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Original Research

The effect of tobacco consumption on semen quality of men undergoing infertility evaluation

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***ABSTRACT*:**
Introduction: Despite the efforts made in order to control tobacco consumption across the world, smoking and chewing is still common. It is considered as a prevalent hazardous social habit and is more common among men compared to women. **Objective:** This study was designed to evaluate the effect of tobacco consumption on sperm quality and the related parameters such as sperm concentration, morphology and motility. **Methods:** A Single centric and cross sectional study was conducted at IVF center of Geetanjali Medical College & Hospital, Udaipur. A total of 120 infertile men, of age group 21-45 years were included in the study. A complete history including social habits like tobacco consumption, smoking and other diseases were obtained using a pre tested, semi structured questionnaire and semen analysis was performed for all participants. Statistical analysis was performed using SPSS software. **Results:** Semen analysis was done in 4 groups Ist control, IInd tobacco smokers, IIIrd tobacco chewers and IVth both habits. The concentration, motility and morphology of sperm were decreased as compared to control group and vitality of sperm was similarly decreased in chewers and both habits group than the smokers. **Conclusion:** It is concluded that tobacco consumption in any form has adverse effect on the semen parameters and thus affecting the male fertility.
Key words: Infertility, Semen Analysis, Sperm Concentration, Chewing, Smoking.

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INTRODUCTION:

Tobacco has been identified as an important risk factor contributing to the burden of non-communicable diseases [1]. Globally, India is the third largest tobacco producer and second largest tobacco consumer after China [2]. GATS (Global Adult Tobacco Survey) India reported tobacco consumption in more than one-third (35%) of adults in India [3]. Around one third of the world's population elder than 15 years of age smokes revealed by the World Health Organization, cigarette smoke contains more than 30 chemical agents identified as mutagens, aneugens, or carcinogens. Probably it has direct detrimental effects on human embryos and female and male germ cells [4].

Infertility is one of the most tragic of all marital problems and even with most recent advances in the treatment the problem cannot be solved satisfactorily and around15% sexually active population suffered from infertility and men is responsible in 50% of cases either directly or combined with female [5].

Male infertility could be caused by unhealthy lifestyle patterns like tobacco consumption in the form of smoking or chewing, these are seldom harmful to human health as a whole. Nearly 120 million Indian adults smoked and the highest prevalence of smoking was observed in young adult men during their reproductive period [6,7]. Tobacco chewing and smoking have detrimental effect on the semen volume, sperm motility and sperm count and it leads to significantly decrease in all semen parameters [8, 9].Generally, chewing tobacco is considerably not as much of injurious as smoking to the semen parameters [10].

Further, a study observed the effect of smoking on the ability of seminal plasma. They exposed sperms of smoker to non smoker's seminal plasma and got considerable improvements in sperm quality, vitality. On

the other hand, when non smoker's sperm exposed to smoker's seminal plasma its sperm quality, vitality, and longevity were reduced [11]. Certain studies are also reported that cigarette smoking can increase reactive oxygen species production in seminal plasma and it leads to increased oxidative stress and also causes decreased total antioxidant capacity, it causes damage to spermatozoa and impairs its morphology, count, motility and vitality ultimately augments male infertility [12, 13].There was no association found between tobacco consumption and characteristics of spermatozoa; motility, morphology, counts and vitality in some other studies [14, 15].

The effect of smoking on semen quality had been investigated in many studies but their results were contradictory, some alleged smokers have a lower semen quality, whereas others reported no effect of smoking on spermiogram, and one more problematic thing is that most of the peoples are well aware about the effect of smoking on lungs, heart, but fewer or don't alert about its harmful outcome on male reproductive system. Hence the present study was designed to find out the effect of tobacco consumption on semen quality.

