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To analyze the effect of covid-19 infection and covid-19 vaccination on semen parameters.

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ABSTRACT

INTRODUCTION: The coronavirus disease 2019 (COVID-19) is a global pandemic which may affect multiple organs and systems including testes and disrupt the gonadal functions. The aim of the study is to compare the semen parameters before and after Covid 19 infection and Covid 19 vaccination.

METHODS: The study included men who came for subfertility evaluation at Institute of Reproductive Medicine, MMM Hospital, with previous history of COVID 19 infection, also who had been administered with COVID 19 vaccination and they were provided with the validated questionnaire and evaluated in terms of macroscopic and microscopic parameters of semen according to WHO guidelines (2021; 6th edition). The results were presented through 3 group analyses, in which group 1 (only COVID -19 infected), group 2 (COVID -19 infected and COVID -19 vaccinated), group 3 (not COVID -19 infected but COVID-19 vaccinated).

RESULTS: The semen parameters in terms of macroscopic and microscopic examination were compared between groups and the pH, progressive motility and non-progressive motility showed statistically significant difference between groups (p=0.03, p=0.03, p=0.04 respectively). There was effect on pH, progressive and non-progressive motility which could might be COVID-19 infection or COVID-19 vaccination.

CONCLUSION: COVID-19 may have unfavourable effects on the gonadal functions and may lead to further deterioration of the semen parameters in infertile men, which should be considered through the evaluation for infertility and COVID-19 vaccine may not have deleterious effects on semen parameters. To understand the further detrimental effects of COVID-19 infection and COVID-19 vaccine on male reproductive system, several studies with more sample size will be needed.

Keywords: Covid-19 infection, Covid-19 vaccination, Semen parameters.

I. INTRODUCTION

The novel Coronavirus was called as Severe Acute Respiratory Syndrome Coronavirus 2(SARS-CoV2) and it belongs to Coronaviridae family [1]. This pandemic caused by COVID-19 virus was a serious threat for public healthin the past 3 years. It has affected various systems of the body and the respiratory system is most commonly affected as itspreads by respiratory droplets and aerosolsand symptoms were fever, cough, dyspnea , fatigue, vomiting, loose stools and also multiple organ failure .The coronavirus has made researchers to explore the effects of this virus on different systems of the human body[2,3].Various studies have found that the coronavirus also has severe impact on human male reproductive system causing gonadal dysfunction and also lead to subfertility. Various studies have shown that the Angiotensin converting enzyme (ACE2) receptor is found in various systems of body such as respiratory, digestive, urogenital, circulatory, and reproductive system and the coronavirus uses this receptor molecule for entering the host. Angiotensin II, Angiotensin converting enzyme 2 regulate the basic functions of male and female reproductive system. ACE2 was found to be expressed in Leydigcells, Sertoli cells, seminiferous tubule, spermatozoa [4] hence affecting male reproduction [5]and has active role

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in sperm function thus contribution to embryo quality [6]. Studies have proven that beside ACE2 receptor, TMPRS2 also helps in viral entry [7]. There was spermatogenesis impairment [8]and decrease in sperm parameters in COVID-19 infected patients [9]. The adverse effects of Coronavirus on semen parameters were noted in patients who had severe illness [10]. The recent studies have demonstrated the presence of SARS COV2 in semen specimen [11]. Due to Leydig cells dysfunction caused by viral invasion there was alteration in the sex hormones [12]. The oxidative stress induced by SARS COV2 had impairment on sperm motility and sperm DNA fragmentation [13]. Vaccination is the effective way in prevention of disease spread and number of Covid vaccines approved by WHO have come henceforth. The effect of the COVID-19 vaccine on gametes is still questionable and many studies were under trail. As per WHO guideline the couple opting for ART services should be vaccinated prior to treatment. Studies have proven there was no effect of COVID19 vaccination on semen parameters [14,15]. Keeping this as the primary analysis of the available data, the aim of this study was to compare the semen parameters before and after COVID-19 infection and COVID-19 vaccination.

II. MATERIALS AND METHODS

OBJECTIVE

This study aimed to compare the semen parameters before and after covid 19 infection and covid 19 vaccination.

