

Supplementary Online Content

Lee LYW, Tilby M, Starkey T, et al; UK COVID Cancer Programme. Association of SARS-CoV-2 spike protein antibody vaccine response with infection severity in patients with cancer: a national COVID cancer cross-sectional evaluation. *JAMA Oncol*. Published online December 22, 2022. doi:10.1001/jamaoncol.2022.5974

eTable 1. Coronavirus (COVS) Antibody Responses in the Cancer Cohort and Population Control

eTable 2. Coronavirus (COVS) Antibody Titres in the Cancer Cohort and Population Control Following Dose 2, Dose 3, and Following Either Dose 2/3

eTable 3. Cancer Cohort Subgroup Analyses of Median Coronavirus (COVS) Antibody Titres and Responses

eTable 4. Univariable and Multivariable Adjusted Odds Ratio for the Risk of Coronavirus Breakthrough Infection and Coronavirus Hospitalisation Amongst Test From Cancer Patients With Undetectable Coronavirus (COVS) Antibody Responses Relative to Those With Positive Antibody Responses

eFigure 1. Study Eligibility Based on Exclusion Criteria

eFigure 2. Median Coronavirus Antibody Titres and Responses in Cancer Patients Based on Cancer and Treatment

This supplementary material has been provided by the authors to give readers additional information about their work.

eTable 1. Coronavirus (COVS) antibody responses in the cancer cohort and population control.

	Cancer Cohort (n=4249)	Population Control (n=294,230)
- COVS Negative	199 (4.7)	376 (0.1)
- COVS Positive	4050 (95.3)	293854 (99.9)
- COVS Median (all)	10176.0 (1388.0-25000.0)	14518.0 (4057.0-25000.0)

eTable 2. Coronavirus (COVS) antibody titres in the cancer cohort and population control following dose 2, dose 3, and following either dose 2/3.

	Cancer Cohort		Population Control	
	<i>Total</i>	<i>COVS Median Titre (IQR)</i>	<i>Total</i>	<i>COVS Median Titre (IQR)</i>
Dose 2	2313	8765.0 (1093.0-25000.0)	230417	12126.0 (2766.0-25000.0)
Dose 3	1936	11146.5 (2278.8-25000.0)	63813	23667.0 (12875.5-25000.0)
Dose 2 & 3	4249	10176.0 (1388.0-25000.0)	294230	14518.0 (4057.0-25000.0)

eTable 3. Cancer cohort subgroup analyses of median coronavirus (COVS) antibody titres and responses.

