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COVID-19 vaccination doesn't influence sperm motility, concentration, and morphology

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ABSTRACT

Background: The COVID-19 pandemic, driven by SARS-CoV-2, necessitated the rapid development and global deployment of vaccines. Despite the high efficacy of vaccines like AstraZeneca and Pfizer-BioNTech in preventing severe COVID-19, concerns about potential side effects, particularly on male fertility, have arisen.

Objective: This study aims to evaluate the impact of COVID-19 vaccination on key sperm parameters (motility, concentration, count, and morphology) and serum interleukin-6 (IL-6) levels in men.

Materials and methods: A cross-sectional study was conducted over six months (March to August 2022) at the High Institute for Infertility Diagnosis and Assisted Reproductive Technologies in Baghdad, Iraq. The study included 63 participants divided into three groups: AstraZeneca vaccine group (N=24), Pfizer vaccine group (N=19), and an unvaccinated control group (N=20). Participants' sperm parameters were analyzed following the WHO guidelines, and serum IL-6 levels were measured using ELISA.

Results: No statistically significant differences were found in sperm motility, concentration, total sperm count, or morphology between vaccinated and unvaccinated groups. Specifically, sperm motility was 57.3±8.9% in the vaccinated group versus 56.8±9.2% in the control group (p=0.782). Sperm concentration was 62.5±14.7 M/mL in the vaccinated group compared to 61.9±15.1 M/mL in the control group (p=0.845). Total sperm count was 185.6±43.8 M in the vaccinated group versus 183.2±44.5 M in the control group (p=0.802). Morphologically normal sperm were 4.2±1.1% in the vaccinated group versus 4.1±1.0% in the control group (p=0.659). Serum IL-6 levels showed no significant differences between the groups.

Conclusion: COVID-19 vaccination with either AstraZeneca or Pfizer-BioNTech does not adversely affect sperm parameters or induce significant changes in serum IL-6 levels. These findings support the safety of COVID-19 vaccines concerning male reproductive health, alleviating concerns about potential adverse effects on fertility.

Introduction

The coronavirus disease 2019 (COVID-19) pandemic, caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), has presented unprecedented challenges to global public health.[1-3] In response to this crisis, the rapid development and deployment of vaccines have been necessary to mitigate the disease's spread and severity.[4] Among the various vaccines developed, the AstraZeneca and Pfizer-BioNTech vaccines have been widely administered worldwide, demonstrating high efficacy in preventing severe COVID-19 outcomes.[5,6] Despite the proven benefits of vaccination, concerns about potential side effects have emerged, including speculations about

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impacts on fertility.[7] These concerns have been particularly pronounced among men of reproductive age, potentially influencing vaccine hesitancy in this demographic.[8] The male reproductive system, specifically the testes, has been identified as a probable target for SARS-CoV-2 due to the expression of angiotensin-converting enzyme 2 (ACE2) receptors in testicular cells.[9] This raised questions about whether the immune response triggered by COVID-19 vaccines might similarly affect testicular function and sperm quality.

Sperm parameters, including motility, concentration, count, and morphology, are critical indicators of male fertility potential.[10,11] Any significant alterations in these parameters could have implications for reproductive health. Moreover, systemic inflammation, assessed through biomarkers such as interleukin-6 (IL-6), has been associated with impaired spermatogenesis and reduced sperm quality.[12] Given that vaccines stimulate an immune response, it is essential to investigate whether this response affects sperm parameters or induces systemic inflammation that could impact male fertility.

Previous studies have explored the effects of COVID-19 infection on male reproductive function, with some suggesting potential negative impacts.[13,14] However, research on the specific effects of COVID-19 vaccination on sperm parameters and relevant inflammatory markers remains unclear. Therefore, and in light of these considerations, this study aims to evaluate the potential effects of COVID-19 vaccination, specifically the AstraZeneca and Pfizer-BioNTech vaccines, on key sperm parameters (motility, concentration, count, and morphology) and serum IL-6 levels.

Materials and methods

Study design subjects

This cross-sectional study was conducted from March to August 2022 at the High Institute for Infertility Diagnosis and Assisted Reproductive Technologies (Baghdad, Iraq). A total of 63 participants were included, divided into three groups: the AstraZeneca vaccine group (N=24), the Pfizer vaccine group (N=19), and the unvaccinated control group (N=20). Participants were assigned to groups based on their vaccination status, with the control group matched to the vaccinated groups for age.