STUDY DESIGN

The current study was conducted in a tertiary healthcare center, Institute of Reproductive Medicine and Women's Health, Madras Medical Mission, Chennai. This is a cohort study which included subfertile men whoattended our IRM, OPD for subfertility evaluation and they should have previous history of COVID 19 infection, alsowho had been administered with COVID 19 vaccination. The participants with both normal and abnormal semen parameters were also included. The participants who did not have semen analysis done prior to COVID -19 infection and COVID-19 vaccination were excluded from the study. A validated questionnaire was designed for the study, to collect demographic data and data on types and the presence of medical conditions that affect seminal fluid parameters.

METHODOLOGY

The participants were given this validated questionnaire after explaining about the study. Their previous semen analysis records were collected from March 2020 till August 2022.If the participants had more than one previous semen analysis report done prior to infection and vaccination then the recent report was taken for comparison and the semen samples was compared in same individual.The semen samples were collected after obtaining informed and written consent from the participants.The semen samples were collected with sexual abstinence of 3-5 days and after 30 minutes of liquefaction time, microscopic and macroscopic analysis done, recorded according to WHO guidelines 2022.

STATISTICAL ANALYSIS

All statistical analysis were performed using Statistical Package for Social Science (SPSS, version 17) for Microsoft windows. The data were not normally distributed. And therefore parametric /non-parametric tests were performed. Descriptive statistics were presented as numbers and percentages. The data were expressed as Mean and SD. One way analysis if variance with a post hoc Turkey HSD test was used for continuous data/Kruskal'sWallis test.A chi-squared test was used for comparison between two attributes. A two-sided p value <0.05 was considered statistically significant.

QUESTIONNAIRE

UHID No
Age
Height: Weight: BMI:
COVIDSTATUS:
Any H/O COVID 19 infection: Yes/no
If any semen analysis done before COVID 19 infection: Yes/no
Date of COVID 19 RTPCR TEST done:
Did you have any symptoms of COVID 19 infection: Yes/no
How were you treated: Hospitalisation /Home quarantine
Vaccination Status
Have you ever received a COVID-19 vaccine? Yes /No
If yes,

International Journal Dental and Medical Sciences Research
Volume 5, Issue 1, Jan-Feb 2023 pp 31-41 www.ijdmsrjournal.com ISSN: 2582-6018

Dose 1. Date of Vaccination: _ _ / _ _ / _ _ _ _ (dd/mm/yyyy)
Vaccine Type: covishield /covaxine
Dose 2. Date of Vaccination: _ _ / _ _ / _ _ _ _ (dd/mm/yyyy)
Vaccine Type: covishield /covaxine
Medical history: Diabetes/ Hypertension/Thyroid disorder /Jaundice /Asthma Cardiac disease /Chronic lung disease/ Cholesterol
Anyhistory of infections in the past:
Mumps /Fever>104ºC/Typhoid/Dengue/Tuberculosis/Jaundice /Recurrent Urinary Tract Infection.
Anyhistory of surgeries in the past: Testicular surgery/ Penile surgery/Varicocelectomy/Circumcision /None
Areyou currently onany medications:
Diabetes/Hypertension/cholesterol/Steroids/ Fertility medication/none
Personalhistory:
Smoking status: Yes/no/occasional/quit
Alcoholic status: Yes/no/occasional/quit
Caffeine exposure: Coffee/tea/cola/others
Occupation exposure: Pesticides / Dust/ Cement/ chemicals/ Paint
Others: Laptop/Driving/Radiation/Gym supplements
What isthe type of infertility history: Primary / Secondary
Is there any history of male infertility in family: Father/Brother/none
Have you had any of the previous ART treatment: IUI / ICSI/ TESA

III. RESULTS

We divided the groups into three: Group 1(only COVID-19 infected), Group 2(COVID-19 infected and COVID -19 vaccinated, Group 3(not COVID-19 infected and only COVID-19 vaccinated). The age (mean ± SD) was 35.8±4.9 years, the height (mean ± SD) was 1.7±6.3m, the weight (mean ± SD) was 76.7± 8.8kg, and the body mass index (BMI; mean ±SD) was 26.7±3 kg/m^2.

