Original Article

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Lifestyle and Occupational Determinants of Semen Quality in Men Attending an Infertility Clinic: A Cross-sectional Study

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ABSTRACT

Introduction: Male infertility contributes to nearly 50% of infertility cases worldwide. Emerging evidence suggests that modifiable occupational and lifestyle factors may adversely affect semen quality.

Aim: To evaluate associations between semen parameters and various lifestyle factors among men presenting to an infertility clinic in India.

Materials and Methods: This cross-sectional analytical study was conducted at the infertility clinic of the Department of Obstetrics and Gynaecology at SBKS Medical Institute and Research Centre, Vadodara, a tertiary care hospital in India, from January 2024 to April 2025. A total of 110 male partners of infertile couples were included. After obtaining informed consent, a detailed history was recorded, including occupation, exposure to heat or chemicals, cell phone usage and addictions (smoking, alcohol). Semen analyses were performed according to the World Health Organisation (WHO) 2021 criteria. Semen samples were categorised as normal or abnormal based on sperm count, motility and morphology. Statistical analyses included the Chi-square test and multivariable logistic regression to identify independent predictors of abnormal semen parameters.

Results: The mean age of the participants was 33.4±5.7 years. A total of 38 (34.5%) were smokers, 44 (40.0%) reported regular alcohol consumption and 69 (62.7%) reported cell phone use >2 hours/day. A total of 26 (23.6%) had exposure to heat, while 15 (13.6%) had exposure to harmful chemicals and 54 (49.1%) had a sedentary occupation. Of the 110 participants, 67 (60.9%) had at least one abnormal semen parameter. Abnormal semen quality was significantly associated with smoking (OR 2.9, p=0.031), daily cell phone usage >2 hours (OR 3.7, p=0.001), occupational heat exposure (OR 4.6, p=0.003) and chemical exposure (OR 5.9, p<0.001). Alcohol use and sedentary occupation were not independently associated with abnormal semen quality.

Conclusion: The present study highlights significant associations between semen abnormalities and modifiable factors such as smoking, prolonged cell phone use and occupational exposures. Addressing these risk factors through lifestyle counselling and workplace interventions may improve male reproductive health outcomes.

Keywords: Cell phone use, Chemical exposure, Heat exposure, Male infertility, Semen analysis, Smoking, Sperm quality

INTRODUCTION

Infertility affects approximately 15% of couples globally, with male factors contributing to nearly half of these cases, either alone or in combination with female factors [1]. In recent decades, there has been growing concern about a decline in semen quality, with studies suggesting downward trends in sperm concentration, motility and morphology across different populations [2,3]. Several modifiable lifestyle factors are believed to play a role in this decline, making them critical targets for evaluation and intervention.

Male infertility is multifactorial, influenced by genetic, hormonal and anatomical factors and increasingly by lifestyle and occupational exposures [4]. Emerging evidence implicates smoking, alcohol use, obesity and sedentary behaviour as risk factors negatively impacting spermatogenesis [5,6]. Additionally, environmental exposures such as heat (e.g., in drivers or welders), industrial chemicals, radiation and electromagnetic waves (including prolonged cell phone usage) have been associated with altered sperm quality [7-10].

In the Indian context, limited studies have comprehensively evaluated the interplay of occupational and lifestyle factors with semen quality among men seeking infertility care [11,12]. The present study was designed to investigate the association between semen parameters and various demographic, lifestyle and occupational exposures in men presenting to an infertility clinic in India. By identifying potentially modifiable risk factors, the present study aimed to contribute to the growing body of evidence guiding the prevention and management of male infertility.

MATERIALS AND METHODS

The present cross-sectional analytical study was conducted at the infertility clinic of the Department of Obstetrics and Gynaecology, SBKS Medical Institute and Research Centre, Vadodara, a tertiary care hospital in India, from January 2024 to April 2025. The study was approved by the Institutional Ethics Committee (SVIEC ION/Medi/BNPG/23/900124/279). Written informed consent was obtained from all participants. Confidentiality of patient data was strictly maintained throughout the study.

