

Effect of Smoking and Alcohol Consumption on Reproductive Hormones and Semen Parameters in Male Partners of Infertile Couples

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ABSTRACT

Introduction: Nearly 15% couples trying to conceive are affected by infertility, and male infertility affects nearly 50% of these. Majority of the men have no apparent reason for infertility. Tobacco smoking and alcohol intake are avoidable factors which may affect male fertility. This study aimed to evaluate the impact of tobacco smoking and alcohol consumption on serum follicle stimulating hormone (FSH) and testosterone levels and on semen microscopy parameters in male partners of infertile couples.

Material and Methods: This cross sectional descriptive study, included male partners of couples presenting with infertility at a rural tertiary teaching hospital. Exposure to risk factors was recorded. Serum FSH and testosterone levels and semen microscopy for sperm concentration, progressive motility and morphology were evaluated.

Results: In the 98 subjects, mean FSH levels, testosterone levels, sperm concentration and sperm progressive motility were significantly lower in smokers ($P=0.001, 0.002, 0.005, 0.003$ respectively). Same parameters were significantly lower in alcoholics ($P<0.001$). Smokers had significantly higher odds of abnormal testosterone levels. Alcohol consumers had significantly higher odds of low FSH levels, abnormal testosterone levels, oligozoospermia and asthenozoospermia.

Conclusions: Smoking and alcoholism may be significant contributors to male infertility. More efforts to inform the youth about effects of smoking and alcoholism on fertility are required.

Keywords: Alcoholism, Cigarette Smoking, Follicle Stimulating Hormone, Male Infertility, Semen Quality, Testosterone

have no apparent reason for it. Lifestyle and environmental factors, like dietary habits, obesity, tobacco smoking, alcohol consumption, drug abuse and exposure to environmental toxins have been implicated to affect reproductive health of men.⁵ Studies suggest that tobacco smoking and alcohol intake are acquired and avoidable lifestyle factors which may impact male fertility.⁵⁻⁸

There is no data available on the effect of smoking and alcohol consumption on semen parameters and the sex hormones, which ultimately play a major role on the fertility, among the rural population of India. This study was thus aimed to evaluate the impact of these factors on serum follicle stimulating hormone (FSH) and testosterone levels and on the semen microscopy parameters in male partners of infertile couples living in the rural parts of Uttar Pradesh, India.

MATERIAL AND METHODS

This cross sectional descriptive study was conducted at a tertiary care rural medical college and hospital in Uttar Pradesh, India. An approval was obtained from the institutional ethics committee.

All male partners of couples presenting to the Obstetrics and Gynecology Out – Patient Department with impaired fertility during the study period of March 2017 to July 2018 were enrolled in the study. Men with known complaints of hydrocoele, varicocele or undescended testes; positive history of surgical intervention of the genitourinary tract; positive treatment history with drugs like cancer chemotherapy, nitrofurantoin, niridazole, colchicine or any hormonal preparation which may directly suppress

INTRODUCTION

Infertility is defined as the inability to achieve pregnancy after 12 months of regular, unprotected intercourse. Infertility affects approximately 15% of couples trying to conceive.¹⁻³ Male infertility, which is the cause in nearly 50% of infertile couples, refers to a male's inability to result in pregnancy in a fertile female. "Male factor" infertility is infertility which is consequent to abnormalities in sperm concentration, motility or morphology. The abnormalities in the semen parameters may occur singly or in combination. Semen quality parameters are thus used as markers of male fertility. Men with semen parameters below the normal values described by the World Health Organization (WHO) are considered to have male factor infertility.⁴

Though some men may have a specific disorder causing infertility, a major proportion of men found to have infertility

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spermatogenesis; currently on antioxidant medication or supplementation; and, history of acute febrile illness in the previous 1 month were excluded from the study. Men who smoked tobacco as well as consumed alcohol and those who previously used to smoke tobacco or consume alcohol but now had stopped for more than 6 months were also excluded from the study.

