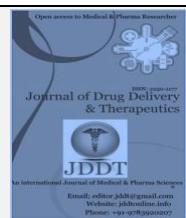


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Research Article

## Impact of Cigarette Smoking on Sperm Parameters of Infertile Men in Center of Algiers (Capital of Algeria)

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### ABSTRACT

**Background :** Cigarette smoking has negative effects on male fertility. Toxins from tobacco smoking can potentially affect sperm development and function, with a negative effect on semen parameters. In fact, the components of cigarette smoke pass through the blood-testis barrier and thus induce an alteration of sperm parameters and nucleus quality of the spermatozoa. The aim is to determine a difference between tobacco and no tobacco patient and semen parameters. This article aimed to assess the relationship between smoking and male infertility.

**Subject and Methods :** this is retrospective study focused on the effects of smoking on semen analyses. 377 men (165 non-smokers, 212 smokers) with infertility for at least 1 year were evaluated between Mars and November 2018, in center of algiers (capital of Algeria). Sperm characteristics (concentration, motility, morphology, and volume) were determined.

**Results:** Sperm concentration, percentage motility and morphology were significantly lower in an infertile Smokers group than the infertile Nonsmokers group. We also observed that the infertility duration were significantly increased ( $p<0.05$ ) in accordance with the age in an infertile Smokers group. Our study shows that cigarette smoking is associated with reduced sperm count and motility.

**Conclusions:** Our results suggest that cigarette smoking has an overall negative effect on semen parameters. Our study suggests that men should be advised to abstain from smoking in order to improve reproductive outcomes.

**Keywords:** smoking, semen, male infertility, sperm, humans

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### INTRODUCTION

An increasing number of reports suggest that chemical and physical agents in the environment, introduced and spread by human activity, may affect male fertility in humans. Humans are exposed to many environmental agents that may be hazardous to their reproductive capacity. Tobacco combustion produces approximately 4000 chemical compounds, and smokers inhale a host of toxins including nicotine, carbon monoxide, cadmium, and other mutagenic compounds, all with potential deleterious effects on male germ cells<sup>1</sup> (WHO., 2015).

Smoking may impact on fertility, as reported in a recent study enrolling 200 men (Zinaman *et al.*, 2000)<sup>2</sup>. In this study it was noted that cigarette smoking was significantly associated with a decreased pregnancy rate and impaired semen parameters. Men with azoospermia were excluded and the authors did not report men with genital disease. In this study only 6% were smokers. Although there were only

six smokers in both the pregnant and the non-pregnant group, a statistical significance was calculated (Sharma R *et al.*, 2013; Calogero A, *et al.*, 2009)<sup>3,4</sup>.

The aim of our study was to compare sperm parameters of infertile men who were cigarette smokers with infertile non-smoking men, in order to ascertain the effect of cigarette smoking on the quality of seminal fluid.

### SUBJECT AND METHODS

This prospective study was conducted between Mars and November 2018 in Assisted Medical Procreation Service CHU Nafissa Hammoud EX: Parnet in center of Algiers (capital of Algeria). A total of 377 infertile men (165 non-smokers, 212 smokers) between the age group 25-66 years were taken into study.

Patients were divided into two groups: smoking (current smoker versus non-smoker). Medical history and particularly any history of previous genital disease was

assessed using a questionnaire. We specified the primary outcome measures a priori as semen volume, sperm count, motility, and morphology because these parameters are the most commonly used measures in the investigation of male fertility.

**Inclusion criteria:** Clinically infertile subjects with a history of infertility persisting longer than one year in reproductive age group were included in the study. Smokers were the men who smoke cigarettes for 6 years or more.

**Exclusion criteria:** History of any chronic illness like hypertension, thyroid disease Tuberculosis, diabetes and varicocele.

### Semen analysis

Semen samples were collected by masturbation in a clean specimen container after a sexual abstinence for 3–6 days, allowed to liquefy and evaluated immediately thereafter according to WHO guidelines (World Health Organization, 1992).