Inclusion criteria: All male partners of couples presenting to the infertility clinic during the study period were considered for inclusion (N=110). Men were eligible to participate if they met the following criteria:

- Age between 21 and 50 years.
- Presented for evaluation as part of an infertile couple (defined as failure to conceive after 12 months of unprotected intercourse).
- Provided informed written consent to participate in the study.

Exclusion criteria:

- History of known genetic or chromosomal abnormalities.
- Azoospermia or obstructive causes of infertility (e.g., vasectomy).
- Current febrile illness or recent urogenital infection (within the past three months).

- History of testicular trauma or surgery within the past year.

Study Procedure

After obtaining informed consent, each participant underwent:

1. **Detailed history and questionnaire:** Data were collected using a structured proforma that included:
   - Demographic data: age, Body Mass Index (BMI), duration of infertility.
   - Lifestyle factors: smoking status, alcohol use, average daily cell phone usage.
   - Occupational exposure: type of work, exposure to heat (e.g., drivers, welders) or chemicals (e.g., solvents, pesticides).
2. **Semen analysis:** Semen samples were collected by masturbation after 2-5 days of sexual abstinence and analysed within one hour according to World Health Organisation (WHO) 2021 guidelines [13]. Parameters assessed included:
   - Semen volume
   - Sperm concentration (million/mL)
   - Progressive motility (%)
   - Morphology (normal forms, %)

Semen samples were categorised as abnormal, if any of the evaluated parameters fell below WHO reference thresholds.

Outcome measures: The primary outcome was the presence of abnormal semen parameters, defined as any deviation in sperm count, motility, or morphology based on WHO 2021 reference ranges [13].

STATISTICAL ANALYSIS

Data were entered into Microsoft Excel and analysed using Stata v14.0. Continuous variables were expressed as means±Standard Deviation (SD) and categorical variables as frequencies and percentages. The association between categorical variables and abnormal semen parameters was assessed using the Chi-squared test. Multivariable logistic regression analysis was conducted to identify independent predictors of abnormal semen parameters. Adjusted Odds Ratios (ORs) with 95% Confidence Intervals (CIs) were calculated. A p-value <0.05 was considered statistically significant.

RESULTS

A total of 110 men undergoing evaluation for infertility were included in the study. The mean age of the participants was 33.4±5.7 years. Among the participants, 38 (34.5%) were smokers and 44 (40.0%) reported regular alcohol consumption [Table/Fig-1]. Overall, 67 (60.9%) of participants had at least one abnormal semen parameter based on WHO 2021 reference criteria [13]. A significantly higher proportion of men with abnormal semen profiles were smokers (78.9% vs. 21.1%, p=0.002) and alcohol users (70.5% vs. 29.5%, p=0.049) [Table/Fig-2]. After adjusting for potential confounders such as age and BMI, the following factors remained significantly associated: smoking (p=0.031), cell phone usage >2 hours/day (p=0.007), heat exposure (p=0.011), chemical exposure (p=0.028) [Table/Fig-3].

Variables	n (%) or Mean±SD
Age (years)	33.4±5.7
BMI (kg/m²)	25.8±3.4
Infertility duration (years)	3.1±2.2
Lifestyle factors	
Smoking	38 (34.5%)
Alcohol use	44 (40.0%)
Cell phone >2 hrs/day	69 (62.7%)
Occupational hazard	
Heat exposure	26 (23.6%)
Chemical exposure	15 (13.6%)
Sedentary occupation	54 (49.1%)
Semen parameters	
Semen volume (mL)	2.6±0.9
Sperm concentration (millions/mL)	34.2±22.1
Sperm progressive motility (%)	38.6±12.5
Morphologically normal sperm (%)	3.2±1.7

[Table/Fig-1]: Baseline characteristics of the study population.