The demographic features and clinical characteristics were summarised in Table1.The 60 participants and33 participants were diagnosed with primary subfertility and secondary subfertilityrespectively. The 27 participants were on medications and 65were not on any medication and 1 had history of varicocele surgery done. Among 93 patients 7needed hospital admission ,52was recovered by home quarantine after COVID-19 infection, 37 were not COVID-19 infected. 84 participants were vaccinated with COVID-19 vaccine and belonged to Group 2 and 3. The duration between diagnosis of COVID-19 infection and semen analysis done after infection was (mean ± SD, months) 7.12±7.2. Among 93 participants, 15 had past medical history such as Diabetes Milletus, Hypertension, Epilepsy, Thyroid disorder, Hypercholesterolemia and 78 had no medical history. Based on the lifestyle habits 46 have habits of caffeine intake,17was alcoholic,10 were smokers.20 participants were laptop user,6 had driving job.

Table 1. Demographic and clinical characteristic data.

DEMOGRAPHIC DATA	GROUP 1	GROUP 2	GROUP 3	MEAN VALUE
No. of participants(n)	9	48	36	93
AGE(Mean±SD)	34.78±4.2	36.27±5.5	35.47±4.2	35.8±4.9
BMI, (Mean±SD)	25.9±2.64	27.12±3.43	26.4±2.54	26.7±3
Existing Medical Condition (%)	1(11.1%)	8(16.6%)	6(16.6%)	15(16.1%)
Smoking (%)	0(0%)	8(16.6%)	2(5.5%)	10(10.7%)
Alcohol (%)	1(11.1%)	10(20.8%)	6(16.6%)	17(18.2%)
Hospital admission (%)	1(11.1%)	3(6.3%)	3(8.3%)	7(7.5%)
Home recovery (%)	8(88.9%)	42(87.5%)	2(5.6%)	52(55.9%)
Past surgical history (%)	0	0	2(5.6%)	2(5.6%)
Primary subfertility (%)	7(77.8%)	31(64.6%)	22(61.1%)	60(64.5%)

Secondary subfertility (%)	2(22.2%)	17(35.4%)	14(38.9%)	33(35.5%)

The semen parameters in terms of macroscopic and microscopic examination were compared between groups and the pH, progressive motility and non-progressive motility showed statistically significant difference between groups (p=0.03, p=0.03, p=0.04 respectively). There was effect on pH, progressive motility which could might be COVID-19 infection or COVID-19 vaccination.

Table 2. Comparison of groups with respect to Volume.

VOUME(ML)	GROUP 1(only COVID19 infected)	GROUP2 (COVID -19 infected and COVID 19 vaccinated)	GROUP 3(not COVID -19 infected but COVID-19 vaccinated).	p-VALUE
BEFORE COVID INFECTION	2.55±0.91	2.65±1.23	2.92±1.25	.857
AFTER COVID INFECTION	2.22±0.8	2.47±1.30	1.86±0.26	.507
BEFORE COVID VACCINATION	-	2.100±0.79	2.64±0.96	.350
AFTER COVID VACCINATION	-	2.4±0.52	2.49±0.89	.857

The volume of the semen before infection showed no much difference and it was Group 1(2.22±0.8), Group 2(2.4±0.52),Group 3(2.49±0.89) and it was the same and above the reference range between groups. (Table 2)

Table 3. Comparison of groups with respect to Liquefaction time.

LIQUEFACTION TIME(MINUTES)	GROUP 1 (only COVID - 19 infected)	GROUP 2 (COVID19 infected and COVID 19 vaccinated)	GROUP 3(not COVID-19 infected but COVID-19 vaccinated)	p-VALUE
BEFORE COVID INFECTION	34.4±10.3	30.7±7.5	28±4.4	.288
AFTER COVID INFECTION	30±.00	30.7±4.5	30±0.00	.818
BEFORE COVID VACCINATION	-	40±17.3	31.45±5.9	0.06
AFTER COVID VACCINATION	-	30±.00	34±10.2	.504

The liquefaction time of semen was similar between the groups, 30 in Group 1 and Group 2, (34±10.2) in Group 3. Thus, the liquefaction time was also decreased from (40±17.3) before infection to (30±.00) after vaccination in Group 2. (Table 3)

International Journal Dental and Medical Sciences Research
Volume 5, Issue 1, Jan-Feb 2023 pp 31-41 www.ijdmsrjournal.com ISSN: 2582-6018

Table 4. Comparison of groups with respect to pH.

