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ORIGINAL ARTICLE

Effect of seasonal variations on semen parameters.

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ABSTRACT… Objective: To determine the correlation between semen analysis parameters and seasonal temperature changes to present the picture of how environmental factors are related to male reproductive health. **Study Design:** Cross Sectional. **Setting:** Department of Microbiology, Jinnah Hospital Lahore. **Period:** February 2024 to January 2025. **Methods:** The total 92 males were enrolled. The semen sample was collected in a sterilized container by participants as per standard collection protocol. After the semen sample collection, the container is immediately transported to the microbiology laboratory for the testing. The statistical data analysis was done through IBM SPSS V.27.0. **Results:** The total 92 males were enrolled. The age range was 16 to 45 years with the mean age of 30.7 ± 4.71. Temperature was noted at the time of ejaculation and six groups of seasons were made. Volume, sperm concentration, progressive motility, non-progressive motility, & immotile sperms showed significant statistical association with average high temperature of environment. **Conclusion:** The present study showed a definite seasonal effect on semen parameters, with summer being most obviously detrimental.

Key words: Male Fertility, Semen, Seasonal Affects Semen Parameters.

INTRODUCTION

The male fertility analysis is an important aspect of the reproductive health. It offers an insight to any gynecologist as well as their patients and sources of information to fertility potential and quality semen.[1] A semen analysis is a laboratory test which determines standards such as sperm concentration, motility, morphology, volume, pH, and liquefaction time. All these factors include the ones that help gauge whether a sperm is willing to fertilize an egg or not. Semen concentration discounts the number of sperm cells living per milligram of semen, the motility and their motion and progress. Morphology looks at sperm structure so they would be the right shape most optimally serving a function. Volume is the most helpful to ascertain that it is sufficient seminal fluid with nutrients a protective bath. pH determines the acidity and alkalinity of an environment and may well influence the life viability of sperm. The liquefaction time will be important in determining how fast the ejaculate converts to more liquid within which the sperm will move.[2,3]

The evaluation of the semen is one of the most frequently indicated tests in infertility cases, where the couple has been having unprotected coitus for more than one year without conceiving. It is also included in the post-vasectomy assessment to confirm the absence of the sperm in the ejaculate, in suspected infection or inflammation affecting the reproductive tract, and in males with history of genetic or endocrine diseases that are likely to affect sperm production. Moreover, the semen analysis could be beneficial to the erectile dysfunction patients, those presenting with varicocele[4], and those exposed to environmental toxins or undergoing chemotherapy or radiotherapy, where fertility concerns exist. Since male factor infertility accounts for almost 40-50% of infertility cases worldwide, this test becomes vital in determining potential problems and guiding different treatment modalities. In fact, semen analysis is beyond just a diagnostic test; it becomes one of the essential pillars of treatment monitoring for patients undergoing assisted reproductive technologies, including intrauterine

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insemination (IUI) and in vitro fertilization (IVF). Thus, since the semen parameters are of time-frame evaluation, medical practitioners reap them as metrics for many such interventions including the hormonal treatments and lifestyle modifications to improve sperm quality.[5]

It is among the various factors affecting semen quality that the temperature ranks high. The human testes can hold on to their physiological at a temperature slightly lower than core body temperature of about 34-35°C; that is the reason why they are scrotal to the outside of the abdominal cavity; environmental change or fluctuation would affect spermatogenesis, which means affecting sperm count, motility, and morphology.[6] Seasonal changes, rather, also have an association with variations in semen parameters, due to extreme hot or cold ambient environment. Heat stress, which occurs in summer months, may lead to decreased sperm production and impaired motility. However, exposure to high temperatures leads to DNA fragmentation in sperm, dangerously decreasing the viability of sperm and leading to increased susceptibility to infertility.[7] In contrast, lower winter temperatures may, among other mechanisms, lead to improved sperm concentration and motility owing to better testicular thermoregulation. Research has shown generally that sperm parameters are better in the cool months, showing significant decreases in summer, which may be the result of oxidative stress induced by heat, in combination with hormonal variations.[8]

Occupational heat exposure, prolonged hot baths or saunas, and tight clothing constitute other temperature-associated stressors that could further impair semen quality. Experience-based lifestyle behaviors, such as extended periods of sitting, obesity, and the use of electronic devices such as laptops on one's lap, have also been associated with increased scrotal temperatures, which can subsequently have implications for reduced production and functionality of sperm.[9] Seasonal variations in sperm quality may unveil how some periods of decreased fertility can be explained among some men and may also point out aspects that require lifestyle modifications to lessen the possible adverse effects. Thus, thermal issues in male reproductive health have taken center stage in the face of changing environmental situations like global climate change and temperature increases of ambient conditions. This study discussed the correlation between semen analysis parameters and seasonal temperature changes to the greater picture of how environmental factors are related to male reproductive health. These seasonal trends are also useful in timing fertility treatments for enhanced clinical outcomes relating to couples struggling with infertility.