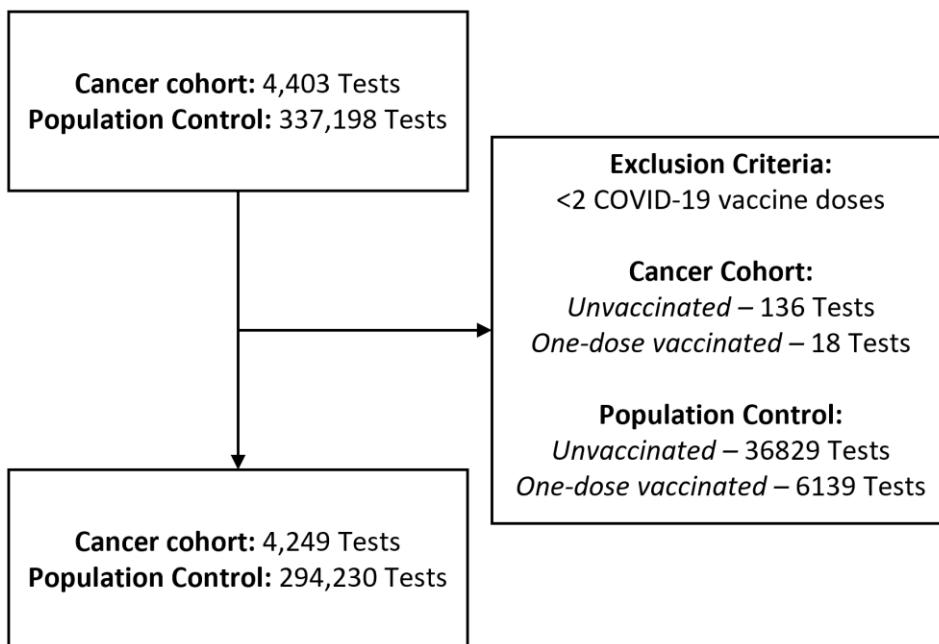
	Dose 2	Dose 3	Dose 2 & 3
Cancer Stage			
<i>Stage 1</i>	535 (100.00)	235 (100.00)	770 (100.00)
- COVS Positive	535 (100.00)	231 (98.30)	766 (99.48)
- COVS Negative	0 (0.00)	4 (1.70)	4 (0.52)
- COVS Median	15255.0 (2995.5-25000.0)	24583.0 (10431.0-25000.0)	18250.0 (5078.8-25000.0)
<i>Stage 2</i>	341 (100.00)	181 (100.00)	522 (100.00)
- COVS Positive	339 (99.41)	180 (99.45)	519 (99.43)
- COVS Negative	2 (0.59)	1 (0.55)	3 (0.57)
- COVS Median	13908.0 (2769.0-25000.0)	18768.0 (8298.0-25000.0)	15891.0 (4157.0-25000.0)
<i>Stage 3</i>	246 (100.00)	130 (100.00)	376 (100.00)
- COVS Positive	245 (99.59)	128 (98.46)	373 (99.20)
- COVS Negative	1 (0.41)	2 (1.54)	3 (0.80)
- COVS Median	14934.0 (3123.3-25000.0)	20114.0 (6296.0-25000.0)	18028.0 (3650.8-25000.0)
<i>Stage 4</i>	61 (100.00)	59 (100.00)	120 (100.00)
- COVS Positive	61 (100.00)	59 (100.00)	120 (100.00)
- COVS Negative	0 (0.00)	0 (0.00)	0 (0.00)
- COVS Median	8069.0 (579.0-25000.0)	16821.0 (4429.5-25000.0)	11914.5 (2154.5-25000.0)
Cancer Treatment			
<i>Systemic Anti-Cancer Therapy (SACT)</i>	416 (100.00)	382 (100.00)	798 (100.00)
- COVS Positive	387 (93.03)	336 (87.96)	723 (90.60)
- COVS Negative	29 (6.97)	46 (12.04)	75 (9.40)
- COVS Median	6273.0 (369.9-25000.0)	10395.0 (1486.0-25000.0)	8131.0 (568.0-25000.0)
<i>No Systemic Anti-Cancer Therapy (SACT)</i>	1661 (100.00)	878 (100.00)	2539 (100.00)
- COVS Positive	1648 (99.22)	851 (96.92)	2499 (98.42)
- COVS Negative	13 (0.78)	27 (3.08)	40 (1.58)
- COVS Median	13213.0 (2032.0-25000.0)	19525.5 (7865.3-25000.0)	15443.0 (3323.5-25000.0)
<i>Radiotherapy</i>	314 (100.00)	173 (100.00)	487 (100.00)
- COVS Positive	309 (98.41)	169 (97.69)	478 (98.15)
- COVS Negative	5 (1.59)	4 (2.31)	9 (1.85)
- COVS Median	12943.5 (2233.8-25000.0)	17391.0 (5191.0-25000.0)	14520.0 (2953.0-25000.0)
<i>No Radiotherapy</i>	1763 (100.00)	1087 (100.00)	2850 (100.00)
- COVS Positive	1726 (97.90)	1018 (93.65)	2744 (96.28)
- COVS Negative	37 (2.10)	69 (6.35)	106 (3.72)
- COVS Median	11553.0 (1554.0-25000.0)	16937.0 (5110.0-25000.0)	13645.0 (2299.5-25000.0)
Cancer Type			
<i>Solid Tumour Malignancy</i>	1847 (100.00)	944 (100.00)	2791 (100.00)
- COVS Positive	1843 (99.78)	938 (99.36)	2781 (99.64)
- COVS Negative	4 (0.22)	6 (0.64)	10 (0.36)
- COVS Median	13511.0 (2310.0-25000.0)	20649.5 (9413.0-25000.0)	16165.0 (3906.0-25000.0)
<i>Haematological Malignancy</i>	230 (100.00)	316 (100.00)	546 (100.00)
- COVS Positive	192 (83.48)	249 (78.80)	441 (80.77)
- COVS Negative	38 (16.52)	67 (21.20)	105 (19.23)
- COVS Median	1004.5 (19.0-12485.0)	4297.0 (11.4-18206.0)	1872.5 (12.8-16772.0)
Solid Tumour Subtypes			
<i>Lip, oral cavity and pharynx (C00-C14)</i>	55 (100.00)	30 (100.00)	85 (100.00)
- COVS Positive	55 (100.00)	30 (100.00)	85 (100.00)
- COVS Negative	0 (0.00)	0 (0.00)	0 (0.00)
- COVS Median	14031.0 (2456.5-25000.0)	25000.0 (20288.8-25000.0)	21290.0 (6207.0-25000.0)
<i>Non-colorectal gastrointestinal (C15-C17, C22-C26)</i>	69 (100.00)	34 (100.00)	103 (100.00)
- COVS Positive	69 (100.00)	34 (100.00)	103 (100.00)
- COVS Negative	0 (0.00)	0 (0.00)	0 (0.00)
- COVS Median	14240.0 (2533.0-25000.0)	17698.5 (6586.0-25000.0)	17558.0 (2992.5-25000.0)
<i>Colorectal gastrointestinal (C18-C21)</i>	218 (100.00)	132 (100.00)	350 (100.00)
- COVS Positive	218 (100.00)	131 (99.24)	349 (99.71)
- COVS Negative	0 (0.00)	1 (0.76)	1 (0.29)
- COVS Median	15121.0 (2645.5-25000.0)	19071.5 (7605.8-25000.0)	17179.0 (3887.8-25000.0)
<i>Respiratory and intrathoracic (C30-C39)</i>	67 (100.00)	45 (100.00)	112 (100.00)
- COVS Positive	65 (97.01)	45 (100.00)	110 (98.21)
- COVS Negative	2 (2.99)	0 (0.00)	2 (1.79)
- COVS Median	8487.0 (1361.0-25000.0)	25000.0 (15921.0-25000.0)	18149.5 (5986.5-25000.0)

