Section: OBG

Original Research Article

# INFLUENCE OF ANTHROPOMETRIC, OCCUPATIONAL AND LIFESTYLE FACTORS ON SEMEN PARAMETERS IN INFERTILE MEN: A CROSS-SECTIONAL STUDY

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***Received*** *: 12/05/2026*
***Received in revised form*** *: 30/06/2026*
***Accepted*** *: 13/07/2026*

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**DOI:** 10.70034/ijmedph.2026.3.98

**Source of Support:** Nil,
**Conflict of Interest:** None declared

**Int J Med Pub Health**
2026; 16 (3); 601-605

**ABSTRACT**

**Background:** Male reproductive health is influenced by several environmental and lifestyle factors beyond substance use. Increasing age, obesity, sedentary behavior, prolonged mobile phone exposure, and occupational heat or radiation may adversely affect spermatogenesis through hormonal imbalance, oxidative stress, and thermal injury. This study evaluated the association of these non-addictive lifestyle and occupational factors with semen quality among men attending an infertility clinic.

**Materials and Methods:** A descriptive cross-sectional study was conducted among 215 men presenting for infertility evaluation. Clinical information regarding age, body mass index, sedentary lifestyle, occupational exposure, prolonged sitting, and mobile phone usage was collected using a structured questionnaire. Semen analysis was performed according to WHO 2010 guidelines. Associations between lifestyle variables and semen abnormalities were evaluated using Pearson's Chi-square test.

**Results:** Increasing age was associated with reduced semen volume and impaired motility. Obesity demonstrated significant associations with reduced sperm concentration and impaired progressive motility. Sedentary lifestyle showed significant relationships with oligospermia, asthenozoospermia, necrozoospermia, and abnormal progressive motility. Occupational heat exposure was associated with impaired sperm concentration, vitality, and motility, while radiation exposure adversely affected multiple semen parameters including morphology. Prolonged sitting was associated with reduced sperm concentration and motility. Mobile phone exposure demonstrated an association with abnormal sperm morphology.

**Conclusion:** Non-addictive lifestyle and occupational factors exert significant adverse effects on semen quality. Weight optimization, increased physical activity, minimizing occupational heat exposure, and reducing prolonged sedentary behavior should be incorporated into fertility counselling for men undergoing infertility evaluation.

**Keywords:** Male infertility, Obesity, Sedentary lifestyle, Occupational exposure, Mobile phone, Semen quality.

## INTRODUCTION

Male infertility represents an increasingly recognized contributor to reproductive failure worldwide and accounts for nearly half of infertility cases among couples seeking conception.[1] Although genetic abnormalities, endocrine disorders, infections, and anatomical defects explain a proportion of male infertility, a substantial number of cases remain idiopathic despite comprehensive evaluation. Growing evidence suggests that environmental, occupational, and lifestyle-related exposures significantly influence male reproductive function and may partly explain the increasing prevalence of abnormal semen parameters observed over recent decades.[2]

Semen analysis remains the primary laboratory investigation for assessing male fertility potential. Parameters including semen volume, sperm concentration, motility, progressive motility, morphology, and vitality reflect the integrity of spermatogenesis and male reproductive capacity. Because spermatogenesis is a highly complex physiological process regulated by hormonal, metabolic, thermal, and environmental factors, disturbances in these mechanisms can result in measurable alterations in semen quality.[3]

Several non-addictive lifestyle factors have emerged as important determinants of male reproductive health. Increasing age has consistently been associated with gradual deterioration in semen quality. Although men retain reproductive potential throughout life, advancing age is associated with declining testosterone production, increased oxidative stress, mitochondrial dysfunction, accumulation of genetic mutations, and impaired DNA repair mechanisms. These biological changes may reduce semen volume, sperm motility, and sperm morphology while increasing sperm DNA fragmentation.[4]

Obesity has become one of the most significant global health concerns and has been increasingly implicated in male infertility. Excess adipose tissue contributes to hormonal imbalance through enhanced aromatization of testosterone to estrogen, resulting in suppression of gonadotropin secretion and impaired spermatogenesis. Obesity is also associated with insulin resistance, chronic low-grade inflammation, oxidative stress, increased scrotal temperature, and metabolic disturbances that adversely affect sperm production and function. Numerous studies have demonstrated associations between elevated body mass index and reduced sperm concentration, impaired motility, and abnormal morphology.[5]

