

Supplementary Table S1: Descriptive statistics for all COVID-19 patients at 12 months with a valid CPET at either 3 or 12 months after hospitalization (n=210) and subgroups of the patients with and without dyspnoea at 3 months.

	All patients (n=210)	Dyspnoea (n=85)	No dyspnoea (n=87)
	Number (%) / Mean (SD)	Number (%) / Mean (SD)	Number (%) / Mean (SD)
Age at hospital discharge, years	210 / 58.1 (13.8)	57.7(13.3)	56.8(14.0)
Female sex	85 (41%)	42(49)	
Body mass index, kg·m ² , 3 months/12 months	28.0 (4.4)/28.5 (4.8)	29.1(4.6)/30.2(5.5)	27.2(3.9)/27.6(3.9)
<i>Smoking status (n=176)</i>			
Never smoked	113 (64)	45(54)	55(64)
Formerly a daily smoker	78 (44)	35(42)	31(36)
Current daily smoker	5 (3)	4(5)	0(0)
<i>Medical history (n=208)</i>			
Myocardial infarction	14 (7)	8(10)	4(5)
Heart failure	8 (4)	6(7)	2(2)
CVA/TIA	3 (1)	2(2)	1(1)
Hypertension (n=203)	66 (32)	27(33)	25(29)
COPD	7 (3)	3(4)	1(1)
Asthma	39 (18)	19(23)	9(10)
Diabetes mellitus	16 (8)	8(10)	7(8)
<i>Spirometry and body plethysmography</i>			
FEV ₁ % predicted, 12 months (n=189)	94 (15)	94(13)	95(14)
FVC % predicted, 12 months (n=187)	97 (13)	96(13)	96(16)
TLC, % predicted, 12 months (n=156)	97 (17)	97(15)	96(15)
<i>Gas diffusion</i>			
D _{LCO} % predicted, 12 months (n=184)	92 (17)	92(15)	96(16)
<i>modified MRC dyspnoea scale 3 months/12 months (</i>			
0	87 (49.4%)/97 (53.0)		
1-4	89 (50.6%)/86(47.0)		
<i>Advanced oxygen treatment</i>			
High flow nasal oxygen	58	28	25
CPAP	3(2)	3(4)	0(0)
BiPAP	15(8)	7(8)	7(8)
Mechanical ventilation with intubation	14(7)	7(9)	7(8)
<i>WHO Ordinal Scale for Clinical Improvement</i>			
3	26(13)	11(13)	11(13)
4	208		
5-7	75 (36)	25(29)	34(40)
	96 (46)	43(51)	39(45)
	37 (18)	17(20)	13(15)

The number of patients represents all patients that had at least one valid CPET at either 3 or 12 months. * Maximum values during hospitalization. CVA: cerebral vascular accident; TIA: transient ischemic attack; PFT: pulmonary function test; FVC: forced vital capacity; FEV₁: forced expiratory volume in one second; TLC: total lung capacity; D_{LCO}: diffusion capacity of

the lung for carbon monoxide; V_A : alveolar volume; MRC: Medical Research Council; CPAP: Continuous Positive Airway Pressure, BiPAP: Bi-level Positive Airway Pressure, WHO: World Health Organization