Seminal volume was measured in a graduated pipette, accurate to within 0.1 ml. Sperm concentration was determined by haemocytometer (improved Neubauer counting chamber), after an appropriate dilution. Sperm motility was assessed by direct observation under a microscope ( $\times 400$ ). Sperm morphology was assessed by staining slides (May–Grunwald–Giemsa) and direct observation under a microscope ( $\times 1000$ ).

For evaluation of sperm morphology, prestained slides (two per semen sample), which are usually used for blood cell differentiation, were smeared with a small volume of semen and allowed to air dry (Testsimplets<sup>®</sup>; Roche Diagnostics). Besides the percentage of morphologically abnormal sperm, the sperm head, neck and mid-piece, tail defects were assessed. The total number of defects was counted and the teratozoospermic index was calculated (total number of defects/number of sperm with defects). Motility was determined by evaluating 200 sperm per sample, 60 min after semen collection. The results of semen analyses were classified according to the nomenclature of semen variables (World Health Organization, 1992).

### Statistics

Men were grouped into smokers and non-smokers. A descriptive analysis of the data was performed and the variables were further analysed with a *t*-test. Comparisons between two groups were performed using the statistical software (Spss version 22). To report the results we used a descriptive analysis method, calculating the means and standard deviations for the continuous data, the means were

then compared using the Student's Test, for the nominal data.

## RESULTS:

In all, 377 men were evaluated for infertility. Of these, 212 were non-smokers and 165 smokers. The percentage of smokers in our study of infertile men was 56,23% (**Table 1**). Our results showed the difference in status of fertility between smokers and nonsmokers (**Fig.1**).

A significant differences in the results of semen analyses were seen between non-smokers and smokers. The results of semen analyses are given in **Table 2**. Mean age, as well as semen parameters for non-smokers, smokers are shown in **Table 2**. Compared with smokers, no-smokers were younger.

Our results showed that Exposure to cigarette smoking was associated with reduced sperm count ( $p=0.02$ ), motility ( $p=0.01$ ) and morphology ( $p=0.02$ ).

Only the sperm count ( $21,94 \pm 15,04 \times 10^6$  ;  $25,82 \pm 13,62 \times 10^6$ ); duration of fertility ( $6,06 \pm 3,65$ ;  $5,02 \pm 2,95$  years;  $P = 0.002$ ), mobility ( $20,22 \pm 16,38$ ;  $24,98 \pm 19,59$ ) and morphology ( $9,54 \pm 11,03$ ;  $12,80 \pm 17,41$ ) were significantly different between smokers and no-smokers respectively (**Table 2**).

### Seminal characteristics

logistic regression were used to assess the association between exposure and seminal characteristics. There is a clear correlation between fertility duration and age ( $R=0.4$ ), (**Fig. 2**).

#### Semen volume

Mean semen volume was  $2,75 \pm 1,25$  ml in smokers and was  $2,66 \pm 1,28$  ml in nonsmokers. Overall, semen volume was not significantly affected by smoking ( $p=0,486$ ).

#### Sperm count

Mean sperm count was  $21,94 \pm 15,04 \times 10^6$  /ml in smokers and  $25,82 \pm 13,62 \times 10^6$  /ml in nonsmokers. The results indicated that the count was lower in smokers than in nonsmokers.

#### Sperm motility

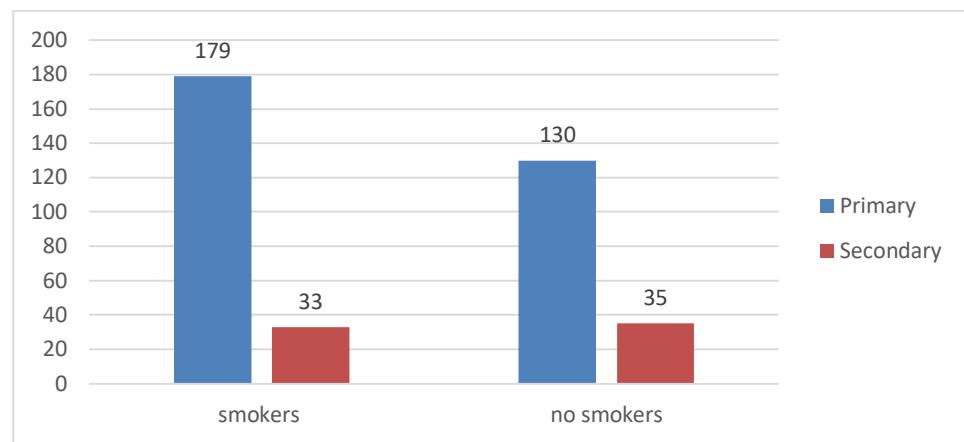
Motility ranged from  $20,22 \pm 16,38$  % in smokers and  $24,98 \pm 19,59$  % in nonsmokers. Overall, smoking was a risk factor for reduced motility ( $p < 0.05$ ), (**Table 2**).