Inclusion criteria for the study were: male participants aged 18-45 years; for the vaccinated groups, participants who received exactly two doses of either vaccine type, with the second dose administered 3-6 months before sample collection; for the control group, individuals who had not received any COVID-19 vaccine; no history of COVID-19 infection; and no known fertility issues. The exclusion criteria included: history of testicular surgery or trauma; current use of medications known to affect spermatogenesis; chronic medical conditions that could influence fertility (e.g., diabetes, thyroid disorders); Body Mass Index (BMI) >35 kg/m²; excessive alcohol consumption (>14 units per week); current smokers; use of recreational drugs; and fever (>38 °C) within the three months preceding sample collection.

The study received approval from the High Institute for Infertility Diagnosis and Assisted Reproductive Technologies, Al-Nahrain University's Ethics Committee (No.0702-PF-2024R34, on March 10th, 2022).

Demographic data collection

Demographic information and medical history were collected from all participants through a standardized questionnaire. The questionnaire included age, height, weight, occupation, lifestyle factors (such as exercise habits and diet), and detailed vaccination history for the vaccinated groups. For the vaccinated participants, information on the type of vaccine received (AstraZeneca or Pfizer), number of doses, and vaccination dates were recorded. All participants were also asked about any history of COVID-19 infection, other recent illnesses, and medication use. The questionnaires were administered by trained research staff, and all data were entered into a secure, password-protected database to ensure confidentiality.

Semen sample collection

Semen samples were collected from all participants following a period of 2-7 days of sexual abstinence. Participants were provided with clear, written instructions on proper sample collection. Samples were obtained through masturbation and collected in sterile, wide-mouthed containers. The containers were labeled with a unique identifier code to maintain participant anonymity. Immediately after collection, the samples were placed in an incubator at 37 °C and processed within one hour of collection to ensure sample integrity.

Semen analysis

Semen analysis was performed according to the World Health Organization (WHO) laboratory manual for examining and processing human semen (5th Ed, 2010). Two laboratory technicians performed all semen analyses, with cross-validation of 20% of samples. The study included an assessment of sperm motility, concentration, total sperm count, and morphology. Sperm motility was evaluated using a computer-aided sperm analysis (CASA) system. Sperm concentration was determined using a Makler counting chamber. Total sperm count was calculated by multiplying the concentration by the semen volume. Sperm morphology was assessed using Diff-Quik stained smears, with at least 200 spermatozoa evaluated per sample. All analyses were performed by trained laboratory technicians blinded to the participants' vaccination status to prevent bias.

IL-6 measurement

Blood samples were collected from all participants on the same day as semen sample collection. Venous blood (5 mL) was drawn from the antecubital vein into serum separator tubes. The blood was allowed to clot at room temperature for 30 minutes, then centrifuged at 1500 x g for 15 minutes to separate the serum. According to the manufacturer's instructions, Serum IL-6 levels were

measured using a commercially available enzyme-linked immunosorbent assay (ELISA) kit (Elabscience, USA). All samples were run in duplicate, and the average of the two measurements was used for analysis. The assay's sensitivity was 0.7 pg/mL, with an intra-assay coefficient of variation of <10%.

Statistical analysis

Statistical analyses were performed using RStudio with R version 4.2.1. Descriptive statistics were calculated for all variables. The Shapiro-Wilk test was used to assess the normality of data distribution. For comparing sperm parameters and IL-6 levels across the three groups (AstraZeneca, Pfizer, and Control), one-way ANOVA was employed, followed by Tukey's post-hoc test for pairwise comparisons if ANOVA showed significant differences. A $p<0.05$ was considered statistically significant.

Results

Table 1 presents the anthropometric characteristics of the study participants. Analysis of these data revealed no statistically significant differences in age, height, weight, or BMI among the AstraZeneca, Pfizer, and Control groups ($p>0.05$).

Table 1. Anthropometric characteristics of study participants by vaccination group.