Supplementary Table S2. Estimated effect of the interaction between the categorical time variable (3 or 12 months) and obesity or comorbidity on the outcome variables, given as the difference in change from 3 to 12 months between obese and non-obese (n=204), and between comorbidity and no-comorbidity (n=208).				
	Time by obesity (BMI>30)		Time by comorbidity	
	Estimate (95% CI)	p	Estimate (95% CI)	p
<i>Performance</i>				
$V'_{O_2\text{peak}}$, mL·min ⁻¹	-110 (-270 to 42)	0.150	-110 (-237 to 12)	0.076
$V'_{O_2\text{peak}}$ % of predicted	-3.4 (-9.0 to 1.8)	0.202	-4.2 (-9.3 to 0.9)	0.098
$V'_{O_2\text{peak}} \cdot \text{kg}^{-1}$, mL·kg ⁻¹ ·min ⁻¹	-1.5 (-3.2 to 0.2)	0.077	-0.7 (-2.5 to 1.0)	0.372
$V'_{O_2\text{peak}} \cdot \text{kg}^{-1}$, % of predicted	-4.3 (-9.2 to 0.5)	0.083	-2 (-7.7 to 3.5)	0.452
Perceived dyspnoea Borg ₁₀ at max load	0.7 (-0.1 to 1.6)	0.110	0.8 (-0.6 to 2.0)	0.230
<i>Ventilation</i>				
V'_E at max. load, L·min ⁻¹	-2.4 (-9.5 to 4.7)	0.482	2.2 (-7.7 to 12.0)	0.672
Breathing reserve, %	0.3 (-6.5 to 7.5)	0.894	-0.7 (-12.6 to 11.7)	0.910
<i>Circulation</i>				
Heart rate at max.load, beats·min ⁻¹	-5.3 (-11.3 to 0.5)	0.074	-0.2 (-8.0 to 7.8)	0.927
Heart rate at max. load, % of predicted	-3.1 (-6.6 to 0.3)	0.070	0.0 (-4.9 to 5.1)	0.976
Systolic BP at max. load, mmHg	-10.7 (-26.7 to 6.0)	0.215	-9.4 (-35.2 to 15.0)	0.430
Diastolic BP at max. load, mmHg	-10.8 (-18.4 to -2.9)	0.006	-4.7 (-16.0 to 6.2)	0.382
Oxygen pulse at max. load, mL·stroke ⁻¹	-0.3 (-1.0 to 0.5)	0.446	-0.8 (-1.9 to 0.2)	0.112
Oxygen pulse at max. load, % of predicted	-0.3 (-5.1 to 4.4)	0.864	-3.3 (-11.0 to 3.9)	0.357
<i>Gas exchange</i>				
V'_E/V'_{CO_2} slope	-0.5 (-2.2 to 1.3)	0.550	-2.6 (-6.5 to 0.8)	0.145
$V'_E/V'_{CO_2\text{nadir}}$	0.2 (-0.8 to 1.3)	0.717	0.8 (-0.9 to 2.6)	0.365
RER at max. load	0.01 (-0.02 to 0.05)	0.474	0.03 (-0.01 to 0.09)	0.180
P_{ETCO_2} at AT, kPa	0.11 (-0.11 to 0.36)	0.368	-0.24 (-0.58 to 0.08)	0.152
P_{CO_2} at max. load, kPa	0.1 (-0.2 to 0.3)	0.522	0.1 (-0.3 to 0.5)	0.662
<i>Anaerobic threshold</i>				
V'_{O_2} at AT, mL·min ⁻¹ (V-slope)	28 (-76 to 137)	0.596	40 (-110 to 201)	0.616
$V'_{O_2\text{peak}}$ at AT, % of predicted $V'_{O_2\text{max}}$	1.0 (-3.0 to 5.4)	0.636	1.4 (-5.7 to 9.0)	0.713
Lactate at max. load, mmol·L ⁻¹	0.1 (-1.0 to 1.2)	0.824	0.1 (-1.4 to 1.6)	0.900

Estimates are from linear mixed models including main effects and interactions with time for ICU stay and dyspnoea, age, sex, obesity and comorbidity at 3 months. 95% CIs and p-values are found by bootstrapping.

Supplementary Table S3. Estimated effect of the interaction between the categorical time variable (3 or 12 months) and obesity or comorbidity on the outcome variables, given as the difference slope for age at 12 months vs 3 months (n=210), and in change from 3 to 12 between males and females (n=210).				
	Time by age		Time by sex	
	Estimate (95% CI)	p	Estimate (95% CI)	p
<i>Performance</i>				
$V'_{O_2\text{peak}}$, mL·min ⁻¹	11 (-27 to 52)	0.525	-70 (-183 to 31)	0.190