METHODS

This is a cross sectional study and conducted at the Microbiology laboratory of Jinnah Hospital Lahore. The study was approved the intuitional review board (Ref No: ERB 145/17/04-01-2024/ S1 ERB). The male patients came from semen analysis during the month of February 2024 to January 2025 were included. The male laboratory staff had instructed all males for sample collection method. The semen sample was collected in a sterilized container by participants as per standard collection protocol.[10,11] After the verbal informed consent taken from all males, their semen sample was enrolled for this study.

After the semen sample collection, the container is immediately transported to the microbiology laboratory and kept in incubator to maintain its temperature (37 °C). According to the WHO laboratory manual for the testing and processing of human semen, semen analysis was analyzed for liquefaction, volume, and vitality assessment.[12] All the values were recorded and entered in an excel sheet for analysis. The statistical data analysis was done through Statistical Package for the Social Sciences (IBM SPSS V.27.0). Shiparo wilk test was performed to check the normal distribution of data. It was found that, data was not normally distributed. The median + Interqurtile ranges were estimated for clinical variables.

RESULTS

The total 92 males were enrolled. The age range was 16 to 45 years with the mean age of 30.7 ± 4.71. All males were divided into three age groups for data analysis. The highest number of patients (n=70, 76.1%) were from age group 26-35 years than 36-45 years (n=12, 13.0%) and 16-25 years (n=10, 10.9%) of age groups. Temperature was noted at the time of ejaculation and six groups of seasons were made. The grouping of seasons and average high temperature of season is mentioned in Table-I.

The effect of seasons on semen volume (ml), sperm concentration, motility, and morphology are described in Table-II. Kruskal Wallis Test showed the p-value between semen parameters and average high temperature (°C). The p-value in comparison with average high temperature & volume, sperm Concentration, progressive motility, non-progressive motility, immotile sperms, and normal morphology was p=0.003, p=0.37, p=0.000, p=0.005, p=0.000, and p=0.37 respectively. Volume, sperm concentration, progressive motility, non-progressive motility, & immotile sperms showed significant statistical association with average high temperature of environment.

Seasons	Months / Dates	Average High Temperature (°C)
Spring	March & April	30.5
Early Summer	May & June	39.5
Middle Summer	July & August	35.6
Late Summer	September & till 15th October	33.6
Autumn	15th October to November	29.7
Winter	December to February	20.7

Table-I. Group of seasons and average high temperature

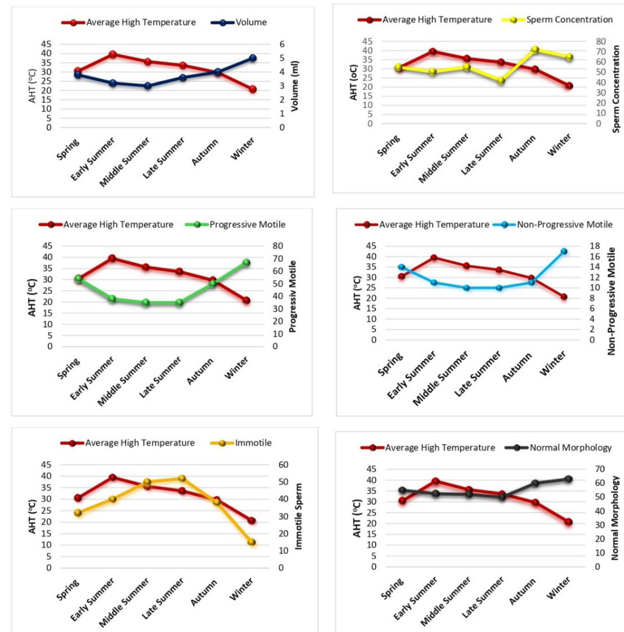

Figure-1. Median values of volume, sperm concentration, progressive motility, non-progressive motility, immotile sperms and morphology of semen

DISCUSSION

Studies have been conducted broadly across different regions to understand the role of the various seasonal variations and meteorological factors affecting semen quality and, therefore, the environment's effect on male fertility. Our findings further reinforce what is already known: seasonal perturbations of sperm parameters are largely correlated to temperature, humidity, and other climate variables. Spermatogenesis, being temperature-sensitive, confirms by findings of[13], that sperm quality was significantly reduced during summertime when compared to winter.