METHODS:

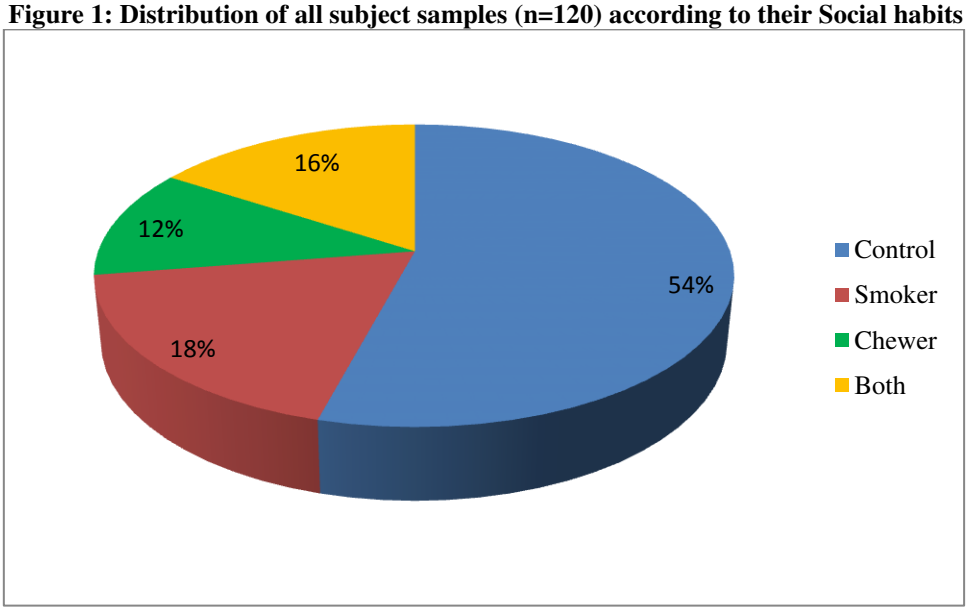
The present study was conducted in the infertility center of a tertiary care hospital of southern Rajasthan. It has carried out on 120 infertile men after obtaining ethical clearance from institutional ethics committee. Before semen analysis, a pretested, semi-structured questionnaire was distributed to participants to obtain information about use of tobacco in the form of smoking or chewing. Patients were also asked about history related to any diseases affecting male reproductive tract.

Semen samples were collected by masturbation into a sterile container at IVF center after 2 to 5 days of sexual abstinence and analyzed after liquefaction of sample. Physiological examination of semen parameters; volume, pH, sperm concentration, sperm motility, sperm vitality and sperm morphology has been done according to WHO guideline manual, 2010 [16]. Azoospermic samples (n=32) were excluded from this study due to the lack of sperm cells in their semen. A written informed consent was obtained from all the participants before commencement of the study. Subjects were divided into four groups; Ist control group consist of normal subjects (n=47), IInd smokers (n=17), IIIrd chewers (n=7) and IVth both habits (n=17) respectively. Semen analysis was done to observe how the physical parameters are affected in smoker, chewer and both habitual groups. The semen samples were analyzed for physical parameters such as concentration, motility, morphology and vitality. The statistical analysis was done using student paired 't'- test using SPSS software.

RESULTS:

This cross-sectional study involved 120 infertile male subjects. The majority of them, 47 (54%) were control group (non-tobacco users), 22 (18%) were smoker, 14 (12%) were chewer and 19 (16%) were both; those who had smoking and chewing habits respectively, shown in figure-1.

Figure 1: Distribution of all subject samples (n=120) according to their Social habits



Out of 120 samples azoospermic samples (n=32) were excluded from this study due to the lack of sperm cells in their semen and rest of subjects (n=88) were divided into four groups; control group consist of normal subjects (n=47), smokers (n=17), chewers (n=7) and both habits (n=17) respectively. Further, semen samples were analyzed to see the effect of tobacco consumption on spermiogram of samples.

