 2009).

Electronic devices/radiations

Long term exposure of laptop has negative impact on sperm parameters (Sheynkin *et al.* 2005).Cell phones have an adverse effect on male fertility due to decreased semen quality with parallel of daily exposure to cell phones. Use of cell phone decrease the percentage of live spermatozoa. Exposure to various kinds of radiations can have lasting effects in humans. Radiations that are in the form of X rays and gamma rays can be devastating to sensitive cells of human body (Wdowiak *et al.* 2007).

Acupuncture

Acupuncture is an adjunctive therapy used with or without electrical stimulation and in combination with herbal medicine for male infertility. In one study, it is observed that improvement in total sperm count but no significant change in motility or morphology and decline of semen volume are seen with acupuncture (Cakbak *et al.* 2008).

Mind body practices

In few studies, it is noted that mind body practices such as yoga, meditation etc. improve the fertility potential of men. Yoga focus on gentle stretching, exercise for breath control and meditation. Yoga reduces anxiety and optimizing erectile functions (Sengupta *et al.* 2013).

Air pollutions

Abnormal sperm morphology, decreased motility and increased chances of DNA fragmentation are observed in men who are highly exposed to air pollution. Sperm concentration and amount of ozone to which a man is exposed is negatively correlated to each other (Sokol *et al.* 2006).

Other life-style factors (Damayanthi, 2017)

- Heat stress increases the risk of male factor infertility.
- Prolonged hours of sitting exposure to radiant heat, varicoceles and cryptorchidism can lead to testicular heat stress.
- Elevated scrotal temperature lead to spermatogenic arrest, germ cells apoptosis, oxidative stress and sperm DNA damage.
- Intense cycling training for 16 weeks in young healthy male road cyclist lead to increase in seminal ROS and malondialdehyde levels along with a decrease in enzymatic antioxidants and total antioxidant capacity.
- Sleep disturbance have adverse effects on male fertility as well as semen volume. Constant use of electronic device also contributes to poor sleep.

Increase in reproductive disorder in male may be correlated at least in part with these factors, which are further added by some of new emergent life styles. Life style factors such as obesity, tobacco smoking or chewing, alcohol and some illicit drugs like cannabis, cocaine, etc and extreme heat, have harmful effects on male reproduction, Further the data on other factors such as use of mobile phone and stress on reproductive health is also accumulated in recent decade. Some “negative lifestyle factors” may be contributing to the growing trends in male infertility. Occupational /environmental exposure to some of the organic solvents, pesticides and ionizing radiations, extreme heat, stress etc. may be associated with declining semen quality.

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CONCLUSION

There may not be conclusive evidence for the entire lifestyle, occupational and environmental factors discussed above but adopting healthy lifestyle and prevention of the usage of reproductive toxicants may be beneficial at least in part in prevention of infertility as well in pregnancy outcome. Sub-fertile and/or even normal individuals have some control over their reproductive function by adopting healthy lifestyles.

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