Section: Pathology

Original Research Article

IMPACT OF ALCOHOL, CIGARETTE SMOKING AND BODY MASS INDEX ON SEMEN QUALITY OF MALE PARTNERS AMONG INFERTILE COUPLES

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ABSTRACT

Background: This study was undertaken to evaluate the impact of body mass index (BMI), smoking, and alcohol consumption on semen quality among male partners of infertile couples attending a tertiary care centre in North India. **Materials and Methods:** A total of 150 infertile males undergoing semen analysis were included. Detailed histories regarding smoking and alcohol consumption were obtained, and BMI was calculated. Semen samples were analysed according to standard physical, chemical, and microscopic parameters. **Results:** Smokers constituted 44.7% and alcohol consumers 43.3% of the study population. Smoking was significantly associated with reduced progressive sperm motility ($p = 0.029$). Alcohol consumption showed a significant negative association with semen volume ($p = 0.046$) and normal sperm morphology ($p = 0.049$). BMI demonstrated a significant negative correlation with sperm concentration ($p = 0.009$), total sperm count ($p = 0.003$), motility ($p = 0.015$), and normal morphology ($p = 0.007$). **Conclusion:** Elevated BMI, cigarette smoking, and alcohol consumption adversely affect semen quality.

INTRODUCTION

According to the International Glossary on Infertility and Fertility Care, 2025, infertility is a disease characterized by the failure to establish a clinical pregnancy after 12 months of regular, unprotected sexual intercourse or due to an impairment of a person's capacity to reproduce either as an individual or with her/his/their partner.[1] It is a significant global health issue, estimates suggest that approximately one in every six people of reproductive age worldwide experience infertility in their lifetime.[2] Overall, the male factor substantially contributes to about 50% of all cases of infertility.[3] Declining semen quality has been increasingly linked to modifiable lifestyle factors rather than genetic causes. Obesity disrupts hormonal regulation and spermatogenesis, resulting in reduced sperm quality, while cigarette smoking induces oxidative stress and DNA damage that impair sperm function.[4] Excessive alcohol consumption further alters reproductive hormones and sperm morphology. Collectively, obesity, smoking, and alcohol use adversely influence male fertility and warrant targeted lifestyle interventions and counselling to improve reproductive outcomes.[5]

MATERIALS AND METHODS

Study design and setting: This observational cross-sectional study was conducted at the Department of Pathology, Teerthanker Mahaveer Medical College & Research Centre Moradabad, for a period of 18 months. Ethical approval was obtained from the Ethical Approval Committee of Teerthanker Mahaveer Medical College & Research Centre Moradabad.

Study Population: The study included 150 male partners of infertile couples presenting for semen analysis who provided informed consent. Participants with an abstinence period of less than 3 or more than 7 days, chronic medical illness, negative seminal fructose test, or occupational exposure to hazardous chemicals or dye industries were excluded.

Statistical Analysis

The collected data were entered and tabulated in Microsoft Excel for subsequent statistical evaluation. Results were expressed as mean ± standard deviation.

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Statistical significance was set at $p < 0.05$, and associations between variables were evaluated using the Pearson correlation test to determine the relationship between lifestyle factors and semen parameters.

RESULTS

The study included 150 infertile males evaluated for semen quality. Most participants were aged 31–40 years (48.67%), followed by 18–30 years (32.0%) and 41–45 years (19.33%). The mean body mass index (BMI) was 25.15 ± 4.19 kg/m², with a median value of 25.60 kg/m², suggesting that a considerable number of participants were overweight and that BMI values showed a relatively symmetric distribution. 44.7% of the subjects were smokers, while 55.3% were non-smokers. Among smokers, the majority consumed more than 10 cigarettes per day, and most had a smoking duration of 6–10 years, reflecting a substantial burden of prolonged tobacco exposure. Alcohol consumption was reported by 43.3% of participants, whereas 56.7% did not consume alcohol. Assessment of alcohol-related risk revealed that 74.7% of subjects belonged to the low-risk category, while 11.3%, 7.3%, and 6.7% were categorized as medium risk, high risk, and likely alcohol addiction, respectively. Semen volume among the study participants ranged from 1.21 mL to 3.99 mL, with a mean value of 2.54 ± 0.82 mL, which falls within the normal reference range, although moderate inter-individual variability was observed.

Table 1: Descriptive Analysis of Semen Parameters

Variables	Minimum	Maximum	Mean	SD
Sperm Count (million/mL)	11.5	64.3	33.36	14.69
Total Sperm Count (million)	19.6	251.0	86.93	52.99
Motility (%)	25	69	47.36	12.92
Progressive Motility (%)	15	55	37.90	12.28
Normal Morphology (%)	2	8	5.20	1.84
Liquefaction Time (min)	15	39	26.73	6.94

The mean sperm concentration was 33.36 ± 14.69 million/mL and the mean total sperm count was 86.93 ± 52.99 million, indicating considerable variability among participants. Mean total motility and progressive motility were 47.36 ± 12.92% and 37.90 ± 12.28%, respectively, while normal sperm morphology averaged 5.20 ± 1.84% and liquefaction time was 26.73 ± 6.94 minutes, reflecting moderate variation in semen characteristics among infertile males.

Among the 150 study participants, 108 (72.0%) had a positive fructose test, while 42 (28.0%) showed a negative result. The predominance of positive fructose tests suggests generally preserved seminal vesicle function in most subjects.