A written informed consent was obtained from all the subjects and their demographic and clinical details were recorded in separate record sheets. A detailed history of the alcohol consumption and tobacco smoking was also recorded on the record sheets.

Semen was obtained by masturbation technique after at least 3 days of sexual abstinence. Samples were collected into sterile containers and examined within 30 minutes of liquefaction according to WHO guidelines.⁴ Semen analysis included sperm concentration (million/mL), total sperm motility (%), sperm progressive motility (%) and sperm normal morphology (%) on microscopic examination.

Same day morning blood samples from the respective patients were obtained in plain vials and the samples were processed according to standard protocols. The FSH and Testosterone levels in serum were estimated by chemiluminescent microparticle immunoassay (CMIA) using commercially

available kits. FSH levels (mIU/mL) of <2, 2 – 15 and >15 were considered as low, normal and high respectively. Testosterone levels (ng/dL) of <3.5, 3.5 – 10 and >10 were considered as low, normal and high respectively.

Statistical Methodology: Statistical analysis was performed using IBM SPSS software (Version 22.0). All quantitative data was expressed as mean \pm standard deviation. Qualitative data was expressed as proportions or percentage. Comparison of categorical variables between groups was done using Chi – square test or Fischer’s exact test as applicable. ANOVA was performed for comparison of more than 2 quantitative groups. The odds ratio was also calculated to assess the probability of various outcomes in the different risk factor groups. A P value < 0.05 was considered statistically significant.

RESULTS

A total of 98 subjects were included in this study. The mean age of all the patients was 31.66 ± 5.37 years. 42 (42.9%) were smokers and the rest were non smokers. 34 (34.7%) consumed alcohol and the rest were non alcoholics. Sixteen (16.3%) subjects had oligozoospermia, 34 (34.7%) had asthenozoospermia and none of the patients had teratozoospermia.

Parameter	Smokers (n=42)	Non smokers (n=56)	P value
Age (years)	31.6 ± 5.67	31.71 ± 5.19	0.921
FSH levels (mIU/mL)	4.26 ± 3.01	6.16 ± 2.56	0.001
Testosterone levels (ng/dL)	3.98 ± 2.94	5.72 ± 2.47	0.002
Sperm concentration (million/mL)	30.86 ± 18.6	45.73 ± 29.72	0.005
Sperm progressive motility (%)	33.45 ± 15.1	45.18 ± 21.74	0.003
Sperm normal morphology (%)	23.9 ± 13.9	24.8 ± 10.56	0.717

Table-1: Clinical, biochemical and semen analysis parameters of the study population grouped according to the status of tobacco smoking (Values in Mean + SD).

Abnormality	Odds Ratio	Confidence Intervals
Abnormal Testosterone levels	3.31	1.42 – 7.72
Oligozoospermia	0.77	0.25 – 2.31
Asthenozoospermia	1.87	0.81 – 4.35

Table-2: Risk of developing hormonal and semen abnormalities among smokers.

Parameter	Alcoholics (n=34)	Non alcoholics (n=64)	P value
Age (years)	30.68 ± 5.93	32.19 ± 5.02	0.187
FSH levels (mIU/mL)	2.91 ± 1.64	6.64 ± 2.58	<0.001
Testosterone levels (ng/dL)	3.28 ± 2.18	5.88 ± 2.69	<0.001
Sperm concentration (million/mL)	18.26 ± 11.37	50.56 ± 25.40	<0.001
Sperm progressive motility (%)	26.03 ± 11.95	47.66 ± 19.32	<0.001
Sperm normal morphology (%)	25.38 ± 11.34	23.91 ± 12.45	0.566

Table-3: Clinical, biochemical and semen analysis parameters of the study population grouped according to the status of alcohol consumption (Values in Mean + SD).

