

## Effects of cigarette smoking on male fertility

Farkhunda NADEEM<sup>1</sup>, Amin FAHIM<sup>2</sup>, Saira BUGTI<sup>3</sup>

**Aim:** This study was done to compare the various semen parameters of infertile male smokers with nonsmokers and also draw comparisons among light, moderate, and heavy smokers.

**Materials and methods:** A total of 130 infertile male patients were included in this study from the outpatient department of Gynecology and Obstetrics at Liaquat University of Medical and Health Sciences, Hyderabad, from January 2010 to May 2010. The subjects were infertile males married for more than 1 year, and they were selected randomly. The subjects were thoroughly interviewed and were selected according to inclusion criteria. History about cigarette smoking and its duration was obtained and was recorded in the questionnaire form. Results of the semen examinations were collected from the laboratory. Subjects were divided into different groups as nonsmokers and smokers. Smokers were further grouped as light, moderate, and heavy smokers. Sperm motility and morphology were taken as parameters for semen analysis.

**Results:** It was found that 33.3% of nonsmokers showed below 5% sperm motility and 25.9% showed below 3% normal sperm morphology. Meanwhile, 66.7% of smokers showed below 5% sperm motility, and 74.1% showed below 3% normal sperm morphology. Among the 3 groups of smokers, sperm motility below 5% was present in 18.8% of light smokers, 31.2% of moderate smokers, and 50% of heavy smokers. Regarding morphology of sperm, less than 3% of normal sperm cells were present in 25% of light, 35% of moderate, and 40% of heavy smokers.

**Conclusion:** It is concluded that cigarette smoking can affect male fertility by decreasing the sperm motility and percentage of normal sperm cells. These abnormalities are also related to the amount of cigarettes smoked per day.

**Key words:** Cigarette smoking, male infertility

### Introduction

Cigarette smoking is a broadly recognized health hazard and a major cause of mortality (1), but still people continue to smoke cigarettes on a regular basis. The World Health Organization (2) has reported that approximately one-third of the world's population older than 15 years are smokers (3,4). The maximum prevalence of smoking is observed in young adult males in the reproductive period (46% of smokers are between 20 and 39 years old) (5).

Infertility can be defined as the incapacity to fulfill pregnancy after a reasonable time of sexual intercourse with no contraceptive measures taken. On the other hand, the World Health Organization definition, based on 24 months of trying to get pregnant, is recommended as the definition that is useful in clinical practice and research among different disciplines (6). The main cause in about 30%–50% of infertile couples is male factor infertility with abnormal semen; in the general population, this

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<sup>1</sup> Department of Pathology, Isra University, Hyderabad – PAKISTAN

<sup>2</sup> Department of Pathology, Al-Tibri Medical College, Karachi – PAKISTAN

<sup>3</sup> Department of Pathology, Mohammad Medical College, Mirpur Khas – PAKISTAN

**Correspondence:** Farkhunda NADEEM, Department of Pathology, Isra University, Hyderabad – PAKISTAN

E-mail: farkhundanadeem@gmail.com

affects 1 in 20 men (7,8). One study reported both female and male factors in infertility to be as prevalent as 40% each (9). Male infertility is characterized by particular multifactorial clinical problems, especially during the early period of sexual development (10). The problem of infertility due to the male partner can be managed and the couple could benefit from intracytoplasmic sperm injection (ICSI) to conceive (11).

Although the general population is well aware of the role of smoking in lung and heart diseases, the undesirable effects of smoking on male reproductive health are less recognized (12).

A number of studies from various parts of the world have observed the effects of cigarette smoking on semen quality, especially in men who are heavy smokers or who have been smoking for a long time (13). One of the studies revealed that smoking leads to a decrease in semen parameters such as viability, sperm concentration, motility, and morphology (14).

Smoking has also been linked with an increase in reactive oxygen species (ROS) levels, leading to oxidative stress in the environment. This oxidative stress may exceed the antioxidant capacity of seminal plasma and can be toxic for sperm, causing oxidative damage (15,16).

The aim of this study was to compare the various semen parameters of infertile men who are cigarette smokers with nonsmoking infertile men and draw comparisons among the light, moderate, and heavy smokers in order to ascertain the effect of cigarette smoking on the quality of seminal fluid.