Characteristic	AstraZeneca (N=24)	Pfizer (N=19)	Control (N=20)	*p* value
Age (years)	34.6±5.2	35.2±4.8	33.9±5.5	0.723
BMI (kg/m²)	26.0±3.1	26.3±3.3	25.4±2.9	0.621

Note: Values are presented as mean±SD, BMI: body mass index. All p values were calculated using one-way ANOVA.

To assess the potential impact of COVID-19 vaccination on sperm parameters, the vaccinated groups (AstraZeneca and Pfizer combined) were compared with the non-vaccinated control group (Figure 1). The analysis of sperm motility showed no significant difference between the vaccinated (57.3±8.9%) and non-vaccinated (56.8±9.2%) groups ($p=0.782$). The sperm concentration was also comparable between the vaccinated (62.5±14.7 M/mL) and non-vaccinated (61.9±15.1 M/mL) groups ($p=0.845$). The total sperm count also showed no significant difference, with the vaccinated group averaging 185.6±43.8 M and the non-vaccinated group 183.2±44.5 M ($p=0.802$). Further analysis of sperm morphology revealed that the percentage of morphologically normal sperm was similar between the vaccinated (4.2±1.1%) and non-vaccinated (4.1±1.0%) groups ($p=0.659$). These results together suggest that COVID-19 vaccination does not significantly affect the main parameters of sperm quality in this study population.

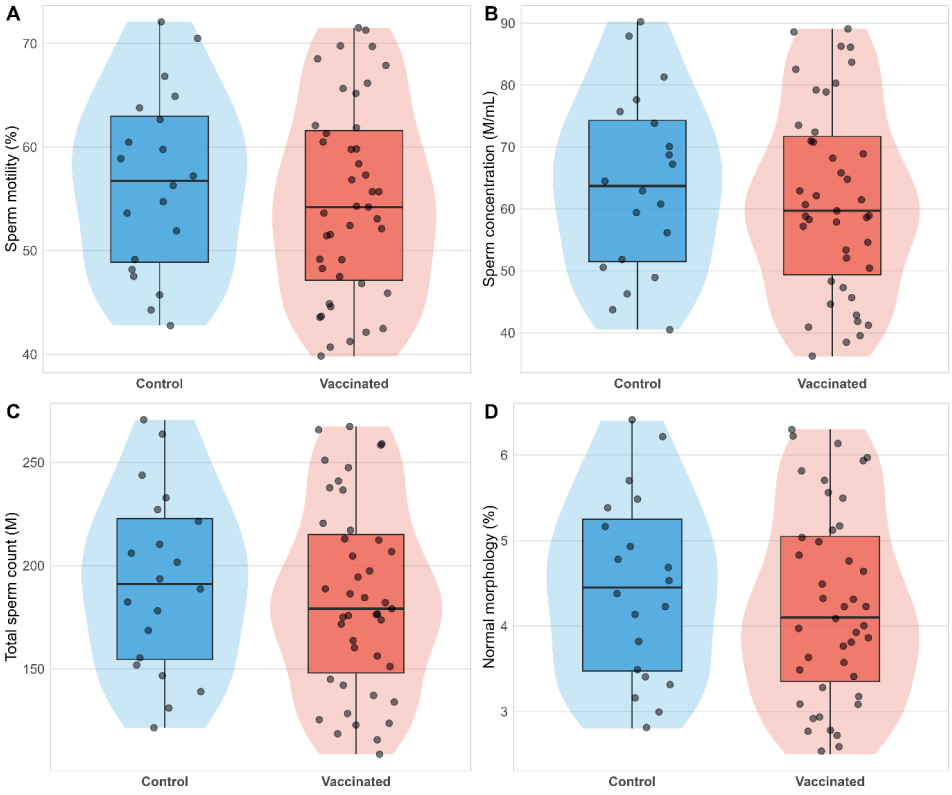

Figure 1. *Sperm parameters of vaccinated (AstraZeneca or Pfizer, N=43) and unvaccinated control (N=20) groups. A: sperm motility (%), B: sperm concentration (M/mL), C: total sperm count (M), D: normal morphology (%). Box plots show the median, quartiles (box), and range (whiskers); dots represent individual values. The vaccinated group includes AstraZeneca (N=24) and Pfizer (N=19) recipients. No significant differences were found between groups (p>0.05).*