Occupational factors represent another potentially modifiable cause of impaired semen quality. Continuous exposure to elevated temperatures has long been recognized to interfere with spermatogenesis because optimal sperm production requires testicular temperatures approximately 2–4°C below core body temperature. Workers exposed to furnaces, kitchens, foundries, boilers, and prolonged driving may experience chronic scrotal hyperthermia, leading to reduced sperm concentration, impaired motility, and increased abnormal sperm forms. Similarly, occupational radiation exposure has been associated with germ cell damage, chromosomal abnormalities, oxidative stress, and impaired spermatogenesis depending on dose and duration of exposure.[5]

The present study was conducted to evaluate the influence of age, body mass index, sedentary lifestyle, mobile phone usage, and occupational exposures including heat, radiation, and prolonged sitting on semen parameters among men undergoing infertility evaluation. The findings are expected to improve understanding of modifiable determinants of male fertility and support targeted lifestyle interventions aimed at optimizing reproductive outcomes.

## MATERIALS AND METHODS

This descriptive cross-sectional study was carried out between March 2018 and August 2019 at the Fertility Unit of the Department of Obstetrics and Gynaecology, Government Medical College, Kottayam, Kerala. The study investigated the influence of demographic characteristics, anthropometric parameters, occupational exposures, and lifestyle-related factors on semen quality among men undergoing infertility evaluation.

Men aged 25 to 60 years attending the fertility clinic for infertility assessment were considered eligible for participation. Subjects fulfilling the inclusion criteria were recruited consecutively after obtaining informed written consent. Individuals with previous testicular trauma, orchitis, torsion testis, varicocele, cryptorchidism, corrective surgery for congenital testicular disorders, mumps orchitis, chronic use of medications known to affect fertility, indigenous medication intake, or ongoing infertility treatment were excluded to minimize potential confounding factors affecting semen quality.

**Sample Size and Sampling Method**

Sample size estimation was performed using the standard formula for estimating a population proportion with specified relative precision. Based on published evidence indicating that approximately one-third of men exposed to adverse lifestyle factors exhibit abnormal semen quality, a prevalence of 33%,[5] 20% relative precision, and 95% confidence level were assumed. The estimated sample size was 195 participants, which was increased to 215 after considering an anticipated 10% dropout rate. Consecutive sampling was adopted to recruit eligible participants.

**Data Collection**

A structured interviewer-administered questionnaire was used to collect demographic and clinical information. Variables assessed included age, body mass index (BMI), sedentary lifestyle, mobile phone carrying habits, occupational exposure to heat, occupational radiation exposure, and prolonged sitting during work. These factors were considered the primary exposure variables for the present analysis.

Participants were instructed to observe three days of sexual abstinence before specimen collection. Semen samples were collected by masturbation into sterile containers and allowed to liquefy completely before laboratory analysis. Semen examination was performed according to the recommendations of the WHO Laboratory Manual (2010). The evaluated parameters included semen volume, sperm concentration, total motility, progressive motility, vitality, and sperm morphology.

The primary study outcomes included abnormalities in semen quality, namely oligospermia, asthenozoospermia, teratozoospermia, necrozoospermia, reduced progressive motility, and altered semen volume. These outcomes were analysed in relation to age, BMI, sedentary lifestyle, mobile phone use, occupational heat exposure, radiation exposure, and prolonged sitting.

**Statistical Analysis**

Data were entered into Microsoft Excel and analysed using IBM SPSS Statistics version 24. Descriptive statistics were expressed as frequencies and percentages. Pearson's Chi-square test was used to determine associations between lifestyle and occupational variables and semen abnormalities. Statistical significance was considered at $p < 0.05$.

**Ethical Considerations**

Ethical approval for the study was obtained from the Institutional Ethics Committee before commencement of the study. Written informed consent was obtained from all participants, and confidentiality of all collected information was ensured throughout the research process.

## RESULTS

**Table 1: Baseline characteristics of the study participants (N = 215)**

| Characteristic | Frequency (n) | Percentage (%) |
|---|---|---|
| Age (years) | | |
| 25–30 | 72 | 33.5 |
| 31–40 | 103 | 47.9 |
| 41–50 | 35 | 16.3 |
| 51–60 | 5 | 2.3 |
| BMI (kg/m²) | | |
| <18.5 | 4 | 1.9 |
| 18.5–22.9 | 50 | 23.3 |
| 23.0–24.9 | 47 | 21.9 |
| 25.0–29.9 | 88 | 40.9 |
| 30–40 | 26 | 12.1 |
| Sedentary lifestyle | 192 | 89.3 |
| Heat exposure | 102 | 47.4 |
| Radiation exposure | 16 | 7.4 |
| Prolonged sitting | 68 | 31.6 |
| Mobile phone kept in trouser pocket | 41 | 19.1 |

The majority of participants belonged to the 31–40-year age group (47.9%). Nearly 41% were pre-obese, while 89.3% reported a sedentary lifestyle. Occupational heat exposure was observed in 47.4% of participants, whereas radiation exposure and prolonged sitting were reported by 7.4% and 31.6%, respectively.