Table 2: Comparison of sperm parameters according to smoking status

Smoking		SV ml	SCM ml	TSC million	Motility%	Progressive Motility%	Normal Morphology%
Yes	Mean	2.52	32.66	82.01	48.70	35.94	5.34
	SD	0.82	13.56	44.75	13.64	11.69	1.87
No	Mean	2.56	34.22	93.02	45.70	40.33	5.03
	SD	0.83	16.03	61.51	11.86	12.65	1.81
p-value		0.78	0.52	0.21	0.16	0.029*	0.31

Comparison of semen parameters between smokers and nonsmokers revealed that smokers had slightly lower mean semen volume, sperm concentration, and total sperm count than nonsmokers; however, these differences were not statistically significant. Although overall sperm motility was marginally higher among smokers, progressive sperm motility was significantly lower in smokers (35.94 ± 11.69%) compared to nonsmokers (40.33 ± 12.65%) ($p = 0.029$). Normal sperm morphology showed no significant difference between the two groups.

Table 3: Comparison of sperm parameters according to alcohol consumption

Alcohol		SV ml	SCM ml	million	Motility%	Progressive Motility%	Normal Morphology%
Yes	Mean	2.42	32.60	80.06	46.69	38.95	4.94
	SD	0.77	14.80	48.89	12.71	12.21	1.82
No	Mean	2.69	34.35	95.92	48.23	36.52	5.54

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	SD	0.87	14.59	57.07	13.23	12.34	1.83
p-value		0.046*	0.47	0.069	0.44	0.23	0.049*

Comparison of semen parameters between alcohol consumers and non-consumers showed that alcohol consumers had significantly lower mean semen volume (2.42 ± 0.77 mL vs. 2.69 ± 0.87 mL; p = 0.046) and normal sperm morphology (4.94 ± 1.82% vs. 5.54 ± 1.83%; p = 0.049). Although alcohol consumers also exhibited lower sperm concentration, total sperm count, and overall motility, these differences were not statistically significant.

Table 4: Correlation between BMI and Sperm parameters

BMI	SV ml	SCM ml	TSCM	Motility%	Progressive Motility%	Normal Morphology %
Pearson Correlation	-0.082	-0.214	-0.241	-0.198	-0.176	-0.221
Sig. (2-tailed)	0.318	0.009*	0.003*	0.015*	0.031*	0.007*

BMI showed a negative correlation with all semen parameters, indicating that increasing BMI was associated with declining semen quality. Significant inverse correlations were observed with sperm concentration (r = -0.214, p = 0.009), total sperm count (r = -0.241, p = 0.003), motility (r = -0.198, p = 0.015), progressive motility (r = -0.176, p = 0.031), and normal morphology (r = -0.221, p = 0.007), while the association with semen volume was not statistically significant.

DISCUSSION

The present study was conducted among 150 infertile males undergoing semen analysis to evaluate the impact of body mass index (BMI), cigarette smoking, and alcohol consumption on semen quality. The age distribution of study participants reflects the trend that men commonly seek infertility evaluation during their third and fourth decades of life. Increasing paternal age has been associated with reduced semen quality, higher sperm DNA fragmentation (SDF), and impaired reproductive outcomes. Boeri L et al.[6] reported similar findings with a positive relationship between advancing age and SDF, while Chua SC et al,[7] demonstrated that ageing contributes to declining sperm motility, morphology, and genomic integrity through cumulative oxidative stress and impaired DNA repair mechanisms.

The mean BMI of the study population was 25.15 ± 4.19 kg/m², indicating that a considerable proportion of participants were overweight. The findings revealed a negative correlation between BMI and all assessed semen parameters, suggesting that increasing BMI adversely affects sperm production and function. These findings were in accordance with the findings of Jensen TK et al.[8] who found greater sperm DNA fragmentation and oxidative sperm damage among overweight infertile men. They also reported lower sperm concentration and total sperm count among men with abnormal BMI, accompanied by hormonal alterations. Sermondade N et al.[9] observed that obesity was significantly associated with reduced semen volume, decreased progressive motility, and erectile dysfunction. Cigarette smoking emerged as another important lifestyle factor influencing semen quality. In the present study, 44.7% of participants were smokers, and smokers exhibited significantly lower sperm concentration and progressive sperm motility compared to non-smokers. Sharma R et al.[10] observed reduced sperm count, semen volume, and motility among moderate and heavy smokers. Boeri L et al.[6] evaluated infertile males, demonstrated that smoking adversely affects sperm concentration, morphology, motility, and reproductive hormone profiles. The detrimental effects of smoking are attributed to toxic compounds such as nicotine, cadmium, carbon monoxide, and polycyclic aromatic hydrocarbons, which increase oxidative stress and impair mitochondrial function within the testes. Excessive production of reactive oxygen species leads to lipid peroxidation, sperm DNA damage, apoptosis, and reduced sperm motility. Although some studies have produced conflicting results regarding sperm DNA fragmentation, the majority of available evidence supports a negative effect of smoking on male reproductive function8. Alcohol consumption was reported by 43.3% of study participants and was significantly associated with reduced semen volume and normal sperm morphology. Boeri L et al.[6] documented poorer semen quality and increased sperm DNA damage among heavy alcohol consumers. Alcohol adversely affects fertility by suppressing hypothalamic gonadotropin-releasing hormone secretion, impairing Leydig and Sertoli cell functions, reducing testosterone production,[11] and promoting oxidative stress through acetaldehyde and reactive oxygen species generation.[12] Chronic alcohol exposure can result in abnormal sperm morphology, impaired spermatogenesis, and hormonal disturbances. Ramon R et al.[13] and Finelli R et al.[14] demonstrated that excessive alcohol intake is associated with lower sperm concentration, altered reproductive hormones, and diminished semen quality.

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CONCLUSION

The present study demonstrates that elevated BMI, cigarette smoking, and alcohol consumption adversely affect semen quality among infertile men. Higher BMI was associated with poorer sperm parameters, while smoking reduced progressive motility and alcohol consumption impaired semen volume and morphology. Lifestyle modification may improve male reproductive health and fertility outcomes.

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