Factors	Abnormal semen (n=67)	Normal semen (n=43)	p-value
Smoking	30 (78.9%)	8 (21.1%)	0.002 **
Alcohol use	31 (70.5%)	13 (29.5%)	0.049 *
Cell phone >2 hrs/day	51 (73.9%)	18 (26.1%)	0.001 **
Heat exposure	21 (80.8%)	5 (19.2%)	0.005 **
Chemical exposure	13 (86.7%)	2 (13.3%)	0.012 *
Sedentary occupation	36 (66.7%)	18 (33.3%)	0.37

[Table/Fig-2]: Association between lifestyle/occupational factors and abnormal semen parameters.
*p<0.05; **p<0.01

Variables	Adjusted OR (95% CI)	p-value
Smoking	2.9 (1.1 - 7.6)	0.031*
Alcohol use	1.8 (0.8 - 4.2)	0.132
Cell phone >2 hrs/day	3.4 (1.4 - 8.2)	0.007**
Heat exposure	4.6 (1.4 - 14.8)	0.011*
Chemical exposure	5.9 (1.2 - 29.1)	0.028*
Age	1.1 (0.96 - 1.24)	0.174
BMI	1.03 (0.91 - 1.18)	0.650

[Table/Fig-3]: Multivariate logistic regression: predictors of abnormal semen parameters.
Model Fit: Hosmer-Lemeshow Test, p=0.72 | Nagelkerke R^2=0.39

DISCUSSION

The present cross-sectional study of 110 men presenting to an infertility clinic found that 60.9% had at least one abnormal semen parameter. Several modifiable factors were significantly associated with semen abnormalities, including smoking, prolonged cell phone use, heat exposure and chemical exposure.

The association between smoking and reduced semen quality is well documented. Cigarette smoke contains oxidative agents that can impair spermatogenesis, reduce motility and increase sperm Deoxyribonucleic Acid (DNA) fragmentation [5,14]. In the present study, smokers had nearly three times the odds of abnormal semen parameters (OR=2.9), consistent with prior research showing impaired sperm function among smokers [15].

Cell phone usage, particularly for prolonged durations, has emerged as a novel area of concern. Electromagnetic radiation emitted by mobile phones may generate Reactive Oxygen Species (ROS), leading to oxidative stress in the testes [10,16]. The present findings echo those of Agarwal A et al., who reported decreased sperm motility and viability in men with high cell phone use [17].

Exposure to heat and industrial chemicals was significantly associated with poor semen quality. Elevated scrotal temperatures from occupational exposure (e.g., drivers, welders) can impair spermatogenesis and reduce sperm motility [18,19]. Chemical exposures such as solvents, pesticides and heavy metals have been linked to hormonal disruption and testicular toxicity [9,20]. In the present study, both heat and chemical exposure showed strong independent associations (OR=4.6 and OR=5.9, respectively), reinforcing the need for occupational safety interventions.

Interestingly, although alcohol use was associated with semen abnormalities in bivariate analysis, it was not an independent

predictor in the multivariable model. This may reflect variable consumption patterns and other confounding factors such as diet and co-morbidities, as also noted in previous studies [6,21,22]. Contrary to some reports [11,23], the authors found no significant association between sedentary occupation and semen quality. This may be due to the broad classification used in the present study or unmeasured confounding such as physical activity outside work.

A strength of the present study is its comprehensive assessment of a wide range of modifiable factors using both clinical data and detailed history. By including men from a real-world clinical population, the present findings have practical relevance for infertility counselling.

Limitation(s)

The sample size was limited due to resource constraints, which may have reduced statistical power for detecting weaker associations. The cross-sectional design precludes causal inferences and the self-reported nature of exposure data may be subject to recall bias. Additionally, more detailed exposure quantification (e.g., duration of chemical exposure, cell phone radiation levels) was not feasible.

CONCLUSION(S)

The present findings highlight the importance of incorporating occupational and lifestyle history into the routine evaluation of male infertility. Counselling on smoking cessation, minimising mobile phone radiation exposure and avoiding heat/chemical hazards may improve reproductive outcomes. Larger prospective studies are needed to explore pathways and interventions.

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