	Dose 2	Dose 3	Dose 2 & 3
<i>Bone, mesothelial and soft tissue (C40-C41, C45-C49)</i>	20 (100.00)	14 (100.00)	34 (100.00)
- COVS Positive	20 (100.00)	14 (100.00)	34 (100.00)
- COVS Negative	0 (0.00)	0 (0.00)	0 (0.00)
- COVS Median	11912.0 (1102.8-25000.0)	18472.0 (8094.3-25000.0)	16371.5 (3287.0-25000.0)
<i>Breast (C50)</i>	678 (100.00)	346 (100.00)	1024 (100.00)
- COVS Positive	676 (99.71)	344 (99.42)	1020 (99.61)
- COVS Negative	2 (0.29)	2 (0.58)	4 (0.39)
- COVS Median	12723.5 (1993.3-25000.0)	19243.5 (7722.5-25000.0)	14557.5 (3324.8-25000.0)
<i>Female gynaecological (C51-C58)</i>	138 (100.00)	56 (100.00)	194 (100.00)
- COVS Positive	138 (100.00)	56 (100.00)	194 (100.00)
- COVS Negative	0 (0.00)	0 (0.00)	0 (0.00)
- COVS Median	10906.0 (2376.5-25000.0)	16222.5 (7065.0-25000.0)	12341.5 (2968.0-25000.0)
<i>Male urological (C60, C62-C63)</i>	23 (100.00)	10 (100.00)	33 (100.00)
- COVS Positive	23 (100.00)	10 (100.00)	33 (100.00)
- COVS Negative	0 (0.00)	0 (0.00)	0 (0.00)
- COVS Median	13474.0 (3665.0-25000.0)	24891.0 (17112.8-25000.0)	20913.0 (4268.0-25000.0)
<i>Prostate (C61)</i>	396 (100.00)	177 (100.00)	573 (100.00)
- COVS Positive	396 (100.00)	175 (98.87)	571 (99.65)
- COVS Negative	0 (0.00)	2 (1.13)	2 (0.35)
- COVS Median	16067.0 (2829.8-25000.0)	24583.0 (11989.0-25000.0)	19680.0 (4539.0-25000.0)
<i>Urinary Tract (C64-C68)</i>	106 (100.00)	68 (100.00)	174 (100.00)
- COVS Positive	106 (100.00)	67 (98.53)	173 (99.43)
- COVS Negative	0 (0.00)	1 (1.47)	1 (0.57)
- COVS Median	17166.5 (2827.8-25000.0)	25000.0 (9927.0-25000.0)	19140.5 (5780.3-25000.0)
<i>Central nervous system (C69-C72)</i>	29 (100.00)	7 (100.00)	36 (100.00)
- COVS Positive	29 (100.00)	7 (100.00)	36 (100.00)
- COVS Negative	0 (0.00)	0 (0.00)	0 (0.00)
- COVS Median	11997.0 (1666.0-18353.0)	10913.0 (7181.0-23361.5)	11942.5 (2065.3-21139.5)
<i>Endocrine glands (C73-C75)</i>	48 (100.00)	25 (100.00)	73 (100.00)
- COVS Positive	48 (100.00)	25 (100.00)	73 (100.00)
- COVS Negative	0 (0.00)	0 (0.00)	0 (0.00)
- COVS Median	12501.5 (1809.5-25000.0)	17828.0 (9296.0-25000.0)	15066.0 (4327.0-25000.0)
Haematological Subtypes			
<i>Lymphoma (C81-C85)</i>	125 (100.00)	153 (100.00)	278 (100.00)
- COVS Positive	103 (82.40)	105 (68.63)	208 (74.82)
- COVS Negative	22 (17.60)	48 (31.37)	70 (25.18)
- COVS Median	736.0 (6.0-17740.0)	799.0 (0.4-9918.0)	777.5 (0.7-11638.0)
<i>Myeloma (C90)</i>	33 (100.00)	60 (100.00)	93 (100.00)
- COVS Positive	32 (96.97)	59 (98.33)	91 (97.85)
- COVS Negative	1 (3.03)	1 (1.67)	2 (2.15)
- COVS Median	5617.0 (849.0-23768.0)	16124.5 (4272.0-25000.0)	10451.0 (2328.0-25000.0)
<i>Leukaemia (C91-C95)</i>	66 (100.00)	91 (100.00)	157 (100.00)
- COVS Positive	52 (78.79)	76 (83.52)	128 (81.53)
- COVS Negative	14 (21.21)	15 (16.48)	29 (18.47)
- COVS Median	631.6 (9.5-3563.3)	5100.0 (137.3-18361.5)	1846.0 (40.0-11385.0)