**Table 2: Overall distribution of abnormal semen parameters (N = 215)**

| Semen parameter | Abnormal n (%) |
|---|---|
| Low semen volume | 26 (12.1) |
| Abnormal liquefaction | 5 (2.3) |
| Oligospermia | 99 (46.0) |
| Asthenozoospermia | 67 (31.2) |
| Reduced progressive motility | 109 (50.7) |
| Reduced vitality | 70 (32.6) |
| Teratozoospermia | 12 (5.6) |

Reduced progressive motility (50.7%) and oligospermia (46.0%) were the most common semen abnormalities observed, whereas abnormal liquefaction and teratozoospermia were relatively uncommon.

**Table 3: Association between age and semen parameters**

| Parameter | $\chi^2$ | P value | Significance |
|---|---|---|---|
| Semen volume | 28.022 | <0.001 | Significant |
| Sperm concentration | 7.152 | 0.067 | Not significant |
| Motility | 13.332 | 0.004 | Significant |
| Progressive motility | 15.394 | 0.002 | Significant |
| Vitality | 14.848 | 0.002 | Significant |
| Liquefaction | 2.785 | 0.426 | Not significant |
| Morphology | 2.907 | 0.406 | Not significant |

Increasing age demonstrated significant adverse effects on semen volume, total motility, progressive motility and vitality. Men aged 51–60 years showed the greatest deterioration in semen quality.

**Table 4: Association between BMI and semen parameters**

| Parameter | $\chi^2$ | P value | Significance |
|---|---|---|---|
| Semen volume | 8.194 | 0.085 | Not significant |
| Liquefaction | 6.552 | 0.162 | Not significant |
| Sperm concentration | 25.215 | <0.001 | Significant |
| Motility | 4.443 | 0.349 | Not significant |
| Progressive motility | 19.120 | 0.001 | Significant |
| Vitality | 5.003 | 0.287 | Not significant |
| Morphology | 3.273 | 0.513 | Not significant |

Higher BMI was significantly associated with reduced sperm concentration and impaired progressive motility. Participants with BMI ≥25 kg/m² demonstrated the highest frequency of oligospermia.

**Table 5: Association between sedentary lifestyle and semen parameters**

| Parameter | $\chi^2$ | P value | Significance |
|---|---|---|---|
| Sperm concentration | 6.125 | 0.015 | Significant |
| Motility | 6.060 | 0.016 | Significant |
| Progressive motility | 6.241 | 0.015 | Significant |
| Vitality | 4.467 | 0.036 | Significant |
| Morphology | 1.522 | 0.217 | Not significant |

Sedentary lifestyle was significantly associated with reduced sperm concentration, motility, progressive motility and vitality. No statistically significant association was observed with sperm morphology.

**Table 6: Association between mobile phone usage and semen parameters**

| Parameter | $\chi^2$ | P value | Significance |
|---|---|---|---|
| Motility | 5.643 | 0.227 | Not significant |
| Progressive motility | 6.069 | 0.194 | Not significant |
| Vitality | 7.756 | 0.101 | Not significant |
| Morphology | 37.140 | <0.001 | Significant |

Keeping mobile phones in the trouser pocket was significantly associated with abnormal sperm morphology. No significant association was identified with sperm motility, progressive motility or vitality.

**Table 7: Association of Occupational Exposures with Semen Parameters among the Study Participants (N = 215)**

| Occupational Exposure | Semen Parameter | $\chi^2$ | P value | Statistical Significance |
|---|---|---|---|---|
| Heat exposure | Sperm concentration | 16.960 | <0.001 | Significant |
| | Total motility | 25.767 | <0.001 | Significant |
| | Progressive motility | 7.899 | 0.005 | Significant |
| | Vitality | 36.721 | <0.001 | Significant |
| | Morphology | 0.170 | 0.680 | Not significant |
| Radiation exposure | Sperm concentration | 8.623 | 0.003 | Significant |
| | Total motility | 5.072 | 0.024 | Significant |
| | Progressive motility | 4.085 | 0.043 | Significant |
| | Vitality | 4.419 | 0.036 | Significant |
| | Morphology | 5.688 | 0.017* | Significant |
| Prolonged sitting | Sperm concentration | 24.111 | <0.001 | Significant |
| | Total motility | 11.715 | 0.001 | Significant |
| | Progressive motility | 1.070 | 0.301 | Not significant |
| | Vitality | 1.460 | 0.227 | Not significant |
| | Morphology | 0.258 | 0.611 | Not significant |