$V'_{O_{2peak}}$, % of predicted	0.6 (-0.9 to 2.1)	0.387	-3.7 (-8 to 0.1)	0.058
$V'_{O_{2peak}} \cdot kg^{-1}$, mL·kg ⁻¹ ·min ⁻¹	0.1 (-0.3 to 0.6)	0.516	-1.4 (-2.9 to -0.1)	0.029
$V'_{O_{2peak}} \cdot kg^{-1}$, % of predicted	0.6 (-0.9 to 2.0)	0.390	-4.1 (-8.5 to -0.3)	0.038
Perceived dyspnoea Borg ₁₀ at max load	-0.1 (-0.4 to 0.2)	0.411	-0.3 (-1.0 to 0.3)	0.300
<u>Ventilation</u>				
V'_E at max. load, L·min ⁻¹	-2.2 (-5.3 to 0.7)	0.148	2.1 (-4.5 to 8.9)	0.521
Breathing reserve, %	0.2 (-2.6 to 3.1)	0.939	-2.6 (-9.3 to 4.4)	0.461
<u>Circulation</u>				
Heart rate at max.load, beats·min ⁻¹	-1.1 (-3.4 to 1.1)	0.321	-3.0 (-8.7 to 2.4)	0.294
Heart rate at max. load, % of predicted	-0.6 (-2.0 to 0.6)	0.319	-1.8 (-5.2 to 1.4)	0.273
Systolic BP at max. load, mmHg	0.0 (-5.9 to 6.3)	0.970	-15.5 (-31.3 to 0.5)	0.054
Diastolic BP at max. load, mmHg	0.5 (-2.3 to 3.5)	0.683	-4.1 (-11.0 to 3.1)	0.244
Oxygen pulse at max. load, mL·stroke ⁻¹	0.3 (0.0 to 0.5)	0.049	-0.2 (-0.9 to 0.5)	0.512
Oxygen pulse at max. load, % of predicted	1.2 (-0.5 to 3.1)	0.173	-2.9 (-7.5 to 1.8)	0.214
<u>Gas exchange</u>				
V'_E/V'_{CO_2} slope	-0.5 (-1.1 to 0.0)	0.075	1.5 (0.1 to 3.0)	0.040
$V'_E/V'_{CO_{2nadir}}$	-0.1 (-0.5 to 0.2)	0.393	0.8 (-0.1 to 1.7)	0.071
RER at max. load	-0.01 (-0.03 to 0.00)	0.088	-0.02 (-0.06 to 0.02)	0.289
P_{ETCO_2} at AT, kPa	-0.01 (-0.07 to 0.07)	0.828	-0.12 (-0.29 to 0.06)	0.171
P_{CO_2} at max. load, kPa	-0.1 (-0.2 to 0.0)	0.163	0.0 (-0.2 to 0.2)	0.900
<u>Anaerobic threshold</u>				
V'_{O_2} at AT, mL·min ⁻¹ (V-slope)	-9 (-50 to 33)	0.674	-32 (-134 to 70)	0.544
$V'_{O_{2peak}}$ at AT, % of predicted $V'_{O_{2max}}$	0.0 (-1.5 to 1.5)	0.986	-2.5 (-6.6 to 1.9)	0.238
Lactate at max. load, mmol·L ⁻¹	0.0 (-0.4 to 0.3)	0.828	1.4 (0.4 to 2.3)	0.002

Estimates are from linear mixed models including main effects and interactions with time for ICU stay and dyspnoea, age, sex, obesity, and comorbidity at 3 months. 95% CIs and p-values are found by bootstrapping.

Supplementary Table S4. RER at max. load greater or less than 1.1 with the estimate of difference between patients and controls at 12 months							
		RER < 1.1		RER ≥ 1.1		Interaction	
	n	Estimate 95% CI	p-value	Estimate 95% CI	p-value	Estimate 95% CI	p-value
<u>Performance</u>							
$V'_{O_{2peak}}$, mL·min ⁻¹	380	-488 (-642 to -335)	<0.001	-553 (-695 to -371)	<0.001	-45 (-269 to 179)	0.693
$V'_{O_{2peak}} \cdot kg^{-1}$, mL·kg ⁻¹ ·min ⁻¹	380	-6.1 (-7.7 to -4.4)	<0.001	-6.4 (-8.2 to -4.7)	<0.001	-0.4 (-2.8 to 2.1)	0.764
Perceived dyspnoea Borg ₁₀ at max. load *	374	0 (-0.5 to 0.5)	0.944	-0.7 (-1.2 to -0.1)	0.017	-0.7 (-1.5 to 0.1)	0.075
<u>Ventilation</u>							
V'_E at max. load, L·min ⁻¹	380	-15.8 (-21.2 to -10.3)	<0.001	-13.0 (-18.7 to -7.2)	<0.001	2.8 (-5.2 to 10.8)	0.489
Breathing frequency at max. load, min ⁻¹	380	-4.6 (-6.7 to -2.6)	<0.001	-4.0 (-6.2 to -1.8)	<0.001	0.7 (-2.4 to 3.7)	0.667
<u>Circulation</u>							
Heart rate at max.load, beats·in ⁻¹	378	-19.4 (-23.8 to -15.0)	<0.001	-11.3 (-15.9 to -6.6)	<0.001	8.1 (1.7 to 14.5)	0.013

Estimated difference between patients and controls in each of the subgroups RER <1.1 and RER ≥ 1.1, and :

Interaction: the difference in differences (Interaction; difference RER ≥ 1.1 - difference RER <1.1), adjusted for age, sex, BMI, systolic blood pressure, chronic obstructive pulmonary disease, diabetes, myocardial infarction, and congestive heart failure. CI: Confidence interval. V'_{O_2} : oxygen uptake; V'_E : expired ventilation; RER: respiratory exchange ratio