#### Sperm morphology

Overall, smoking was a risk factor for impaired morphology ( $p = 0.01$ ), (**Table 2**).

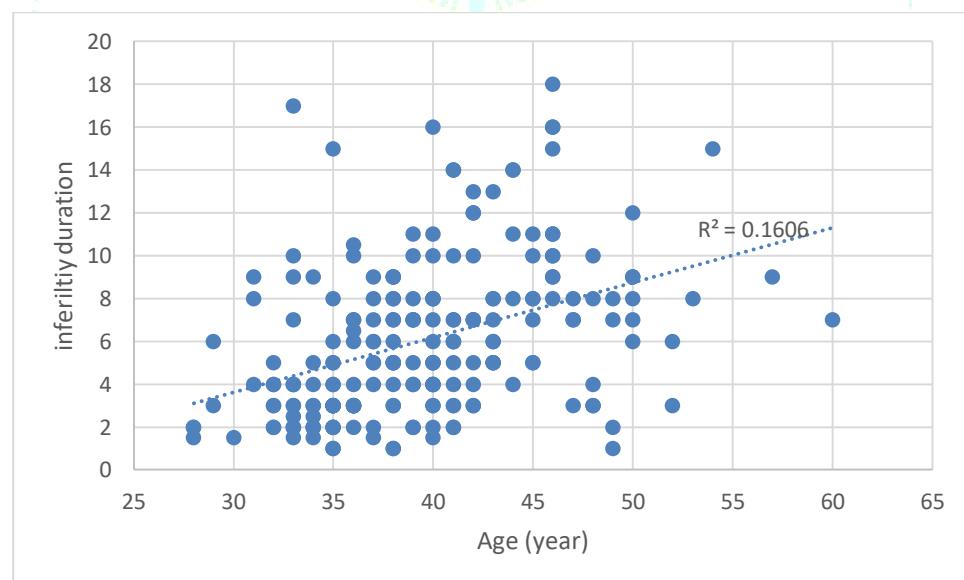
**Table 1** : Distribution of patients according to type of infertility

	Primary	Secondary	Total	P
smokers	(179)47,48%	(33)8,75%	(212)56,23%	0.15
nonsmokers	(130)34,48%	(35)9,28%	(165)43,77%	
<b>Total</b>	<b>(309)81,96%</b>	<b>(68)18,04%</b>	<b>(377)100,00%</b>	

**Figure 1 :** Status of fertility in smokers than nonsmokers**Table 2 :** Comparison of sperm parameters in all semen samples collected from smokers and no-smoker

	Smokers	No-smokers	P
<b>Age</b>	39,53±5,72	38,55±6,53	0,117
<b>Infertilité duration</b>	6,06±3,65	5,02±2,95	0,002
<b>Volume (ml)</b>	2,75±1,25	2,66±1,28	0,486
<b>Sperm count (×10<sup>6</sup> /mL)</b>	21,94±15,04	25,82±13,62	0,020
<b>Motility (%)</b>	20,22±16,38	24,98±19,59	0,01
<b>Morphology (%)</b>	9,54±11,03	12,80±17,41	0,02

Note: Values are expressed as mean ± standard deviation. P<0.05 was considered significant using unpaired t test.

**Figure 2 :** Correlation between age and fertility duration in smokers men

## DISCUSSION

The involvement of environmental factors in male infertility and the suspected increased incidence of male-related infertility induced by such agents are of great concern. Smoking has been shown to have a detrimental effect on various parameters of semen analysis.

