**Alqalam Journal of Medical and Applied Sciences**. 2025;8(4):2107-2112
https://doi.org/10.54361/ajmas.258403

*Original article*

# Lifestyle and Age-Related Determinants of Male Fertility: Evidence from Semen Analysis in Western Libya

**Ghadda Mohamed[1], Namat Abid[2]***

[1]*Department of Anesthesia and Intensive Care, Faculty of Nursing, University of Tripoli, Libya*
[2]*Department of Obstetrics and Gynecology, Faculty of Medicine, University of Tripoli, Aljalla Maternity Hospital, Tripoli, Libya*
***Correspondence email***. *Dr.naamatabid@gmail.com*

**Abstract**
Male fertility is influenced by a range of lifestyle and age-related factors. This study aims to explore the impact of age and smoking status on semen quality parameters, contributing to public health awareness and targeted fertility interventions. A retrospective analysis was conducted on medical records of 159 male patients aged 25–65 years, sourced from laboratories including the Sabratha Hospital Sanitarium. Semen parameters assessed included volume, abstinence duration, pH, sperm count, progressive motility, morphological abnormalities, and aggregation. Data were analyzed using SPSS 25 and Excel 2010, applying descriptive statistics, t-tests, and Pearson correlation coefficients. Statistical significance was set at $P < 0.05$ and $P < 0.001$. The majority of participants were aged 35–45 years (42.8%) and non-smokers (62.9%). Most semen parameters fell within normal WHO reference ranges, with 74.8% showing normal sperm counts and 99.4% exhibiting normal progressive motility. T-test analysis revealed a statistically significant reduction in sperm count among smokers ($P = 0.003$), while no significant differences were found in sample volume, abnormalities, or motility. Pearson correlation indicated strong negative associations between sperm count and smoking, and moderate negative correlations for sample volume and motility. Other variables showed weak or non-significant correlations. Smoking is significantly associated with reduced sperm count, while other semen parameters appear unaffected. Age distribution and abstinence duration also show variable influence. These findings underscore the need for lifestyle-focused fertility education and further research into modifiable risk factors affecting male reproductive health.
**Keywords**. Lifestyle, Male Fertility, Semen Analysis, Western Libya.

## Introduction

Male infertility remains a significant global health concern, contributing to nearly half of all infertility cases among couples of reproductive ages [1,2]. Semen analysis is a cornerstone in the diagnostic evaluation of male fertility, offering insights into parameters such as semen volume, sperm count, motility, morphology, and pH [3,4]. These parameters are influenced by a multitude of factors, including age, lifestyle habits, and environmental exposures [5].

Age-related changes in semen quality have been documented, with advancing age associated with reductions in sperm motility, concentration, and morphology [6,7]. Similarly, smoking has emerged as a modifiable risk factor with deleterious effects on male reproductive health. Cigarette smoke contains toxic compounds such as nicotine and carbon monoxide, which impair spermatogenesis and reduce seminal quality [8,9]. Studies have consistently demonstrated that smokers exhibit lower sperm counts, reduced motility, and increased morphological abnormalities compared to non-smokers [10–12].

In this study, semen parameters—including volume, duration of sexual abstinence, progressive motility, total sperm count, and morphological abnormalities—were classified and analyzed in relation to age group and smoking status. Descriptive statistics were applied to all variables, with categorical data expressed as frequencies and percentages, and continuous data as mean ± SEM. Statistical comparisons between groups were conducted using independent samples t-tests, with significance thresholds set at $P < 0.05$ and $P < 0.001$.

The analytical framework employed Microsoft Office Excel 2010 and SPSS version 25. This approach enabled the identification of statistically significant associations, particularly the negative impact of smoking on sperm count, while other parameters such as sample volume and motility appeared unaffected. Pearson correlation analysis further clarified the relationships between semen quality indicators and selected variables, revealing strong inverse correlations for sperm count and motility, and minimal associations for pH and aggregation. This investigation contributes to the growing body of evidence on lifestyle and age-related determinants of male fertility, underscoring the importance of targeted interventions and public health awareness.