Abnormality	Odds Ratio	Confidence Intervals
Low FSH levels	26.25	3.19 – 216.24
Abnormal Testosterone levels	3.0	1.26 – 7.11
Oligozoospermia	5.64	1.77 – 18.03
Asthenozoospermia	5.10	2.07 – 12.60

Table-4: Risk of developing hormonal and semen abnormalities among alcoholics

The clinical, biochemical and semen analysis parameters of the study population grouped according to the status of tobacco smoking are shown in Table 1. The mean FSH levels, testosterone levels, sperm concentration and sperm progressive motility were found to be significantly lower in smokers as compared to non smokers ($P=0.001$, 0.002 , 0.005 , 0.003 respectively). Eleven (26.2%) smokers had low FSH levels, 31 (73.8%) smokers had normal FSH levels and none of the smokers had high FSH levels. All of the non smokers had normal FSH levels. Twenty one (50%) smokers had low testosterone levels, 19 (45.2%) smokers had normal testosterone levels and 2 (4.8%) smokers had high testosterone levels. Amongst the non smokers, 14 (25%) had low testosterone levels, 41 (73.2%) had normal testosterone levels and 1 (1.8%) had high testosterone levels. Table 2 shows the risk of developing hormonal and semen abnormalities among smokers. As all the non smokers had normal FSH levels, so the odds of low FSH levels among smokers could not be calculated.

The clinical, biochemical and semen analysis parameters of the study population grouped according to the status of alcohol consumption are shown in Table 3. The mean FSH levels, testosterone levels, sperm concentration and sperm progressive motility were found to be significantly lower in alcoholics as compared to non alcoholics ($P<0.001$ in all). Ten (29.4%) alcoholics had low FSH levels, 24 (70.6%) alcoholics had normal FSH levels and none of the alcoholics had high FSH levels. Amongst the non alcoholics, 1 (1.6%) had low FSH levels, 63 (98.4%) had normal FSH levels and none had high FSH levels. Eighteen (52.9%) alcoholics had low testosterone levels, 15 (44.1%) alcoholics had normal testosterone levels and 1 (2.9%) alcoholic had high testosterone levels. Amongst the non alcoholics, 17 (26.6%) had low testosterone levels, 45 (70.3%) had normal testosterone levels and 2 (3.1%) had high testosterone levels. Table 4 shows the risk of developing hormonal and semen abnormalities among alcoholics.

DISCUSSION

Certain exogenous environmental substances have been studied to disrupt the normal endocrine system functioning in humans and in animals.⁹⁻¹¹ In this cohort of 98 male partners of couples attending the infertility clinic at a rural teaching hospital, we found that smokers and alcoholics had statistically significant low levels of FSH and testosterone, and abnormal semen parameters like sperm concentration and sperm progressive motility. This is, to the best of our knowledge, the first study to correlate the effects of tobacco smoking and alcohol consumption on hormonal and seminal parameters among males attending an infertility clinic in rural India.

We found that smokers had significantly higher odds of abnormal testosterone levels. Tobacco smoking has been associated with impaired fertility in males. A few studies have reported decreased sperm concentration, decreased sperm motility and a decreased proportion of morphologically normal sperm amongst men who smoke.^{12,13} However, there

is no consensus on the effect of smoking on male infertility. There are some studies that show no effect of cigarette smoking resulting in abnormal semen parameters. A large case control study in Britain consisted of > 2000 men who were undergoing treatment for infertility and it was concluded from the study that smoking was not an independent risk factor for impaired sperm motility.¹⁴ This study did not assess other semen parameters like percentage of morphologically normal sperms. Twenty seven studies which evaluated the effect of cigarette smoking and semen parameters were evaluated in a meta-analysis.¹⁵ It was found that smokers had 13% lower mean sperm concentration, 10% lower mean percentage of motile sperms and 3% lesser morphologically normal sperms as compared to non smokers. However, it is worth noting that the majority of the studies included healthy volunteers. Only one fourth of the studies were on men with suspected infertility. Exclusion of a pair of studies which had an inconsistent and large impact on the outcomes from the meta-analysis was done by another author.¹⁶ This resulted that there was no statistically significant decrease in sperm concentration amongst non smokers. This also highlighted a significant difference seen in the study population i.e. healthy volunteers and men with suspected infertility. A meta-analysis of results from 57 observational studies included more than 29000 fertile as well as infertile men.¹⁷ It was seen that semen volume, sperm concentration, total sperm count and percentage of progressively motile sperms were adversely affected by cigarette smoking.