The effects of COVID-19 vaccination on sperm parameters were evaluated by comparing AstraZeneca-vaccinated, Pfizer-vaccinated, and unvaccinated control (N=20) groups. Figure 2 presents the results of motility, concentration, total count, and normal morphology. The analysis revealed non-statistically significant differences among the three groups for the measured parameters. The sperm motility was comparable across AstraZeneca (55.2±10.1%), Pfizer (54.3±9.2%), and control (56.1±9.8%) groups (p=0.808). Similarly, sperm concentration showed no significant differences, with AstraZeneca, Pfizer, and control groups averaging 60.3±14.8 M/mL, 62.1±13.9 M/mL, and 59.2±15.2 M/mL, respectively (p=0.380). Total sperm count also remained consistent across groups, with mean values of 180.5±44.7 M, 185.2±39.8 M, and 178.3±49.4 M for AstraZeneca, Pfizer, and control groups, respectively (p=0.859). Lastly, the percentage of sperm with normal morphology was similar among AstraZeneca (4.0±1.0%), Pfizer (4.1±0.9%), and control (4.2±1.0%) groups (p=0.790). To further investigate the distribution of sperm parameters across vaccination groups, density analysis was performed (Figure 3). The study of sperm motility revealed relatively similar distributions across all three groups, with most values falling between 45% and 70%. The AstraZeneca group showed a slightly wider distribution than the Pfizer and control groups, but this difference was not statistically significant (Kolmogorov-Smirnov test, p=0.213 and p=0.189, respectively). In addition, sperm concentration distributions were comparable among the three groups, with most values ranging from 40 to 80 M/mL. The Pfizer group exhibited a minor skew towards higher concentrations, but this trend did not reach statistical significance (p=0.167 compared to AstraZeneca, p=0.144 compared to control). Total sperm count distributions mirrored the concentration patterns, with no significant differences observed among the groups (p>0.05 for all). Lastly, among the sperm parameters, the distribution of normal sperm morphology was notably consistent across all groups, with most values falling between 2% and 6%. No significant differences were detected in the shape or spread of these distributions (p>0.05).