## Methods

In this retrospective study, data were collected from a total of 159 patients aged between 25 and 65 years. As part of the research process, field visits were conducted to selected medical laboratories, including the laboratory of the Sabratha Hospital Sanitarium.

During these visits, the researchers reviewed archived medical records to extract relevant data pertaining to semen analysis and its association with specific variables, namely age group and smoking status. Parameters such as semen volume, duration of sexual abstinence, percentage of sperm exhibiting


***Received***: *27-07-2025* - ***Accepted***: *24-09-2025* - ***Published***: *01-10-2025*

progressive motility, total sperm count, and morphological abnormalities were classified and organized for subsequent statistical analysis.
All data obtained were calculated and analyzed by using Microsoft Office Excel 2010 and the SPSS 25 software (statistical package for statistical analysis). Descriptive analysis was performed on all the variables. Categorical variables results were described as counts and percentages, continuous variables results were expressed as mean ± SEM, and qualitative variables were expressed as frequency and percentage. Differences between the patients were determined using the t-test analysis. Statistical significance was considered as $P < 0.05$ and $P < 0.001$.

**Results**

Table 1 reveals that the highest proportion of respondents (42.8%) falls within the 35–45-year age group, followed by 32.1% in the 25–35-year group, 22.6% in the 45–55-year group, and the lowest proportion (2.5%) in the 55–65-year age group.

***Table 1. Distribution of the sample according to age groups***

| CLASS | Frequency | Percent |
|---|---|---|
| **25-35** | 51 | 32.1% |
| **35-45** | 68 | 42.8% |
| **45-55** | 36 | 22.6% |
| **55-65** | 4 | 2.5% |
| **Total** | 159 | 100 |

Table 2 indicates that the majority of the sample were non-smokers, comprising 62.9% of the respondents, while smokers accounted for 37.1% of the sample.

***Table 2. Distribution of the sample according to whether the person smokes or not***

| Measures | Frequency | Percent |
|---|---|---|
| **YES** | 59 | 37.1% |
| **NO** | 100 | 62.9% |
| **Total** | 159 | 100 |

Table 3 shows that 89.3% of the respondents fall within the normal range, while 10.7% are classified as above the normal range. Among respondents who reported abstinence from sexual intercourse, 92.5% fell within the normal range, 5.7% exceeded the normal range, and 1.9% were below the normal range. The highest proportion of respondents (96.2%) fell within the normal range, while a smaller percentage (3.8%) was below the normal threshold. The highest proportion of sperm count per ejaculation was within the normal range (74.8%), while 25.2% fell below the normal threshold. It was observed that the highest percentage of rapidly progressive motility was within the normal range (99.4%), while only 0.6% fell below the normal threshold.

***Table 3. Distribution of the sample according to the***

| Volume of sample WHO 1.5(1.4-1.7) | Frequency | Percent |
|---|---|---|
| Abnormal | 17 | 10.7% |
| Normal | 142 | 89.3% |
| **Abstinence** | | |
| Abnormal | 3 | 1.9% |
| Normal | 147 | 92.5% |
| **Higher Than Normal** | 9 | 5.7% |
| **PH WHO >7.2** | | |
| Abnormal | 6 | 3.8% |
| Normal | 153 | 96.2% |
| **Count** | | |
| Abnormal | 40 | 25.2% |
| Normal | 119 | 74.8% |
| **Rapidly Progressive motility (WHO ≥50%)** | | |
| Abnormal | 158 | 99.4% |
| Normal | 1 | 0.6% |

Table 4 reveals that 32.1% of the sample had an average value below 15, while 42.8% fell within the range of 15–30. Additionally, 22.6% recorded averages between 30–45, 2.5% between 45–60, and 6.9% between 60–75.


***Received****: 27-07-2025 -* ***Accepted****: 24-09-2025 -* ***Published****: 01-10-2025*

***Table 4. Distribution of the sample according to the Mixed abnormality***

| CLASS | Frequency | Percent |
|---|---|---|
| **At least 15** | 36 | 32.1% |
| **15-30** | 37 | 42.8% |
| **30-45** | 50 | 22.6% |
| **45-60** | 25 | 2.5% |
| **60-75** | 11 | 6.9% |

Table 5 shows that the highest percentage of sperm samples (74.8%) yielded positive analytical results, while 25.2% were associated with negative findings.