The percentage of smokers in our study of infertile men was 56,23% and was therefore not different from the Austrian male population between 18 and 50 years, which was reported to be 44.2% during the study period (Langgassner,

1999). Approximately 37% of male adults worldwide use tobacco, mainly cigarettes. Smoking rates have gradually declined in the United States, but Europe still has the highest tobacco use among all the World Health Organization (WHO) regions (WHO, 2015).

Our results showed the presence of normal sperm count, motility, and morphology was associated with normal sperm morphology in the no-smokers men. Semen volume was not significantly affected by smoking ( $p= 0,486$ ) in our study. **Cigarette** smoking was associated with reduced sperm count, sperm motility, and sperm morphology, but the effects

on semen volume were equivocal. These effects were overall more pronounced in infertile men than in the general population, and deterioration of semen quality was particularly associated with moderate and heavy smoking (Kunzle R et al., 2003)<sup>6</sup>.

The results obtained in the present study showed that the sperm concentration, percentage motility and morphology were significantly lower in an infertile Smokers group than the infertile Nonsmokers group. Smoking cigarettes has been associated with a deterioration of sperm quality including motility, concentration, and morphology, which are the parameters most frequently used in clinical settings to assess fertility (Kunzle R et al., 2003 ; Al-Matubsi HY et al., 2011)<sup>6,7</sup>.

The mechanisms through which smoking affects semen parameters are not fully understood, but chemical compounds produced by cigarettes were shown to have deleterious effects on the development of male germ cells (Zenzes MT., 2000)<sup>5</sup>.

A cross-sectional analysis of 2542 healthy men from 1987 to 2004 by RamlauHansen et al found that on semen analysis, cigarette smokers had lower semen volumes, sperm counts, and percentage of motile sperm compared to men who did not smoke (Ramlau-Hansen CH. and al., 2007)<sup>8</sup>.

In another large cohort of 1786 men undergoing infertility workup (655 smokers and 1131 nonsmokers), Kunzle et al demonstrated that smoking was associated with decreases in sperm density (15.3%), total sperm counts (17.5%), and total motile sperm (16.6%) compared with nonsmokers. Furthermore, morphology (percent of normal forms) as well as ejaculate volume was slightly affected by smoking but not to any significant degree (Kunzle R. and al. , 2003)<sup>9</sup>.

Merino and colleagues, who studied 358 Mexican men stratified into 3 categories based on the number of cigarettes smoked per day, also confirmed this type of dose dependency. The authors confirmed the effects of smoking on reduced sperm density and abnormal morphology, but also extended these findings to note that men who smoked < 10 cigarettes per day experienced significant changes in their semen analysis parameters (Merino G and al. ; 1998)<sup>10</sup>.

Most papers have argued that smokers demonstrate lower semen volume, sperm count, sperm motility and viability compared with non-smokers. In addition, smokers showed increased seminal leukocytes, oval sperm percentage, head-piece spermatozoa defects percentage and spermatozoa with cytoplasmic droplets (Shiffman S. , 1989 ; Al-Turki HA., 2015)<sup>11,12</sup>.

Four studies (Mitra A et al., 2012 ; El-Melegy NT et al., 2011 ; J Joo KJ et al., 2012 ; Anifandis G et al., 2014)<sup>13,14,15,16</sup> compared the effects of cigarette consumption on sperm count. The pooled results showed that counts were significantly lower in moderate smokers (REM MD: -9.93; 95% CI, 18.04 to 1.82; p = 0.02) and heavy smokers (REM MD: 28.06; 95% CI, 42.27 to 8.86; p = 0.004) than in nonsmokers.

The mechanisms through which smoking affects semen parameters are not fully understood, but chemical compounds produced by cigarettes were shown to have deleterious effects on the development of male germ cells. The consequences of smoking while pregnant on future

fertility as well as the outcomes of second-hand smoke are analyzed (Agarwal A. et al., 2005)<sup>17</sup>.

## CONCLUSION

Our study have demonstrated a negative impact of smoking on human semen parameters. Our results suggest that cigarette smoking was found to be a significant risk factor for decreased semen parameters in men. It was associated with reduced sperm count, sperm motility, and sperm morphology, but the effects on semen volume were equivocal.

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