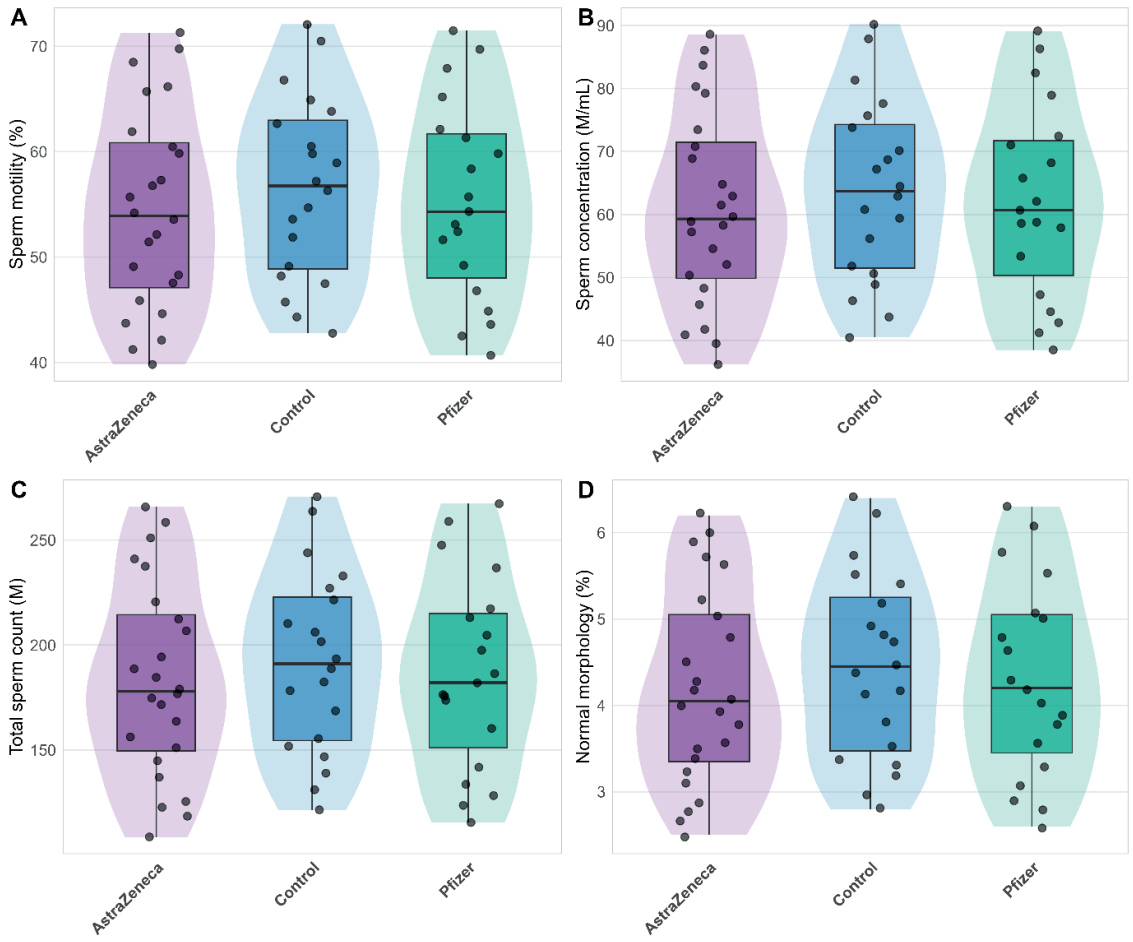

Figure 2. *Sperm parameters of AstraZeneca (N=24), Pfizer (N=19), and control (N=20) groups. A: sperm motility (%), B: sperm concentration (M/mL), C: total sperm count (M), D: normal morphology (%). Box plots show the median, quartiles (box), and range (whiskers); dots represent individual values. No significant differences were found among groups (p>0.05).*