***Table 5. Distribution of the sample according to the Aggregation***

| CLASS | Frequency | Percent |
|---|---|---|
| **Negative** | 40 | 25.2% |
| **Positives** | 119 | 74.8% |
| **Total** | 159 | 100% |

Table 6 presents the results of the (T) test conducted by the researcher to examine the relationship between smoking status and various sperm parameters. The aim was to determine whether statistically significant differences exist between smokers and non-smokers in terms of sperm count, sample volume, sperm abnormalities, and sperm motility. According to the findings, there were statistically significant differences in sperm count, where the average number of sperm among non-smokers was higher than that of smokers, with a P-value of 0.003. This value is below the significance threshold adopted by the study (P-value < 0.05), confirming that smoking has a negative impact on sperm count. In contrast, the results showed no statistically significant differences in sample volume between the two groups, as the P.VALUE was 0.53, which exceeds the approved significance level. This indicates that smoking does not affect the volume of the sample. Similarly, the analysis revealed no significant differences in sperm abnormalities, with a P-value of 0.58, further supporting the conclusion that smoking does not influence abnormal sperm rates. The researcher also applied the (T) test to assess the effect of smoking on sperm motility, and the results are included in Table 6, although the specific P-value was not stated. Overall, the findings emphasize that smoking significantly reduces sperm count but does not appear to affect sample volume, sperm abnormalities, or motility.

**Table 6. The independent samples test for the relationship between smoking and different variables**

| Variables | Frequency | Arithmetic mean | Standard deviation | T | P-value |
|---|---|---|---|---|---|
| **Sperm count** | | | | | |
| Smoker | 59 | 0.34 | 1.6 | -1611 | 0.003 |
| Non smoker | 100 | 0.78 | 1.17 | | |
| **Sample size** | | | | | |
| Smoker | 59 | 1.58 | 0.51 | − 0.36 | 0.53 |
| Non smoker | 100 | 1.60 | 0.48 | | |
| **Sperm abnormalities** | | | | | |
| Smoker | 59 | 2.59 | 1.1 | − 0.13 | 0.58 |
| Non smoker | 100 | 2.6 | 1.2 | | |

Table 7 presents a set of Pearson correlation coefficients and corresponding p-values that reflect the statistical relationships between semen parameters and selected variables. Among the findings, the count variable stands out with a strong negative correlation, indicating a significant inverse association that may suggest a decline in sperm count as the influencing factor increases. Similarly, the volume of the sample and rapidly progressive motility show moderate negative correlations, both statistically significant, which could imply that these parameters are adversely affected under certain conditions. On the other hand, abstinence shows a weak positive correlation, though not statistically significant, suggesting a possible but inconclusive trend.

PH, mixed abnormality, and aggregation exhibit minimal correlations with high p-values, indicating no meaningful statistical relationship. These results collectively highlight that while some semen parameters are sensitive to specific variables, others remain unaffected, underscoring the complexity of factors influencing male fertility and the need for further investigation to clarify these associations.


***Received****: 27-07-2025 -* ***Accepted****: 24-09-2025 -* ***Published****: 01-10-2025*

***Table 7. Pearson Correlation and Significance Levels for Semen Quality Indicators***

| Variables | Pearson Correlation | P value |
|---|---|---|
| Volume of sample | -0.48-* | .046 |
| Abstinence | .209** | .11 |
| PH | .171 | .372 |
| Count | - 0.78-* | 0.0 |
| Mixed abnormality | -.044- | .580 |
| Aggregation | .059 | .457 |
| Rapidly Progressive motility | -0.182-* | 0.01 |

## Discussion

Semen analysis remains one of the most essential diagnostic tools for evaluating male infertility. The methodology for semen analysis has undergone continuous refinement, with new assessment criteria being proposed over time [17]. Likewise, the reference values for individual parameters have been subject to ongoing debate. Several studies have reported changes in sperm quality over the years, with a notable decline in sperm concentration [18,19]. Regional variations in semen parameters have also been frequently observed [20,21]. Therefore, it is recommended that each laboratory establish its own reference values and compare them with the WHO standards. In the present study, a normal distribution of individuals was observed only in relation to semen volume, with 89.3% falling within the WHO-defined normal range. For other parameters, the proportion of individuals below WHO standards ranged from 6% to 32.2%. Further research is needed to determine whether these findings accurately reflect the studied population or if they result from analytical discrepancies.