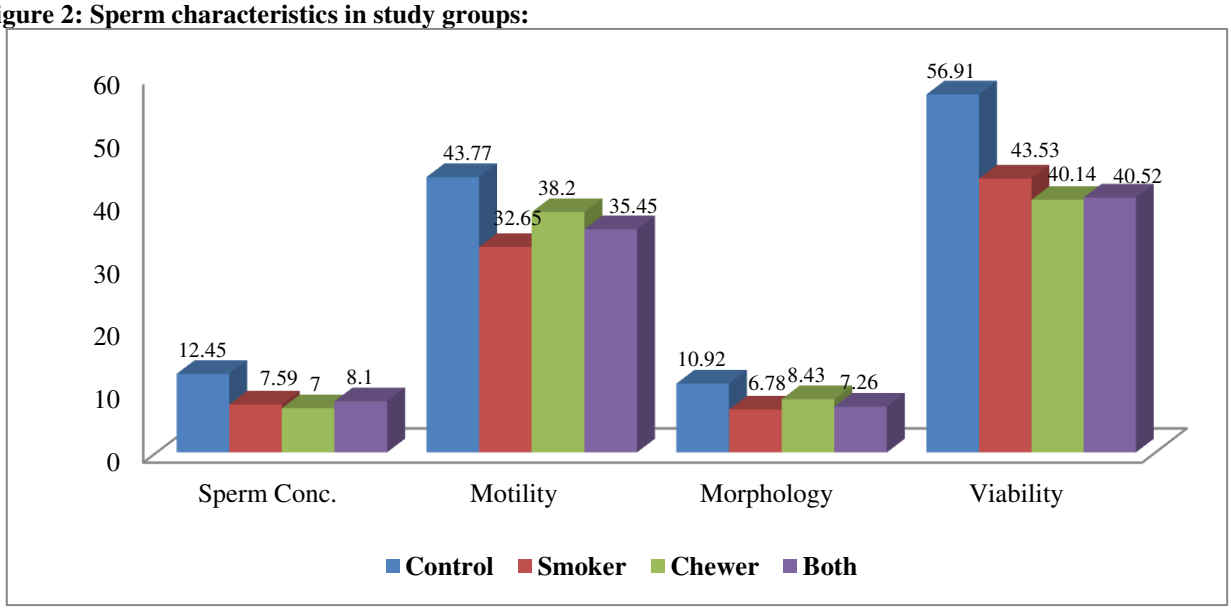
The sperm concentration, motility and morphology of semen were extremely decreased in smoker group as compared to other groups. It is highest in control group. This indicates that decreased concentration, motility and morphology of sperm leads to decreased fertility. It is shown in table 1 and figure 2.

Table 1: Sperm characteristics of study groups (n=88):

Variables	Control (n=47)	Smoker (n=17)	Chewer (n=07)	Both (n=17)	P value
Sperm Concentration (million/ml.)	12.45±9.24	7.59±3.21	7.00±2.83	8.10±3.92	0.05**
Sperm motility (%)	43.77±17.85	32.65±12.52	38.20±9.80	35.45±13.92	0.001***
Sperm morphology (%)	10.92±7.51	6.78±3.51	8.43±3.60	7.26±2.99	0.0275**
Sperm vitality (%)	56.91±18.56	43.53±11.49	40.14±9.15	40.52±14.88	0.001**

Values are expressed as Mean ± SD and p-values were expressed as * P<0.05, **P<0.01, ***P<0.001.
When the percentage of sperm viability was compared among tobacco consumers such as smokers, chewers and both habits group, it was observed that smokers had over 43.53% vitality, while chewer and both habits group respectively had over 40% viability, with p<0.001. It is depicted in table 1 and figure 2. It contributes to the deterioration of the semen quality and augments the infertility.

Figure 2: Sperm characteristics in study groups:



Our findings reported that infertile subjects who had addiction for any social habits had significantly (p<0.05) reduced semen parameters than control group subjects.

DISCUSSION:

The present study revealed that tobacco consumption adversely affected male fertility. All semen parameters were declined in tobacco consumers as compared to control with significantly diminished in sperm concentration, motility, morphology and vitality; it was supported by several studies i.e. Zhang et al and Vine MF et al revealed that cigarette smoking is related with decline in semen quality comprising sperm motility, concentration and morphology [17, 18].

The sperm count was significantly decreased and the seminal oxidative stress levels were significantly increased with the severity of smoking observed by Gaisamudre KB et al [7] and Hansen R et al stated that smoking at adult age moderately harms the semen quality [19].