pH	GROUP 1(only COVID19 infected)	GROUP2 (COVID-19infectedand COVID-19 vaccinated)	GROUP 3(not COVID-19 infectedbut COVID-19 vaccinated)	p-VALUE
BEFORE COVID INFECTION	6.62±1.95	7.4±0.38	7.2±0.44	.034
AFTER COVID INFECTION	7.5±.52	7.5±.50	7.9±0.38	.164
BEFORE COVID VACCINATION	-	7±0.00	7.5±0.41	.049
AFTER COVID VACCINATION	-	7.8±0.23	7.3±0.38	.038

The pH of the semen samples was found to be (7.8±0.23) in both infected and vaccinated Group 2. The pH was within reference range (7.3±0.38) in Group 1 and only vaccinated Group 3 (7.3±0.23). There was statistical significance between the groups thus showing there was no effect after Covid-19 vaccination alone. The Group 2 also showed there was marked rise of pH which point outs the infection. (Table 4)

Table 5. Comparison of group with respect to Sperm concentration.

SPERM CONCENTRATION (M/ML)	GROUP 1 (only COVID 19 infected)	GROUP 2 (COVID19 infected and COVID-19 vaccinated)	GROUP 3 (not COVID-19 infected but COVID-19 vaccinated)	p-VALUE
BEFORE COVID INFECTION	33.34±18.9	45.7±33.3	46.8±27.1	.545
AFTER COVID INFECTION	32.5±15.5	43.24±31.8	41±29.1	.623
BEFORE COVID VACCINATION	-	52±22.2	51±25.2	.989
AFTER COVID VACCINATION	-	40.33±14.5	50.4±28.59	.554

The sperm concentration showed there was no much change prior and after infection (Group 1). In Group 2 there was notable decrease from (52±22.2) to (40.33±14.5) after vaccination. Though there was no statistical significance noted in sperm concentration there was decrease of (40.33±14.5) in Group 2 and (32.5±15.5) Group 1 than (50.4±2.85) Group 3. But there was no variance found between before vaccination (51±25.2) and (50.4±28.59) after Covid-19 vaccination. (Table 5)

International Journal Dental and Medical Sciences Research
Volume 5, Issue 1, Jan-Feb 2023 pp 31-41 www.ijdmsrjournal.com ISSN: 2582-6018

Table 6. Comparison of groups with respect to Total motility.

TOTAL MOTILITY (%)	GROUP 1 (only COVID -19 infected)	GROUP 2 (COVID -19 infected and COVID -19 vaccinated)	GROUP 3(not COVID -19 infected but COVID-19 vaccinated)	p- VALUE
BEFORE COVID INFECTION	37.4±19.3	45.9±20.8	62.6±13.3	.091
AFTER COVID INFECTION	43.6±14.3	47.4±17.8	59.2±3.9	.245
BEFORE COVID VACCINATION	-	49±28.5	56±18.3	.541
AFTER COVID VACCINATION	-	43.3±15.2	49.7±18	.557

The total motilitywas rather decreasedin Group 1 (43.6±14.3), Group 2 (43.3±15.2) than Group 3(49.7±18) albeit there was no significance. The total motility of sperm parameter was within the reference range in groups and there was moderate difference noted between groups. There is no much variation noted before and after vaccination but there was slight decrease after vaccination. (Table 6)

Table 7. Comparison of group with respect to Progressive motility.

PROGRESSIVE MOTILITY (%)	GROUP 1 (only COVID -19 infected)	GROUP 2 (COVID -19 infected and COVID -19 vaccinated)	GROUP 3(not COVID -19 infected but COVID-19 vaccinated)	p-VALUE
BEFORE COVID INFECTION	26.3±11.3	31.0±14.9	33.6±9.4	.617
AFTER COVID INFECTION	26.3±13.8	31.7±13.8	37.6±8.3	.317
BEFORE COVID VACCINATION	-	29.3±19	35.1±16.2	.565
AFTER COVID VACCINATION	-	18.3±7.6	34.3±11.8	0.03

The progressive motility was strikingly decreased in Group 2(18.3±7.6) and Group 1 (26.3±13.8) than Group 3(34.3±11.8), showed significance of p-value of 0.03. The progressive motility of groups was less than the reference range but we found there was no further detoriation of total motility in Group 1 who already had mean value of (26.3±11.3). Group 2 showed striking decline in total motility after infection and vaccination (18.3±7.6). (Table 7)

International Journal Dental and Medical Sciences Research
Volume 5, Issue 1, Jan-Feb 2023 pp 31-41 www.ijdmsrjournal.com ISSN: 2582-6018

Table 8. Comparison of groups with respect to non-progressive motiltiy.