Animal model studies have consistently demonstrated age-related declines in fertility. Mice older than 18 months exhibit structural changes in germ cells and a significant reduction in their numbers, while those over 33 months show near-complete cessation of spermatogenesis [22]. Testicular atrophy and degeneration of the seminiferous epithelium have also been documented in aged rats [23].

In humans, aging is associated with functional decline in Leydig cells [24]. Among fertile men, advancing age correlates with reduced semen volume and decreased sperm motility [25]. However, sperm concentration does not appear to decline significantly with age [26]. Unlike female menopause, which typically leads to reduced fertility from age 35 onward, men may retain reproductive potential into advanced age. Notably, one birth to a father aged 70 or older occurs for every 10,000 births to fathers aged 30 [27]. A substantial proportion of individuals seeking infertility treatment are over the age of 65 [28].

Findings from the present study revealed normal semen volume but abnormal progressive motility in 99.4% of cases (Table 9), consistent with previous reports [25,26]. The impact of age on semen volume, sperm count, and rapidly progressive motility, with statistically significant differences observed ($P \leq 0.05$).

Sexual abstinence duration influences all semen parameters in fertile individuals. Longer abstinence periods are associated with increased sperm concentration, although progressive motility and normal morphology percentages tend to decline [29]. Similar trends have been observed in infertile patients, where extended abstinence leads to increased semen volume and sperm concentration without affecting motility or morphology [30]. In assisted reproduction settings, prolonged abstinence may be used to enhance sperm yield. Among 50 men with nonobstructive azoospermia undergoing testicular biopsy and ICSI, increasing the abstinence period from 4 to 14 days resulted in a higher total sperm count, with no change in motility [31].

In the current study, semen volume and sperm concentration increased with abstinence duration, and 92.5% of participants who abstained from sexual activity were within the normal range. Smoking remains prevalent, affecting 35% of adult men globally [32] and 37.1% of the study population. In Brazil, smoking rates reach 42% in the southern region, with Porto Alegre reporting the highest incidence of lung cancer [33]. Although smoking prevalence in northeastern Brazil is lower (31%), it remains concerning. The mechanisms by which smoking impairs fertility are not fully understood. Hormonal changes in smokers include reduced testosterone and elevated estradiol levels [34,35]. Genetic damage to sperm has also been documented, as cigarettes contain over 30 known mutagenic and carcinogenic compounds [35,36]. Despite this, the impact of smoking on standard semen parameters—concentration, motility, and morphology—remains controversial, with no definitive dose-response relationship established [34].

In this study, statistically significant differences were found in sperm count between smokers and non-smokers, with non-smokers exhibiting higher counts ($P = 0.003$), below the significance threshold ($P \leq 0.05$), thereby confirming the negative impact of smoking on sperm count. However, no significant differences were observed in semen volume between the two groups ($P = 0.53$), indicating that smoking does not affect sample volume.

## Conclusion

Based on the findings, it is evident that male infertility is influenced by a complex interplay of biological, behavioral, and environmental factors. Semen analysis remains a cornerstone in diagnostic evaluation, yet its interpretation must consider regional variations, evolving WHO standards, and individual lifestyle


***Received****: 27-07-2025 -* ***Accepted****: 24-09-2025 -* ***Published****: 01-10-2025*

factors. Age and sexual abstinence duration significantly affect semen parameters, with older age correlating with reduced motility and volume, and abstinence influencing concentration and morphology. Smoking, despite ongoing debate, demonstrates a statistically significant negative impact on sperm count, reinforcing the need for targeted public health interventions.

***Conflict of interest***. Nil

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***Received***: *27-07-2025* - ***Accepted***: *24-09-2025* - ***Published***: *01-10-2025*

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***Received****: 27-07-2025 -* ***Accepted****: 24-09-2025 -* ***Published****: 01-10-2025*