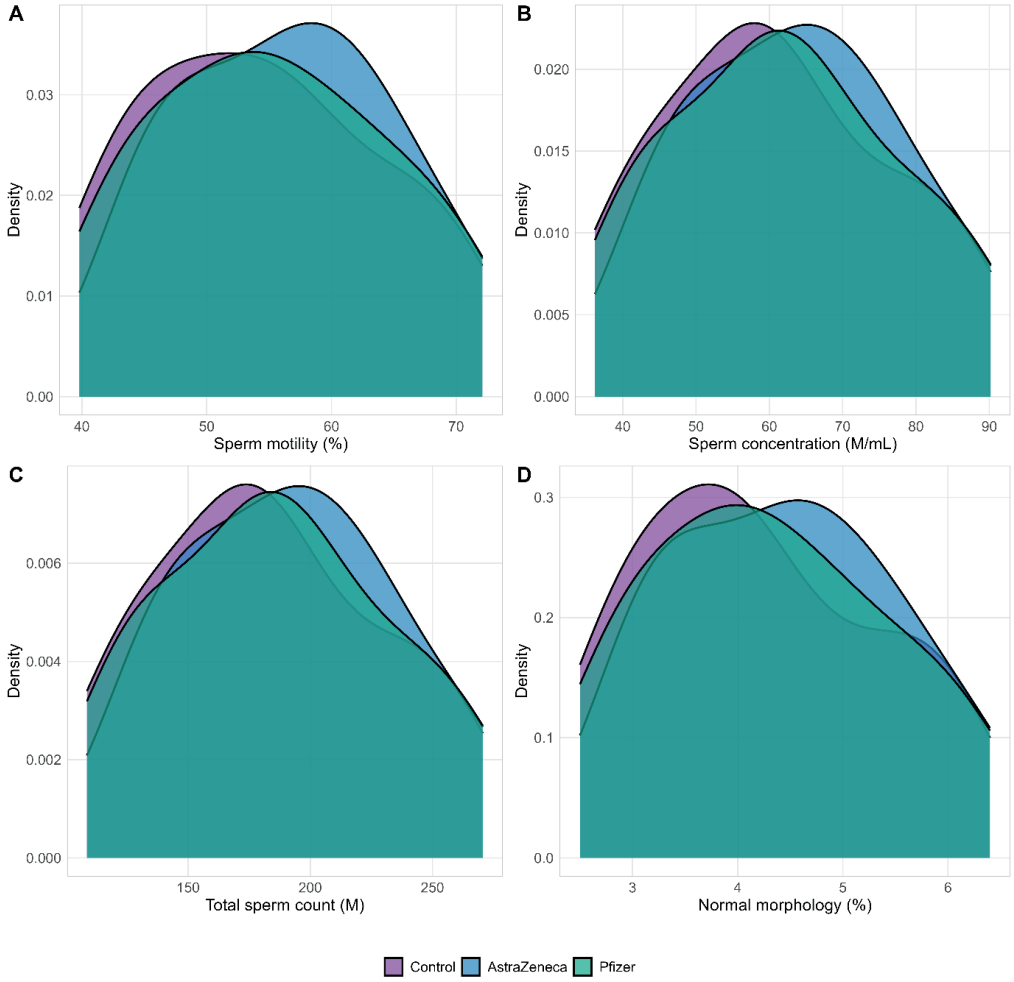

Figure 3. *Distribution of sperm parameters in AstraZeneca, Pfizer, and control groups. A: sperm motility (%), B: sperm concentration (M/mL), C: total sperm count (M), D: normal morphology (%). Density plots show the distribution pattern for each group. No significant differences were found between distributions (p>0.05).*

The levels of IL-6 were also assessed for the same groups (Figure 4). The results showed non-significant differences between the vaccinated and non-vaccinated groups (p>0.05, Figure 4A), and the type of vaccine didn't change the results (Figure 4B). However, it showed slightly more variability in distribution, with the control group displaying a marginally more comprehensive range (Figure 4C). However, statistical analysis confirmed these differences were insignificant (p=0.231 for AstraZeneca *vs*. control, p=0.256 for Pfizer *vs*. control).

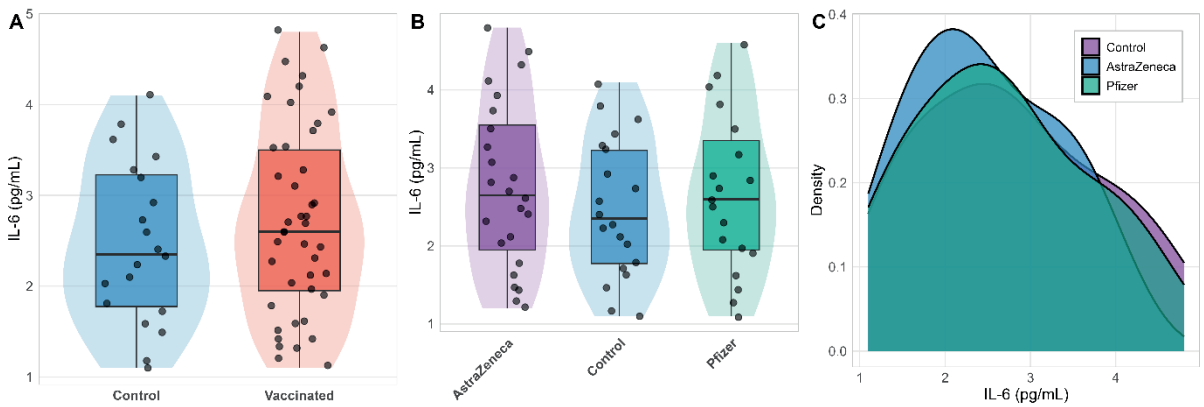

Figure 4. *IL-6 levels across groups. A: comparison between vaccinated and control groups, B: comparison among AstraZeneca, Pfizer, and control groups, C: distribution pattern for each group. Box plots show the median, quartiles (box), and range (whiskers); dots represent individual values. No significant differences were found between groups (p>0.05).*

Discussion

This study investigated the potential effects of COVID-19 vaccination on key sperm parameters and serum IL-6 levels in men of reproductive age. These findings demonstrate that immunization with the AstraZeneca or Pfizer-BioNTech COVID-19 vaccines does not significantly impact sperm motility, concentration, count, or morphology compared to unvaccinated controls. Additionally, no significant differences in serum IL-6 levels between vaccinated and unvaccinated individuals were observed.