NON-PROGRESSIVE MOTILITY(%)	GROUP 1 (only COVID19 infected)	GROUP 2 (COVID19 infected and COVID-19 vaccinated)	GROUP 3 (not COVID-19 infected but COVID-19 vaccinated)	p-VALUE
BEFORE COVID INFECTION	16.2±10	16.4±11	29±10	.054
AFTER COVID INFECTION	21.7±7.9	16±6	20.6±5.3	.045
BEFORE COVID VACCINATION	-	19.6±9.5	21±11.6	.825
AFTER COVID VACCINATION	-	25±13.2	17.4±9	.192

The non-progressive motility was significantly increased in Group 1(21.7±7.9), Group 3(20.6±5.3) and the mean value in Group 2 after infection was (16±6) which was same before infection. In group 2 there was increase in sperm non-progressive motility parameter of (25±13.2) and it was less comparatively in Group 3 (17.4±9). (Table 8)

MORPHOLOGY (%)	GROUP 1(only COVID19 infected)	GROUP 2 (COVID19 infected and COVID-19 vaccinated)	GROUP 3(not COVID-19 infected but COVID-19 vaccinated)	p- VALUE
BEFORE COVID INFECTION	3.3±0.86	2.84±2.3	2.6±2	.005
AFTER COVID INFECTION	2.78±0.97	2.39±1.26	2.4±1.1	.684
BEFORE COVID VACCINATION	-	3±1.41	2.79±1.34	.835
AFTER COVID VACCINATION	-	1.67±1.15	2.14±1.18	.517

Table 7. Comparison of group with respect to Morphology.

The morphology was below the referencevalue in all 3 groups and it was (2.78±0.97) in Group 1,(2.14±1.18) in group 3 and (1.67±1.15) in group 2 which was comparatively low, even though there is nosignificance. (Table 9)

IV. DISCUSSION

Covid-19 infection has deleterious effects on semen and the possible mechanism was inflammation of testis causing testicular damage[16] and also epididymitis with coexisting orchitis which could lead to damage of spermatozoa [17].The HPG axis was affected due to infection and there was alteredsex hormonal secretion and spermatogenesis[18].Due to cytokine storms due to immune activation caused by virus there were severe multiple organ injury[19].Along with dysfunction of Leydig and Sertoli cells ,fever, hypoxia and mental stress are also responsible for male fertility and sperm quality

impairment[20].The patient's demographic data and clinical data such as age ,BMI, severity of infection , personal lifestyle and occupation also plays important role in maintaining the quality of sperms.

The mean age of the patients in our study was 30-40 years old and only 7.5% had hospital admission and 52% were home recovered.Thus, this indicates that most of the reproductive group men was affected with infection and the severely affected patients who had hospital admission also showed degree of impairment in semen parameters.

In our study 10.7% were cigarette smokers and 18.2% were alcoholic. Cigarette smoke carcinogenic and hazardous compounds [21] and this is the one of the risk factors in male infertility. Thus, smoking impairs the semen quality by increasing reactive oxygen species which leads to oxidative stress, high DNA fragmentation [22]. The alcohol also acts on hypothalamus pituitary gonadal axis and cause alteration in sex hormone production and spermatogenesis is decreased. There is partial or complete spermatogenesis arrest due to chronic alcoholic intake [23]. Sansone ét al,2018 found that there was decreased sperm count and concentration due to defective spermatogenesis in alcoholic patients [24]. The impaired spermatogenesis could have been the cause of those participants who had altered semen parameters prior to Covid-19 infection.

In our study the total mean of BMI was 26.7% (overweight) and the participant who are obese and overweight had altered sperm parameters such as oligoasthenozoospermia prior to Covid infection. Obesitywas found to be important factor for male infertility by altering spermatogenesis thus decreasing sperm count [25]. The study conducted by Norouzabadét al,2008 concluded that there was positive correlation between altered semen parameters and overweight and obese categories [26]. The study conducted byHammoud ét al,2020 concluded that there was significant decrease in sperm count and motility in obese patients [27].