Occupational exposures demonstrated varying effects on semen quality. Heat exposure was significantly associated with reduced sperm concentration, total motility, progressive motility, and vitality, but not sperm morphology. Radiation exposure adversely affected all evaluated semen parameters, including sperm morphology, indicating the broadest impact on semen quality among the occupational factors studied. Prolonged occupational sitting was significantly associated with reduced sperm concentration and total motility, whereas progressive motility, vitality, and sperm morphology were not significantly affected.

## DISCUSSION

Male infertility is increasingly recognized as a multifactorial disorder in which environmental, occupational, and lifestyle-related factors contribute substantially to impaired reproductive function. In addition to genetic and endocrine abnormalities, several potentially modifiable exposures including obesity, sedentary behaviour, occupational hazards, and prolonged exposure to heat have been implicated in altered spermatogenesis. The present study evaluated the influence of these factors on

semen quality among men attending an infertility clinic.

The study population predominantly consisted of men aged 31–40 years, with a mean body mass index corresponding to the pre-obese category according to Asian criteria. A large proportion of participants reported sedentary lifestyles, occupational heat exposure, and prolonged sitting, reflecting changing occupational and lifestyle patterns among reproductive-age men.

The present findings are consistent with those reported by Zavos et al, who demonstrated progressive deterioration of both quantitative and qualitative sperm characteristics after 40 years of age.[6] Similar age-related declines in semen quality have been documented in several population-based studies, supporting the concept that paternal ageing should be considered during infertility evaluation.[7,8]

Body mass index also demonstrated a significant relationship with semen quality. Participants with BMI ≥25 kg/m² showed significantly lower sperm concentration and impaired progressive motility compared with men of normal body weight. Obesity may impair reproductive function through hormonal imbalance, increased aromatization of testosterone to estrogen, insulin resistance, chronic inflammation, oxidative stress, and elevation of scrotal temperature.

Our findings are comparable with those reported by Hammoud et al,[9] who observed oligospermia as the predominant abnormality among overweight and obese men. Sedentary lifestyle was another important determinant of semen quality in the present study. Men with sedentary behaviour demonstrated significantly higher frequencies of oligospermia, asthenozoospermia, impaired progressive motility, and reduced vitality. Reduced physical activity may contribute to obesity, oxidative stress, metabolic dysfunction, and prolonged scrotal warming, all of which adversely affect spermatogenesis. These findings reinforce current recommendations promoting regular physical activity as part of male fertility optimization.

Mobile phone use was evaluated because of increasing concerns regarding radiofrequency electromagnetic radiation. In the present study, mobile phone carriage in trouser pockets was significantly associated only with abnormal sperm morphology, whereas other semen parameters were unaffected. Although this finding suggests a limited effect, the widespread use of mobile phones warrants continued investigation.

Previous studies have reported conflicting results regarding mobile phone exposure. Agarwal et al,[10] observed significant reductions in sperm count, motility, viability, and morphology with increasing mobile phone use, while La Vignera et al. reported reductions in sperm concentration, motility, morphology, and vitality.[11,12]

Overall, the present study demonstrates that several modifiable anthropometric, lifestyle, and occupational factors are associated with impaired semen quality. Weight optimization, regular physical activity, minimizing occupational heat exposure, reducing prolonged sitting, and implementing appropriate workplace safety measures should form an integral part of infertility counselling. Early identification and correction of these modifiable risk factors may improve reproductive outcomes and reduce the need for invasive fertility treatments.

## CONCLUSION

The present study demonstrates that several non-addictive lifestyle and occupational factors significantly influence semen quality in men undergoing infertility evaluation. Advancing age, increased body mass index, sedentary lifestyle, occupational heat exposure, radiation exposure, prolonged occupational sitting, and mobile phone carriage were associated with deterioration of one or more semen parameters. Occupational heat and radiation exposure showed the greatest adverse effects, while obesity and sedentary behaviour were associated with impaired sperm concentration and motility. These findings emphasize that many determinants of male infertility are potentially modifiable through lifestyle modification and workplace interventions. Incorporating weight management, regular physical activity, ergonomic workplace practices, minimization of occupational heat and radiation exposure, and appropriate counselling into infertility care may contribute to improved semen quality and better reproductive outcomes.

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