The lack of significant differences in sperm parameters between vaccinated and unvaccinated groups aligns with recent studies examining the impact of COVID-19 vaccines on male fertility. Gonzalez *et al*. (2021) found no significant decreases in sperm parameters among 45 men after receiving two mRNA COVID-19 vaccines.[15] Relatedly, Barda, *et al*. reported no deleterious effects on sperm quality following BNT162b2 mRNA vaccination in a cohort of 37 sperm donors.[16] The current study's results extend these findings by including both mRNA (Pfizer-BioNTech) and viral vector (AstraZeneca) vaccines and suggest that different vaccine platforms do not differentially affect sperm quality.

The stability of sperm parameters post-vaccination is particularly noteworthy given the concerns about the potential impacts of COVID-19 itself on male fertility. Studies have shown that SARS-CoV-2 infection can lead to impaired spermatogenesis and reduced sperm quality, possibly due to the expression of ACE2 receptors in testicular cells.[17,18] The findings indicate that the immune response triggered by vaccination does not induce similar detrimental effects on spermatogenesis, which is reassuring for men considering vaccination.

The analysis of serum IL-6 levels provides further insight into the systemic effects of COVID-19 vaccination. IL-6 is a critical pro-inflammatory cytokine associated with impaired spermatogenesis when chronically elevated.[12,19] The lack of significant differences in IL-6 levels between vaccinated and unvaccinated groups suggests that COVID-19 vaccination does not induce a persistent inflammatory state that could potentially impact sperm production. This is consistent with the transient nature of vaccine-induced immune responses and supports the overall safety profile of COVID-19 vaccines.

The study's strengths include comparing two different vaccine types, including a matched control group, and the comprehensive assessment of multiple sperm parameters. However, certain limitations should be acknowledged. First, the small sample size in each group may limit statistical power. Second, as a single-center study, the generalizability of results to broader populations may be limited. Third, the cross-sectional nature of the survey allows for assessment at only one time point, without the ability to track temporal changes or establish long-term effects. Fourth, patient self-reports obtained vaccination information, which may introduce reporting bias. To confirm these findings, future multi-center studies with larger sample sizes and longitudinal designs are needed.

Conclusion

The current study demonstrates that COVID-19 vaccination with either AstraZeneca or Pfizer-BioNTech vaccines does not adversely affect key sperm parameters or induce systemic inflammation as measured by serum IL-6 levels. These findings support the safety of COVID-19 vaccines concerning male reproductive function and can help inform decision-making for men considering vaccination. Future research on larger cohorts, longer-term follow-up, and the inclusion of other vaccine types to further analyze these observations is needed.

Conflict of interest

The author declares no competing interests.

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References

[1] Zhu N, Zhang D, Wang W, Li X, Yang B, Song J, *et al*. A novel coronavirus from patients with pneumonia in China, 2019. 2020; 382(8): 727-33. doi: 10.1056/NEJMoa2001017

[2] Luay A, Mohsen Al-Essawe E, Al-Kawaz U. Prevalence of erectile dysfunction in males post COVID-19 infection. Iraqi J Embryos Infertil Res. 2021; 11(1): 89-98. Available from: https://ijeir.net/index.php/ijeir/article/view/70

[3] Chandramouli T, Mishra SB, Rath A. Reinfection of SARS CoV-2 in patients with relapse of symptoms after clinical recovery: A case series. J Assoc Med Sci. 2022; 55(3): 105-8. Available from: https://he01.tci-thaijo.org/index.php/bulletinAMS/article/download/255037/174080

[4] Polack FP, Thomas SJ, Kitchin N, Absalon J, Gurtman A, Lockhart S, *et al*. Safety and efficacy of the BNT162b2 mRNA Covid-19 vaccine. N Engl J Med. 2020; 383(27): 2603-15. doi/10.1056/NEJMoa2034577

[5] Voysey M, Clemens SAC, Madhi SA, Weckx LY, Folegatti PM, Aley PK, *et al*. Safety and efficacy of the ChAdOx1 nCoV-19 vaccine (AZD1222) against SARS-CoV-2: an interim analysis of four randomised controlled trials in Brazil, South Africa, and the UK. Lancet. 2021; 397(10269): 99-111. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0140673620326611