## Materials and methods

This study was conducted during the period from January 2010 to May 2010 among patients treated in the outpatient department of Gynecology and Obstetrics at Liaquat University of Medical and Health Sciences Hospital, Hyderabad. Patient selection criteria were laid down in order to exclude as many coexisting factors as possible, as they may otherwise influence or modify the effect of cigarette smoke on semen parameters. Only patients with primary infertility who were either smokers or strict nonsmokers, between the ages of 20 and 45 years, were selected randomly. Patients labeled as having primary

infertility were married at least for the past 1 year, and none of them were using any contraceptive measures for the past 1 year or longer. Strict nonsmokers were those men who had never smoked before. Informed consent was taken, as a routine procedure, from all patients. Only one sample per patient was included in this study.

The following were excluded from the study group:

1. Patients suffering from secondary infertility.
2. Former smokers, to avoid any persistence of the effects of smoking.
3. Patients with occupational exposure to chemicals or excessive heat, e.g., patients working at petrol pumps, chemical factories, or bakeries.
4. Patients with history of varicocele, hydrocele, undescended testis, or corrective surgery for these problems.
5. Patients with history of any chronic illness, such as tuberculosis, diabetes mellitus, hypertension, and thyroid diseases, or any ailment for which long-term medication was being given.
7. Patients above 45 years of age, to avoid effects of ageing on sperm variables.

Thus, the selected study group of smokers and strict nonsmokers had only one known factor that differentiated them: cigarette smoking. The smokers were categorized further, based on the number of cigarettes smoked per day, as light, moderate, and heavy smokers (Table 1). All semen samples were analyzed microscopically for the following parameters: motility and morphology (normal forms).

The results of the percentage of progressive motility of sperm cells were divided into 4 groups (17): group 1, over 50% motility; group 2, from 20% to 40% motility; group 3, from 5% to 19% motility; group 4, below 5% motility.

Based on the percentage of normal sperm cells, results were divided into the following groups (17): group 1, over 30% normal sperm cells; group 2, from 20% to 30% normal cells; group 3, from 10% to 19% normal cells; group 4, from 3% to 9% normal sperm cells; group 5, below 3% normal sperm cells.

### Sample size

The sample size of 130 men was taken for the study. The data were collected randomly.

### Statistical analysis

The data were analyzed by chi-square test to find the P-values.  $P < 0.05$  was taken as statistically significant.

### Results

From the data of 130 males, 2 groups were formed: smokers and nonsmokers. There were 77 smokers (59.2%) and 53 nonsmokers (40.8%). The smokers were further grouped as 27 light smokers (35.1%), 36 moderate smokers (46.8%), and 14 heavy smokers (18.2%) (Table 1).

While evaluating the effect of smoking on the motility of sperm cells, it was observed that 54.9% of the nonsmokers showed over 50% motility, while the same parameter was seen in 45.1% of all smokers. Below 5% motility was observed in 33.3% of nonsmokers and 66.7% of all smokers at  $P = 0.04$ .

When the percentage of sperm motility was compared among light, moderate, and heavy smokers, it was observed that among light smokers, 47.8% of males had over 50% motility, while 39.1% and 13% of moderate and heavy smokers respectively had over 50% motility. While marked disturbances in the motility of sperm cells (below 5%) was observed in 18.8% of light smokers and 31.2% of moderate smokers, for heavy smokers, these disturbances concerned 50% of the patients, with  $P < 0.01$  (Table 2).

Table 1. Smoking status of the patients.

Smoking status	No. of cigarettes/day	No. of patients
Nonsmoker		53 (40.8%)
Smoker		77 (59.2%)
Light	1–20	27 (35.1%)
Moderate	21–40	36 (46.8%)
Heavy	≥41	14 (18.2%)

Table 2. Relationship between smoking and motility of sperm cells in semen.

Sperm motility	Smokers (n = 77)			Total (n = 77)	Nonsmokers (n = 53)
	Light smokers	Moderate smokers	Heavy smokers		
Over 50% motility	11 47.8%	9 39.1%	3 13%	23 45.1%	28 54.9%
20%–40% motility	8 33.3%	15 62.5%	1 4.2%	24 75%	8 25%
5%–19% motility	5 35.7%	7 50%	2 14.3%	14 60.9%	9 39.1%
Below 5% motility	3 18.8%	5 31.2%	8 50%	16 66.7%	8 33.3%
Total	27 35.1%	36 46.8%	14 18.2%	77 59.2%	53 40.8%
P-value		0.01			0.04

While investigating the relationships between the morphology of sperm and the effects of smoking, it was observed that 29% of the nonsmokers and 71% of all smokers showed over 30% sperm cells with normal morphology, while this percentage decreased to below 3% of sperm cells with normal morphology in 74.1% of all smokers and 25.9% of nonsmokers at  $P < 0.05$ .

