

Supplementary Material

COVID-19 associates with semen inflammation and sperm quality impairment that reverses in the short term after disease recovery

María Sol Martínez^{1†}, Fernando Nicolás Ferreyra^{1†}, Daniela Andrea Paira¹, Virginia Elena Rivero¹, José Javier Olmedo², Andrea Daniela Tissera², Rosa Isabel Molina², Rubén Darío Motrich^{1*}

¹ CIBICI-CONICET, Facultad de Ciencias Químicas, Universidad Nacional de Córdoba, Argentina.

² Fundación Urológica Córdoba para la Docencia e Investigación Médica (FUCDIM), Córdoba, Argentina.

³ Laboratorio de Andrología y Reproducción (LAR), Córdoba, Argentina.

[†]These authors contributed equally to this work and share first authorship.

*** Correspondence:** Ruben D. Motrich (rmotrich@unc.edu.ar)

Supplementary Table 1: Semen analysis in COVID-19 patients and control individuals

Semen analysis	Subjects (mean $\pm$ SD)					Lower reference limit ^c
	Controls (n=62)	Mild COVID-19 Patients (n=199)	<i>p</i> ^a	Severe COVID-19 Patients (n=32)	<i>p</i> ^b	
Volume (mL)	3.22 $\pm$ 1.46	2.64 $\pm$ 1.31	* 0.01	2.43 $\pm$ 1.36	* 0.009	$\geq$ 1.5
pH	7.65 $\pm$ 0.19	7.65 $\pm$ 0.16	> 0.99	7.68 $\pm$ 0.18	0.87	$\geq$ 7.2
Sperm concentration (x10 ⁶ /mL)	106.10 $\pm$ 65.88	108.50 $\pm$ 89.70	> 0.99	100.40 $\pm$ 92.09	> 0.99	$\geq$ 15.00
Total sperm count (millions)	317.60 $\pm$ 196.50	258.70 $\pm$ 235.50	* 0.02	236.4 $\pm$ 258.50	* 0.03	$\geq$ 39.0
Total sperm motility (%)	52.75 $\pm$ 14.39	43.05 $\pm$ 20.07	* 0.002	41.44 $\pm$ 19.15	* 0.02	$\geq$ 40.0
Progressive sperm motility (%)	34.00 $\pm$ 12.96	25.25 $\pm$ 15.85	* 0.0001	22.63 $\pm$ 14.06	* 0.002	$\geq$ 32
Sperm viability (%)	87.15 $\pm$ 5.21	83.93 $\pm$ 7.98	* 0.01	86.29 $\pm$ 6.30	> 0.99	$\geq$ 58
Peroxidase (+) cells (x10 ⁶ /mL)	0.07 $\pm$ 0.11	0.30 $\pm$ 0.61	0.22	0.23 $\pm$ 0.86	0.36	$\leq$ 1.00
Anti-sperm IgG antibodies (MAR test, %)	1.29 $\pm$ 1.10	1.73 $\pm$ 1.83	0.53	1.27 $\pm$ 1.72	> 0.99	< 50
Krüger's morphology (normal sperm, %)	5.98 $\pm$ 3.07	5.37 $\pm$ 3.12	0.78	5.93 $\pm$ 3.44	> 0.99	$\geq$ 4
WHO's morphology (normal sperm, %)	5.98 $\pm$ 3.07	5.27 $\pm$ 3.16	0.38	5.79 $\pm$ 3.49	> 0.99	$\geq$ 4

(^a) Mild COVID-19 patients vs. controls. (^b) Severe COVID-19 patients vs. controls. (^c) Lower reference value according to the World Health Organization Semen Analysis Manual 5th Ed. 2010. ND: not determined. MAR: mixed antiglobulin reaction. A * $p < 0.05$ was considered statistically significant.

Supplementary Table 2: Follow up semen analysis in COVID-19 patients before and after disease recovery

Semen analysis	Patients (mean $\pm$ SD)					Lower reference limit ^c
	Pre COVID-19	Early after COVID-19	<i>p</i> ^a	Late after COVID-19	<i>p</i> ^b	
Volume (mL)	2.61 $\pm$ 1.24	2.61 $\pm$ 1.39	> 0.99	2.45 $\pm$ 1.24	> 0.99	$\geq$ 1.5
pH	7.61 $\pm$ 0.13	7.61 $\pm$ 0.11	> 0.99	7.63 $\pm$ 0.14	0.66	$\geq$ 7.2
Sperm concentration (x10 ⁶ /mL)	98.42 $\pm$ 79.06	85.44 $\pm$ 79.34	0.97	109.80 $\pm$ 74.64	0.55	$\geq$ 15.00
Total sperm count (millions)	255.80 $\pm$ 171.04	171.09 $\pm$ 152.60	* 0.02	223.00 $\pm$ 151.00	0.86	$\geq$ 39.0
Total sperm motility (%)	44.68 $\pm$ 20.72	32.70 $\pm$ 21.52	* 0.013	43.82 $\pm$ 20.27	> 0.99	$\geq$ 40.0
Progressive sperm motility (%)	27.71 $\pm$ 16.50	18.36 $\pm$ 15.67	* 0.011	26.46 $\pm$ 15.89	> 0.99	$\geq$ 32
Sperm viability (%)	83.88 $\pm$ 8.29	78.13 $\pm$ 11.49	* 0.02	84.95 $\pm$ 8.92	0.67	$\geq$ 58
Peroxidase (+) cells (x10 ⁶ /mL)	0.18 $\pm$ 0.29	0.50 $\pm$ 1.48	> 0.99	0.32 $\pm$ 0.54	> 0.99	$\leq$ 1.00
Anti-sperm IgG antibodies (MAR test, %)	1.76 $\pm$ 1.53	1.79 $\pm$ 1.97	> 0.99	1.51 $\pm$ 1.14	> 0.99	< 50
Krüger's morphology (normal sperm, %)	6.09 $\pm$ 3.56	5.18 $\pm$ 3.12	0.61	5.79 $\pm$ 3.28	> 0.99	$\geq$ 4
WHO's morphology (normal sperm, %)	6.09 $\pm$ 3.56	4.84 $\pm$ 3.18	0.22	5.64 $\pm$ 3.37	> 0.99	$\geq$ 4

(^a) Early after COVID-19 vs. Pre COVID-19. (^b) Late after COVID-19 vs. Pre COVID-19. (^c) Lower reference value according to the World Health Organization Semen Analysis Manual 5th Ed. 2010. ND: not determined. MAR: mixed antiglobulin reaction. Patients, n=231. A * $p < 0.05$ was considered statistically significant.