[6] Baden LR, El Sahly HM, Essink B, Kotloff K, Frey S, Novak R, *et al*. Efficacy and safety of the mRNA-1273 SARS-CoV-2 vaccine. N Engl J Med. 2021; 384(5):403-16. doi/10.1056/NEJMoa2035389

[7] Diaz P, Reddy P, Ramasahayam R, Kuchakulla M, Ramasamy R. COVID-19 vaccine hesitancy linked to

increased internet search queries for side effects on fertility potential in the initial rollout phase following Emergency Use Authorization. Andrologia. 2021; 53(9):e14156. doi/10.1111/and.14156

[8] Roozenbeek J, Schneider CR, Dryhurst S, Kerr J, Freeman ALJ, Recchia G, *et al*. Susceptibility to misinformation about COVID-19 around the world. R Soc Open Sci. 2020; 7(10): 201199. doi/10.1098/rsos.201199

[9] Wang Z, Xu X. scRNA-seq profiling of human testes reveals the presence of the ACE2 receptor, a target for SARS-CoV-2 infection in spermatogonia, Leydig and Sertoli cells. Cells. 2020; 9(4): 920. Available from: https://www.mdpi.com/2073-4409/9/4/920

[10] Guzick DS, Overstreet JW, Factor-Litvak P, Brazil CK, Nakajima ST, Coutifaris C, *et al*. Sperm morphology, motility, and concentration in fertile and infertile men. N Engl J Med. 2001; 345(19): 1388-93. doi/abs/10.1056/NEJMoa003005

[11] Cooper TG, Noonan E, von Eckardstein S, Auger J, Baker HWG, Behre HM, *et al*. World Health Organization reference values for human semen characteristics*‡. Hum Reprod Update. 2010; 16(3):231-45. Available from: http://academic.oup.com/humupd/article/16/3/231/639175/World-Health-Organization-reference-values-for

[12] Moretti E, Cosci I, Spreafico A, Serchi T, Cuppone AM, Collodel G. Semen characteristics and inflammatory mediators in infertile men with different clinical diagnoses. Int J Androl. 2009; 32(6): 637-46. doi/10.1111/j.1365-2605.2008.00911.x

[13] Erbay G, Sanli A, Turel H, Yavuz U, Erdogan A, Karabakan M, *et al*. Short-term effects of COVID-19 on semen parameters: A multicenter study of 69 cases. Andrology. 2021;9(4): 1060-5. doi/10.1111/andr.13019

[14] Gacci M, Coppi M, Baldi E, Sebastianelli A, Zaccaro C, Morselli S, *et al*. Semen impairment and occurrence of SARS-CoV-2 virus in semen after recovery from COVID-19. Hum Reprod. 2021; 36(6):1520-9. Available from: https://academic.oup.com/humrep/article/36/6/1520/6125160

[15] Gonzalez DC, Nassau DE, Khodamoradi K, Ibrahim E, Blachman-Braun R, Ory J, *et al*. Sperm parameters before and after COVID-19 mRNA vaccination. JAMA. 2021; 326(3): 273-4. doi: 10.1001/jama.2021.9976

[16] Barda S, Laskov I, Grisaru D, Lehavi O, Kleiman S, Wenkert A, *et al*. The impact of COVID-19 vaccine on sperm quality. Int J Gynecol Obstet. 2022; 158(1): 116-20. doi/10.1002/ijgo.14135

[17] Li H, Xiao X, Zhang J, Zafar MI, Wu C, Long Y, *et al*. Impaired spermatogenesis in COVID-19 patients. EClinicalMedicine. 2020; 28:100604. Available from: https://linkinghub.elsevier.com/retrieve/pii/S2589537020303485

[18] Navarra A, Albani E, Castellano S, Arruzzolo L, Levi-Setti PE. Coronavirus disease-19 infection: Implications on male fertility and reproduction. Front Physiol. 2020; 11. Available from: https://www.frontiersin.org/articles/10.3389/fphys.2020.574761/full

[19] Qian L, Sun G, Zhou B, Wang G, Song J, He H. Study on the relationship between different cytokines in the semen of infertility patients. Am J Reprod Immunol. 2011; 66(2): 157-61. doi/10.1111/j.1600-0897.2010.00980.x