When the percentages of the normal sperm morphology were compared among light, moderate, and heavy smokers, it was seen that 54.5% of the light smokers had semen with over 30% normal sperm cells with proper morphology, while 25% showed below 3% normal sperm cells. In the group of moderate smokers, 40.9% of respondents did not show deviations from the standard with respect to the morphology of sperm, while in 35% the pathology reached to rates below 3% normal sperm cells. In the group of heavy smokers, 4.5% possessed normal semen morphology, whereas rates of below 3% normal sperm occurred in 40% of respondents from this group, with  $P < 0.05$  (Table 3).

## Discussion

The etiology of male infertility in a major proportion of cases is unknown; hence, these situations are provisionally known as idiopathic infertility (16). In these cases, smoking may be one of the factors responsible. Smoking is a lifestyle hazard for both active and passive smokers and its effects on fertility status have been less documented. The potential hazardous chemicals present in cigarette smoke may cause sperm abnormality by affecting the chromosomes. About 4% to 5% of infertile males show chromosomal abnormalities in comparison with 0.5% to 0.7% in the general population (18).

In this study, among the nonsmokers, 54.9% showed over 50% and only 33.3% showed below 5% sperm motility. In contrast, samples from smokers showed over 50% motility in 45.1% and below 5% motility in 66.6% of cases (Table 2). This finding underscores the fact that smoking certainly has an adverse influence on semen quality, as concluded in other studies (19). This fact is also supported by the results when sperm morphology was studied

Table 3. Relationship between smoking and pathology of sperm cell structure.

Sperm cell structure	Smokers (n = 77)			Total (n = 77)	Nonsmokers (n = 53)
	Light smokers	Moderate smokers	Heavy smokers		
Over 30% normal sperm	12 54.5%	9 40.9%	1 4.5%	22 71%	9 29%
20%–30% normal sperm	4 30.8%	7 53.8%	2 15.4%	13 44.8%	16 55.2%
10%–19% normal sperm	4 40%	6 60%	0 .0%	10 43.5%	13 56.5%
3%–9% normal sperm	2 16.7%	7 58.3%	3 25%	12 60%	8 40%
Below 3% normal sperm	5 25%	7 35%	8 40%	20 74.1%	7 25.9%
Total	27 35.1%	36 46.8%	14 18.2%	77 59.2%	53 40.8%

for the same patients, which showed that 29% of nonsmokers and 71% of all smokers had over 30% sperm with normal morphology, while only 25.9% from nonsmokers but 74.1% from smokers showed below 3% normal sperm morphology (Table 3). This again shows that smoking contributes to the deterioration of the semen quality of smokers when compared with nonsmokers, a fact supported by Zinaman et al. in their study done in 2000 (20).

When the effects of smoking on sperm quality were compared among the different groups of smokers, a significant reduction in sperm motility was observed (Table 2), whereby among light smokers, 47.8% of males had over 50% sperm motility, while among moderate smokers and heavy smokers, 39.1% and 13% of the males were classified into the group with normal semen motility, respectively. It was also seen that 31.2% of the moderate smokers and 50% of the heavy smokers showed below 5% sperm motility, as compared to 18.8% of the light smokers at  $P < 0.01$ . This shows that there is a strong relationship between the decline in sperm motility and the number of the cigarettes smoked per day, as was also evidenced by Zhang et al. in 2000 (21).

The adverse effects of cigarette smoking on sperm morphology among the different groups are also evident from Table 3, which shows that 54.5%

of light smokers had over 30% normal sperm cell morphology, while among the moderate and heavy smokers, 40.9% and 4.5% of males had normal sperm morphology, respectively. Table 3 also shows that a marked reduction in the number of normal sperm cells occurred in heavy smokers, as 40% of them had below 3% normal sperm cells in comparison to the moderate and light smokers, who had 35% and 25% of sperm cells with normal morphology, respectively, with  $P = 0.05$ . These findings also indicate a strong dose-dependent relationship between smoking and a decrease in semen quality (22).

In this study, more cases of abnormal sperm motility and morphology were present in moderate and heavy smokers as compared to light smokers, which confirms that smoking and the number of the cigarette smoked per day significantly reduces the sperm motility and number of normal sperm, a finding proven by many other studies (23). It is concluded from the study that smoking can decrease male fertility by decreasing the sperm motility and percentage of normal sperm cells, and that a decrease in the percentage of motility of sperm cells and normal morphology is correlated with the number of cigarettes smoked per day. More studies, however, are needed to identify the precise mechanism involved in the reduction of sperm quality and testicular structure.

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