We observed there is no effect of COVID-19 infection and COVID-19 vaccination on semen volume of the patients as the mean value was similar and above the reference range. In consistent to our study Ma ét al,2022 also showed no significant changes in semen volume [12] and Sunnu ét al,2022 evaluated the long-term effect of Covid-19 infection on semen quality and found no alteration on semen volume [28]. Gatét al,2021 compared semen parameters of vaccinated and non-vaccinated semen donors and found no much changes in semen volume[29]. Zhuét al, conducted the retrospective cohort study which showed the slight decrease in semen volume after first vaccination and then normal semen volume after second vaccination [30].

In our study, the pH of the semen parameter was high around 7.8±0.23 in Covid infected and vaccinated (GROUP 2). The percentage change of patients with Covid -19 infected and vaccinated (GROUP 2) is less than then percentage change in only infected group (group 1). Hence vaccine administration has less impact of COVID-19 infection on pH.

In our study we found that the sperm concentration has decreased in Group 1 and Group 2 than Group 3 although there was no statistical significance. Our study also showed no notable variance in only infected and only vaccinated group. Thus, the decrease in sperm concentration could be due to either infection or vaccination. Tiwariét al, on systematic analysis showed the sperm concentration was decreased in infected group [31]. In the comparative study, byAskak ét al,2022 showed significant decrease of sperm concentration in infected group[32]. A prospective study by Lifshitz ét al,2021 the semen parameters of 75 vaccinated participants was compared with WHO reference and there was only one participant showed oligozoospermia hence concluded vaccine does not have any detrimental effect on semen parameters[33].

When the total motility parameter was compared between groups there was no changes between before and infection but slight decrease was found between vaccinated groups. Wang ét al,2022 conducted study which showed no statistical significance in sperm motility after infection which is consistent with our study[34].Bardaét al,2022 concluded the sperm concentration increased after second vaccination [35].In our study the Group 2 revealed there was decrease in sperm progressive motility than Group 1 and 3, in consistent with the multicentric study which assessed short term effects of infection in which there was significant decrease in the progressive motility in both mild and moderately infected group[36]. Reschiniét al, 2022 showed no much difference in sperm parameters after different types of vaccination[37].

Interestingly our study showed that there is rise in non-progressive sperm motility after Covid -19 infection and vaccination and not many studies have compared the non-progressive sperm motility, Group 3(only vaccinated) have shown decrease in non-progressive motility after vaccination even though not significant statistically.

The participants of each group had morphology of below reference range and we could find there was less sperm morphology in Group 2 albeit there was no significance between groups. Wangét al,2022 concluded the percentage of sperm morphology was lower in infected group but was within normal range [34].

V. CONCLUSION

The Covid-19 infection continues to affects the population worldwide and it is necessary to consider the possible effects of this infection on semen quality, thus this must be kept in mind while evaluating men with low semen parameters.Our study suggests there could be possible effects of COVID vaccination and COVID infection on semen parameters.As we are still new to this disease and its prevention, the better understanding the effect of SARS CoV-2 on male fertility needs sufficient shortand long-term studies. Many accumulating evidence have proved that the Covid-19 vaccines have less adverse effects and can be advised for couples seeking fertility service, thus preventing the Covid -19 virus adverse effects on reproductive system.

LIMITATIONS: Larger sample size is needed for better comparison and outcomes.

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REFERNCES

[1]. The Johns Hopkins Coronavirus Resource Center. COVID-19 Map 2021 [updated 15 Aug 2021].

[2]. Adams JG, Walls RM (2020) Supporting the health care workforce during the COVID-19 global epidemic. JAMA 323(15):1439–1440.

[3]. Wong JE, Leo YS, Tan CC (2020) COVID-19 in Singapore—current experience: critical global issues that require attention and action. JAMA 323(13):1243–1244.

[4]. Dutta S., Sengupta P. In press. SARS-CoV-2 and male infertility: possible multifaceted pathology. Reprod. Sci. 1–4.

[5]. 4.Segars J, Katler Q, McQueen DB, et al. Prior and novel coronaviruses, coronavirus disease 2019 (COVID-19), and human reproduction: what is known Fertil Steril. 2020;113(6):1140-1149.

[6]. Douglas GC, O'Bryan MK, Hedger MP, Lee DK, Yarski MA, Smith AI, Lew RA. The novel angiotensin-converting enzyme (ACE) homolog, ACE2, is selectively expressed by adult Leydig cells of the testis. Endocrinology. 2004 Oct;145(10):4703-11.