Groups	Semen Volume (ml)	Sperm Concentration	Progressively Motile	Non-progressively Motile	Immotile	Normal Morphology
Spring	3.8 ±3.1	55 ± 50	54 ± 52	14 ± 10	32 ± 20	55 ± 50.25
Early Summer	3.2 ± 2.5	50.5 ± 47.7	38 ± 30.70	11 ± 5.0	40 ± 16.25	52.50 ± 45.25
Middle Summer	3.0 ± 1.3	55 ± 35	35 ± 25	10 ± 10	50 ± 47	52 ± 30
Late Summer	3.6 ± 3	42 ± 7.5	35 ± 15	10 ± 8	52 ± 20	50 ± 45
Autumn	4 ± 2.9	72 ± 66.5	50 ± 42	11 ± 10	38 ± 27.5	60 ± 55
Winter	5 ± 3.7	65 ± 16	67 ± 61.5	17 ± 13.5	15 ± 18.5	63 ± 60

Table-II. Group of seasons and average high temperature

Data show as median ± Interquartile range.

Moreover, high ambient temperature negatively affected spermatozoal concentration, motility, and viability in our dataset whereby all these parameters were found to be below optimal during peak summer temperatures ($p < 0.05$). In addition to these, study by Verón GL et al.[13], showed that lowered humidity and increased sunshine duration impair semen parameters, whereby, in the highest sunshine duration quartile, sperm motility and concentration were significantly reduced. In the present study, sperm motility decreased by about 12% in the summer versus the winter, closely conforming to the study by Verón GL et al.[13], observed trends.

According to study by Balhara K et al.[14], conducted in north India, seasons have been defined on the basis of average highest temperature with regard to which 20-30°C (autumn) average highest temperature was noted to be the most favorable for semen quality, while both extremes either above or below were unfavorably affecting sperm parameters. Similar to our findings, sperm concentration was best at 15-25°C, as it significantly decreased beyond 30°C ($p=0.002$). They also reported a significantly lower functional sperm concentration and motile sperm concentration at summer (average highest temperature >30°C), like our finding, wherein motile sperm concentration reduced by 15% in summer compared with autumn.

Malathi A et al.[15], conducted the study in a tropical place, reported that summer recorded a low sperm concentration, although it was statistically non-significant. However, the decreased sperm motility was significantly higher in the rainy season ($p=0.002$) and the defects of sperm heads and tails differed according to season ($p=0.011$; 0.024). Our findings also corroborated these trends with an increase of 8-10% defects in sperm morphology in summer over winter, which places the greatest emphasis on sperm head integrity ($p=0.015$). This study further supports the evidence that seasonal variation affects semen parameters. No significant differences were noted in total spermatozoa count, dead spermatozoa percentage, and sluggish spermatozoa percentage amongst the seasons. In contrast, semen volume was significantly reduced during the summer compared to the winter ($p=0.002$). The present study observations further confirm this finding, where 9% reduction in semen volume was recorded during peak summer months ($p=0.004$), reinforcing the view that high ambient temperatures have an effect on semen production.

CONCLUSION

The present study showed a definite seasonal effect on semen parameters, with summer being most obviously detrimental. These findings further highlight the importance of factoring seasonal and other environmental issues into male fertility assessments, especially where such variations occur. More longitudinal studies with larger datasets as well as controlled exposures should be done to better understand the mechanisms that cause these seasonal influences on male reproductive health.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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AUTHORSHIP AND CONTRIBUTION DECLARATION	
1	**Sana Saleem:** Concept of paper.
2	**Warda Samad:** Data collection.
3	**Hira Samad:** Data collection.
4	**Afshan Zia:** Literature review.
5	**Zainab Yousaf:** writing, statistical analysis.
6	**Muhammad Arslan Tariq:** Drafting.