A recent meta-analysis including 10823 participants which has been published after this study was conducted has concluded that tobacco smoking decreased the sperm concentration and affected the sperm morphology but did not have any effect on the sperm motility in infertile males.⁶ The harmful effects of alcohol have been demonstrated at all the levels of the human male reproductive system. Impaired formation, secretion, amount and potency of FSH and LH, as a result of alcohol consumption, have been found to result in poor Sertoli cell function. Studies suggest that this may result due to the interference of alcohol in the feedback mechanism of the Hypothalamic Pituitary Gonadal (HPG) axis.¹⁸ Alcohol may also affect Sertoli cell function by damaging proteins essential for the production of spermatozoa.¹⁹ It has also been suggested in studies that alcohol consumption impairs the functioning of the Leydig cells and thereby lead to decreased blood testosterone levels. Blood levels are also low because the metabolic clearance of testosterone is facilitated by alcohol.²⁰ Heavy alcohol consumption has therefore been implicated in decreasing the levels of testosterone, LH and FSH. As a result, the development of morphologically normal spermatozoa and maturation of spermatozoa is hampered and may manifest as teratozoospermia. It may thus also result in reduced production of spermatozoa by the testicular germ cells manifesting as oligozoospermia.¹⁸

We found that alcoholics had significantly higher odds of low FSH levels, abnormal testosterone levels, oligozoospermia and asthenozoospermia. However, a study conducted in China which included 1346 men did not find any association

between semen quality or alcohol intake, even in high doses.²¹ No definite association has been established between alcohol consumption and semen quality with several studies giving contradicting results.^{14,22-28} A recent systematic review and meta analysis also suggested alcohol as a risk factor for semen quality.¹⁷

There are several strengths in our study. It was large, cross sectional and included men attending the infertility clinic at a rural teaching hospital of India. The cross sectional nature of the study empowered the detailed and in depth data collection and recording of the tobacco smoking and alcohol consumption. There is paucity of data correlating life style risk factors and male infertility in rural settings. As majority of the Indian population lives in villages, more studies pertaining to this cohort are needed.

Due to constraints of time and resources, the study also has certain limitations which can be addressed in intensive research using social and epidemiological methods measuring multiple parameters and outcomes. Larger studies that may include control groups of proven fertile men who are non alcoholic and non smoker and another group of fertile men who consume alcohol and smoke tobacco may better substantiate the comparison. The exact dose response relationship of alcohol intake and tobacco smoking can be assessed in well designed, large prospective cohort studies which quantify in detail the amount of alcohol intake and tobacco smoking. The combined effect of these factors and other related factors also deserve further studies. The effect of passive smoking and exposure to tobacco smoke from other family members may also act as confounders. Apart from the hormonal levels and semen parameters, achieving pregnancy can also be studied as an outcome.

Our study has implications for practice also. Tobacco smoking and alcohol consumption are modifiable life style habits. They are risk factors for abnormal hormonal profile and semen parameters. Public health programs directed towards these habits are expected to have an important impact on male fertility. This is of utmost importance in the current times as the maximum prevalence of smoking is seen in young men²⁹ and the incidence of alcohol drinking is increasing worldwide.³⁰

CONCLUSIONS

Our study found that up to 42.9% of the males attending the infertility clinic were smokers and up to 34.7% of the males attending the infertile clinic were alcoholics. The reproductive hormones and semen parameters were significantly lower in the smokers and the alcoholics. This is a public health concern as the total number of young adults who are alcoholic or smokers is very high, especially in rural India. Smoking and alcoholism could thus be significant contributing factors to male infertility. We believe that the health care providers and the government should be more active to spread awareness amongst the youth about the effects of smoking and alcohol consumption on fertility.

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