[7]. Liu C et al. 2020 Autophagy is required for ectoplasmic specialization assembly in Sertoli cells. Autophagy 12, 814–832.

[8]. Li H, Xiao X, Zhang J, Zafar MI, Wu C, Long Y, Lu W, Pan F, Meng T, Zhao K et al. 2020 Impaired spermatogenesis in COVID-19 patients. EClinicalmedicine 28 100604.

[9]. Ruan Y, Hu B, Liu Z, Liu K, Jiang H, Li H, Li R, Luan Y, Liu X & Yu G 2020 No detection of SARS-CoV-2 from urine, expressed prostatic secretions, and semen in 74 recovered COVID-19 male patients: a perspective and urogenital evaluationAndrology.

[10]. Holtmann N, Edimiris P, Andree M et al (2020) Assessment of SARS-CoV-2 in human semen-a cohort study. Fertil Steril 114(2):233–238.

[11]. Li D, Jin M, Bao P, Zhao W, Zhang S. Clinical characteristics, and results of semen tests among men with coronavirus disease 2019. JAMA network open. 2020 May 1;3(5):e208292-.

[12]. Ma, Ling et al. “Evaluation of sex-related hormones and semen characteristics in reproductive-aged male COVID-19 patients.” Journal of medical virology vol. 93,1 (2021): 456-462. doi:10.1002/jmv.26259.

[13]. Agarwal A, Rana M, Qiu E, AlBunni H, Bui AD, Henkel R. Role of oxidative stress, infection and inflammation in male infertility. Andrologia. 2018;50(11):e13126.

[14]. Zhu H, Wang X, Zhang F, Zhu Y, Du MR, Tao ZW, Sun C, Ma HT, Li YD, Liang GQ, Ren J, Feng BL, Jiang F. Evaluation of inactivated COVID-19 vaccine on semen parameters in reproductive-age males: a retrospective cohort study. Asian J Androl. 2022 Sep-Oct;24(5):441-444.

[15]. Xia W, Zhao J, Hu Y, Fang L, Wu S. Investigate the effect of COVID-19 inactivated vaccine on sperm parameters and embryo quality in in vitro fertilization. Andrologia. 2022 Jul;54(6):e14483.