eTable 4. Univariable and multivariable adjusted odds ratio for the risk of coronavirus breakthrough infection and coronavirus hospitalisation amongst test from cancer patients with undetectable coronavirus (COVS) antibody responses relative to those with positive antibody responses. Multivariable corrected models were fitted for the patient age, sex, ethnicity and deprivation. Sensitivity analyses were done according to number of vaccine doses and on cancer type.

	Coronavirus Breakthrough infection				Coronavirus Hospitalisation			
	Univariable OR (95% CI)	p. value	Multivariable OR (95% CI)	p.value	Univariable OR (95% CI)	p. value	Multivariable OR (95% CI)	p.value
Overall	2.56 (1.69-.400)	<0.0001	3.05 (1.96-4.72)	<0.0001	5.88 (3.13-11.11)	<0.0001	6.48 (3.31-6.48)	<0.0001
Sensitivity analysis 1								
- Dose 2 only	2.17 (0.97-4.76)	0.0580	2.25 (0.99-5.12)	0.0532	6.67 (2.27-20.00)	0.0006	6.71 (2.21-20.35)	0.0007
- Dose 3 only	2.56 (1.54-4.35)	0.0003	3.16 (1.86-5.37)	<0.0001	5.26 (2.27-12.0)	0.0001	6.28 (2.63-14.99)	<0.0001
Sensitivity analysis 2								
- Solid only	5.88 (1.25-25.00)	0.0250	5.33 (1.05-27.06)	0.0436	50.00 (9.09-inf)	<0.0001	50.50 (9.13-279.19)	<0.0001
- Haem only	1.59 (0.85-3.03)	0.1470	2.04 (1.04-3.98)	0.0376	3.23 (1.27-8.33)	0.0137	3.64 (1.35-9181)	0.0106

eFigure 1. Study eligibility based on exclusion criteria.



eFigure 2. Median coronavirus antibody titres and responses in cancer patients based on cancer and treatment. Bars represent % COVS positive results, dots represent antibody response titres (COVS/U/ml).

