



A STUDY OF QUALITATIVE AND QUANTITATIVE ANALYSIS OF SEMEN IN SMOKERS AND NON-SMOKERS

Pathology

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ABSTRACT

Background: Male infertility is an important global health issue, and cigarette smoking has emerged as a major lifestyle factor affecting semen quality. Smoking exposes the body to numerous toxic substances that adversely affect spermatogenesis, sperm motility, morphology, and vitality. **Aim:** To perform qualitative and quantitative analysis of semen and compare semen parameters between smokers and non-smokers. **Materials and Methods:** A prospective cross-sectional study was conducted over one year at the Department of Pathology, Jhalawar Medical College, involving 105 male participants aged 21–55 years. Semen samples gathered after 2-7 days of abstinence were evaluated according to standard WHO criteria for microscopic and macroscopic parameters and compared between smokers and non-smokers. Statistical analysis was performed using SPSS, with $p \leq 0.05$ considered significant. **Results:** Significant detrimental effects from smoking were identified in key microscopic semen parameters. Smokers exhibited a marked reduction in mean sperm concentration (30.83 ± 36.34 million/ml) versus non-smokers (74.67 ± 52.45 million/ml, $p < 0.001$). Total motility was significantly lower in smokers ($52.27 \pm 19.25\%$) than non-smokers ($67.61 \pm 11.24\%$, $p < 0.001$). Sperm vitality was also reduced in smokers ($58.05 \pm 17.93\%$) compared to non-smokers ($68.57 \pm 11.43\%$, $p < 0.001$). Macroscopic profiles (volume, viscosity) showed no significant variances. **Conclusion:** Cigarette smoking severely impairs male reproductive health by lowering sperm concentration, motility, and vitality. These alterations strongly suggest compromised spermatogenesis and restricted fertilization potential.

KEYWORDS

Semen Analysis, Infertility, Cigarette Smoking, Sperm Motility.

INTRODUCTION

Infertility refers to the incapacity of a sexually active couple who do not use contraception to naturally conceive a child within a year, where it can be primary, meaning no previous pregnancies; or secondary, meaning previous successful conceptions but subsequent difficulties(1).

According to the WHO, Infertility impacts 48 million couples globally, affecting a total of 186 million individuals across the world. Infertility is a common problem for 8–15% of couples globally and 10–15% of couples in developed countries (2).

In a developing country, like ours, where most societies are organized, the inability to bear children is a tragedy for the families. So it becomes important to know about various risk factors associated with infertility as awareness of male infertility is low in India(3).

Cigarette smoking is a major public health problem. The highest prevalence of smoking is observed in young adult males in their reproductive period. Cigarette smoking may be associated with sub-fertility in males, which may be attributed to decreased sperm concentration, lower sperm motility and a reduced percentage of morphologically normal sperms(7).

Semen parameters might be sensitive markers for these influencing factors, hence our study was focused on effects of cigarette smoking on semen parameters.

AIMS AND OBJECTIVES

1. To perform the quantitative and qualitative analysis of semen.
2. To compare the sperm parameters in smokers and non-smokers

MATERIALS AND METHODS

Study Design: Cross-sectional study

Study Area: This study was carried out in Department of Pathology in Jhalawar Medical College.

Sample Size: 105 patients.

Study Period: 1 Year.

Inclusion Criteria: Patients in the age group of 21 to 55 years referred for semen analysis for infertility.

Exclusion Criteria: -Men below 21 years and over 55 years of age.
-Cases that will not give consent.

Sample Collection: After written consent, semen sample was collected from all 105 patients by masturbation after 2-7 days of sexual abstinence. The ejaculate was collected into a clean, dry, sterile, leak proof container with a wide mouth. Semen samples were allowed to liquefy in an incubator at 37°C and analysed according to WHO guidelines.

Parameters Studied:

Gross Examination-

- Semen volume
- Liquefaction time

Microscopic Examination-

- Sperm concentration
- Sperm motility
- Progressive motility
- Vitality
- Morphology
- Pus cells
- RBCs and epithelial cells

STATISTICAL ANALYSIS:

Data were tabulated and analyzed using appropriate statistical methods. Mean values and percentages were calculated, and comparisons between smokers and non-smokers were performed. Statistical analysis was performed using SPSS, with $p \leq 0.05$ considered significant.

RESULTS & OBSERVATION

Table 1: Distribution of Study Population According to Smoking Status

Smoking Status	Number of Cases	Percentage
Smokers	58	55.2%
Non-Smokers	47	44.8%
Total	105	100%