[16]. J. Xu, L. Qi, X. Chi et al., "Orchitis: a complication of severe acute respiratory syndrome (SARS)," Biology of Reproduction, vol. 74, no. 2, pp. 410–416, 2006.
[17]. F. Pan, X. Xiao, J. Guo et al., "No evidence of severe acute respiratory syndrome-coronavirus 2 in semen of males recovering from coronavirus disease 2019," Fertility and Sterility, vol. 113, no. 6, pp. 1135–1139, 2020.
[18]. F. M. Falahieh, M. Zarabadipour, M. Mirani et al., "Effects of Moderate COVID-19 Infection on Semen Oxidative Status and Parameters 14 and 120 Days after Diagnosis," Reproduction, Fertility and Development, vol. 33, no. 12, pp. 683–690, 2021.
[19]. P. Rajak, S. Roy, M. Dutta et al., "Understanding the cross-talk between mediators of infertility and COVID-19," Reproductive Biology, vol. 21, no. 4, article 100559, 2021.
[20]. M. Z. Temiz, M. M. Dincer, I. Hacibey et al., "Investigation of SARS-CoV-2 in semen samples and the effects of COVID-19 on male sexual health by using semen analysis and serum male hormone profile: a cross-sectional, pilot study," Andrologia, vol. 53, no. 2, p. e13912, 2021.
[21]. Centers for Disease Control and Prevention (US)National Center for Chronic Disease Prevention and Health Promotion (US)Office on Smoking and Health (US). How tobacco smoke causes disease: the biology and behavioral basis for smokingattributable disease: a report of the Surgeon GeneralPublications and Reports of the Surgeon General. Atlanta (GA): Centers for Disease Control and Prevention (US); 2010.
[22]. Harlev A, Agarwal A, Gunes SO, Shetty A, du Plessis SS. Smoking and male infertility: an evidence-based review. World J Mens Health 2015;33:143–60.
[23]. Pajarinen JT, Karhunen PJ. Spermatogenic arrest and 'Sertoli cell-only' syndrome–common alcohol-induced disorders of the human testis. Int J Androl 1994;17:292–9.
[24]. Sansone, A., Di Dato, C., de Angelis, C., Menafra, D., Pozza, C., Pivonello, R., et al. (2018). Smoke, alcohol and drug addiction and male fertility. Reprod. Biol. Endocrinol. 16:3.
[25]. Slama R, Eustache F, Ducot B, Jensen TK, Jorgensen N, Horte A, et al. Time to pregnancy and semen parameters: a cross-sectional study among fertile couples from four European cities. Hum Reprod 2002;17:503–15.
[26]. Maghsoumi-Norouzabad, L., Zare Javid, A., Aiiashi, S., Hosseini, S. A., Dadfar, M., Bazyar, H., & Dastoorpur, M. (2020). The Impact of Obesity on Various Semen Parameters and Sex Hormones in Iranian Men with Infertility: A Cross-Sectional Study. Research and reports in urology, 12, 357–365.
[27]. Hammoud, A. O., Wilde, N., Gibson, M., Parks, A., Carrell, D. T., & Meikle, A. W. (2008). Male obesity and alteration in sperm parameters. Fertility and sterility, 90(6), 2222–2225.
[28]. Sunnu, C. C., Tribowo, J. A., Juwita, W., Rezano, A., I'tishom, R., Supardi, S., & Margiana, R. (2022). The long-term impact of COVID-19 infection on semen quality of the COVID-19 survivors.International Journal of Health Sciences,6(S6), 925–936.
[29]. Gat, I., Kedem, A., Dviri, M., Umanski, A., Levi, M., Hourvitz, A., & Baum, M. (2022). Covid-19 vaccination BNT162b2 temporarily impairs semen concentration and total motile count among semen donors. Andrology, 10(6), 1016–1022.
[30]. Zhu, H., Wang, X., Zhang, F., Zhu, Y., Du, M. R., Tao, Z. W., Sun, C., Ma, H. T., Li, Y. D., Liang, G. Q., Ren, J., Feng, B. L., & Jiang, F. (2022). Evaluation of inactivated COVID-19 vaccine on semen parameters in reproductive-age males: a retrospective cohort study. Asian journal of andrology, 24(5), 441–444.
[31]. Tiwari, S., Kc, N., Thapa, S., Ghimire, A., Bijukchhe, S., Sah, G. S., & Isnuwardana, R. (2021). Semen parameters in men recovered from COVID-19: a systematic review and meta-analysis. Middle East Fertility Society journal, 26(1), 44.
[32]. Aksak, T., Satar, D. A., Bağci, R., Gülteki N, E. O., Coşkun, A., & Demi Rdelen, U. (2022). Investigation of the effect of COVID-19 on sperm count, motility, and morphology. Journal of medical virology, 94(11), 5201–5205.
[33]. Lifshitz, D., Haas, J., Lebovitz, O., Raviv, G., Orvieto, R., & Aizer, A. (2022). Does mRNA SARS-CoV-2 vaccine detrimentally affect male fertility, as

reflected by semen analysis? Reproductive biomedicine online, 44(1), 145–149.

[34]. Wang, M., Hu, J., Huang, B., Yang, Q., Liu, S., Li, Z., Yang, L., Xi, Q., Zhu, L., & Jin, L. (2022). Investigating the impact of SARS-CoV-2 infection on basic semen parameters and in vitro fertilization/intracytoplasmic sperm injection outcomes: a retrospective cohort study. Reproductive biology and endocrinology : RB&E, 20(1), 46.

[35]. Barda, S, Laskov, I, Grisaru, D, et al. The impact of COVID-19 vaccine on sperm quality. Int J Gynecol Obstet. 2022; 158: 116– 120.

[36]. Hamarat, M. B., Ozkent, M. S., Yilmaz, B., Aksanyar, S. Y., & Karabacak, K. (2022). Effect of SARS-CoV-2 infection on semen parameters. Canadian Urological Association journal = Journal de l'Association des urologues du Canada, 16(3), E173–E177.

[37]. Reschini, M., Pagliardini, L., Boeri, L., Piazzini, F., Bandini, V., Fornelli, G., Dolci, C., Cermisoni, G. C., Viganò, P., Somigliana, E., Coccia, M. E., & Papaleo, E. (2022). COVID-19 Vaccination Does Not Affect Reproductive Health Parameters in Men. Frontiers in public health, 10, 839967.