Some researchers found that sperm concentration of the smokers was significantly lower than nonsmokers and also revealed that smoking has damaging effects on sperm vitality, motility, seminal zinc levels, DNA fragmentation and semen reactive oxygen species levels equally in fertile men which is directly associated with number of cigarette and smoking period [20, 21].

Tobacco combustion produces approximately 4000 chemical compounds, and smokers inhale a host of toxins including nicotine, cadmium, carbon mono-oxide and other mutagenic composites, all have harmful effects on sperm cells. Chewing tobacco is obviously less injurious than smoking, but it is not risk-free. Its nicotine absorbance is equivalent to that from cigarettes, but with a fewer toxic effects[12] because cigarette smoke produces toxins which diminishes mitochondrial activity and damages chromatin structure of sperm. Therefore it leads to impairment of fertility capability was discovered by Sharma R et al [22], similarly Elshal M et al [23] was disclosed smoking might prompt oxidative stress that leads to harm the chromatin structure and production of endogenous DNA strand breaks in human sperm. Infact smoking causes chromosome damage in Golgi-phase or cap-phase in spermatids and severe DNA damage of spermatocyte, which might be inhibits oocyte fertilization or the growth of the embryo, could be a cause of

infertility perceived by Mostafa T. Whereas in smokers, it was observed that spermatozoa has axoneme structure abnormalities leads to reduced flagellar movement and decreased creatine kinase activity (which required for energy production)lowers the acrosin activity; it leads to cause infertility [24].

The unique cellular structure of spermatozoa renders them particularly sensitive to oxidative stress because spermatozoa has less amount of cytoplasm therefore; hold minimal amount of cytoplasmic antioxidant enzymes. Secondly, the high concentration of polyunsaturated fatty acids in sperm cell membranes makes more susceptible to lipid peroxidation than other non-germ cells. This combination of susceptibility to lipid peroxidation along with a relative lack of vigorous intracellular defense mechanisms is exacerbated by the autogenously production of ROS by spermatozoa [25]. Smoking is a source of potential free radical which is the strong risk factor to raise oxidative stress by lipid peroxidation and it might be responsible for sperm immobility and inability to fertilize [26].

However an experiment have done by Said TM et al., on murine model and reported that exposure to nicotine which is absorbed in considerable quantities, causes dangerous inflammatory reaction and striking ultra-structural changes in the testes of animals could be a reason of infertility in men [10].

On the other hand a study described that nicotine and its metabolite cotinine (water-soluble) are measurable in the seminal plasma of smokers suggested that other harmful components of tobacco smoke would pass through the blood–testis barrier and reduced motility has also been coupled with abnormalities in the ultrastructure of the flagellum and the axonemal structures of the sperm tail [4].Another study suggested that FSH and LH levels were enhanced in smokers which effects hypothalamo-pituitary-gonadal system. Increase levels of FSH and LH initially causes increase in level of testosterone and inhibin B consequently prompt a decrease in FSH and LH by negative feedback in fact it might disrupts the normal function of this system finally leads to 'compensated Leydig cell failure'[19].

Kumar R, 2006 was stated that chewing tobacco is considered a milder form of tobacco use but it is highly widespread in India, mainly among the lower socio-economic groups and suggested that tobacco chewing is strongly associated with a decline in sperm quality [27].

In our study findings were also correlates the results revealed by Wu JQ, 2012; as man smoked more than 20 cigarettes per day (heavy smoker) faced a 19% reduction in sperm density as compared to nonsmokers, though adult smoking moderately impairs semen quality [28, 29].Hence, the present study is revealed that tobacco consumption, mainly through smoking and secondary through chewing has a potential cause of male infertility.

CONCLUSION:

Tobacco consumption addiction is very common in men now a day. Most vulnerable or concerning thing is that those men who have habituated to tobacco seldom undergo to infertility medical services. Hence semen examination should be included in regular checkup and awareness programs for prevention and cessation of tobacco consumption could be implemented. In finally men who have tendency of tobacco consumption in any form smoking or chewing should be counseled or advised about the detrimental effects on fertility and to decrease the prevalence of infertility in men. However further studies are required in this field.

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