Table 2: Comparison of Semen Parameters Between Smokers and Non-Smokers

Parameter	Non-Smokers Mean $\pm$ SD	Smokers Mean $\pm$ SD	P-value
Semen Volume (ml)	2.59 $\pm$ 1.02	2.74 $\pm$ 1.56	0.552
Liquefaction time (min)	40.96 $\pm$ 17.53	45.86 $\pm$ 31.51	0.343
Total Sperm Concentration (million/ml)	74.67 $\pm$ 52.45	30.83 $\pm$ 36.34	<0.001
Percentage Motility (%)	67.61 $\pm$ 11.24	52.27 $\pm$ 19.25	<0.001
Grade A Fast Progressive (%)	43.00 $\pm$ 13.28	31.84 $\pm$ 16.88	<0.001
Grade B Slow Progressive (%)	24.93 $\pm$ 11.27	20.52 $\pm$ 9.21	0.032
Grade C Immotile (%)	32.39 $\pm$ 11.24	46.66 $\pm$ 19.63	<0.001
Vitality (%)	68.57 $\pm$ 11.43	58.05 $\pm$ 17.93	<0.001
RBC (/hpf)	1.50 $\pm$ 1.41	2.61 $\pm$ 3.58	0.409
Pus Cells (/hpf)	5.06 $\pm$ 4.16	5.32 $\pm$ 4.54	.803
Epithelial Cells (/hpf)	2.44 $\pm$ 1.82	1.83 $\pm$ 1.23	0.172
Normal Morphology (%)	71.78 $\pm$ 17.27	68.41 $\pm$ 21.65	0.394
Abnormal Morphology (%)	28.11 $\pm$ 17.40	31.59 $\pm$ 21.65	0.394

- Smokers showed significantly decreased sperm concentration compared to non-smokers.
- Progressive sperm motility was significantly reduced among smokers.
- Smokers had significantly higher immotile sperm percentage.
- Sperm vitality was significantly reduced in smokers.
- Smokers showed mildly increased abnormal sperm morphology and reduced normal morphology; however, the difference was not statistically significant.
- No statistically significant difference was observed in pus cells, RBC count, or epithelial cell count between smokers and non-smokers.
- Semen volume was slightly higher in smokers; however, the difference was not statistically significant.
- Liquefaction time was slightly higher in smokers; however, the difference was not statistically significant.

DISCUSSION

Smoking is considered a major modifiable risk factor affecting male fertility. The present study demonstrated adverse effects of cigarette smoking on both qualitative and quantitative semen parameters.

We showed that smoking did not significantly affect semen volume or liquefaction time in our study. We observed that Eslamian et al. (2020) reported semen volume of 2.8 ± 1.1 ml in non-smokers and 2.6 ± 1.3 ml in smokers, with no significant difference ($p > 0.05$), and liquefaction time of 38.5 ± 12.4 min vs 42.1 ± 18.6 min respectively (11). We found that WHO (2021) also reports normal semen volume range of 1.5–6 ml and states that smoking-related changes in volume are inconsistent across populations (12).

We found that smoking significantly impairs sperm concentration and motility. We observed that Sharma et al. (2016) reported sperm concentration of 32.5 ± 18.4 million/ml in smokers vs 78.6 ± 25.3 million/ml in non-smokers, and motility of $51.2 \pm 14.6\%$ vs $69.4 \pm 10.2\%$, which closely matches our findings (13). We found that Agarwal et al. (2019) also demonstrated reduced motility ($55.1 \pm 12.3\%$ in smokers vs $70.5 \pm 9.8\%$ in non-smokers) and lower concentration ($28\text{--}35$ million/ml vs $70\text{--}80$ million/ml) due to oxidative stress-mediated sperm damage (14). We observed that EAU Guidelines (2024) confirm that smokers show 20–40% reduction in sperm motility and concentration compared to non-smokers (15).

We found that sperm vitality was significantly reduced in smokers compared to non-smokers. Immotile sperm was increased in smokers compared to non-smokers. We observed that Mostafa et al. (2017) reported sperm vitality of $59.8 \pm 10.5\%$ in smokers vs $70.2 \pm 9.3\%$ in non-smokers, and immotility of $45.1 \pm 15.2\%$ vs $30.8 \pm 10.7\%$, which is similar to our results (16). We found that Agarwal et al. (2019) also reported increased oxidative stress leading to reduced vitality by approximately 10–15% in smokers compared to non-smokers (14).

We observed no significant difference in pus cells, RBCs, or epithelial cells, similar to WHO (2021) findings that smoking does not significantly affect seminal inflammatory cell count unless infection is present (12).

We showed that smoking causes mild but non-significant deterioration in sperm morphology. We observed that De Iuliis et al. (2015) reported normal morphology of $70.5 \pm 12.3\%$ in non-smokers vs $66.2 \pm 14.8\%$ in smokers, with increased DNA fragmentation index (28.4% vs 16.2%) in smokers (17).

The findings of the present study are consistent with previously published literature showing significant association between cigarette smoking and impaired semen quality.

CONCLUSION

Cigarette smoking has a significant negative impact on semen quality. These impact strongly suggest compromised spermatogenesis and restricted fertilization potential.

Smokers demonstrate reduced sperm concentration, decreased motility, impaired vitality, and increased abnormal morphology compared to non-smokers.

Smoking cessation should be strongly recommended in males undergoing infertility evaluation. Public health awareness regarding the adverse reproductive effects of smoking may help improve fertility

outcomes. Clinical workflows and fertility counseling for couples must prioritize targeted smoking cessation programs as an essential lifestyle modification to improve baseline semen quality..

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