

**Table S1.** Sleep disorders diagnostic codes.

OSA	
ICD code*	Diagnosis
780.57	Unspecified sleep apnea
G47.30	Sleep apnea, unspecified
780.53	Hypersomnia with sleep apnea, unspecified
R06.83	Snoring
327.23, G47.33,	Obstructive sleep apnea (adult) (pediatric)
Hypoventilation	
ICD code*	Diagnosis
G47.36	Sleep related hypoventilation in conditions classified elsewhere
278.03	Obesity hypoventilation syndrome
E66.2	Morbid (severe) obesity with alveolar hypoventilation
G47.34, 327.24	Idiopathic sleep related non-obstructive alveolar hypoventilation
327.26	Sleep related hypoventilation/hypoxemia in conditions classifiable elsewhere
G47.35, 327.25	Congenital central alveolar hypoventilation syndrome
CSA	
ICD code*	Diagnosis
G47.31, 327.21	Primary central sleep apnea
R06.3	Periodic breathing
G47.37, 327.27	Central sleep apnea in conditions classified elsewhere
Insomnia	
ICD code*	Diagnosis
G47.00, 780.52	Insomnia, unspecified
F51.04	Psychophysiologic insomnia
G47.01	Insomnia due to medical condition
F51.05	Insomnia due to other mental disorder
F51.01	Primary insomnia
G47.09	Other insomnia
327.01	Insomnia due to medical condition classified elsewhere
327.02	Insomnia due to mental disorder
F51.02	Adjustment insomnia
327.00	Organic insomnia, unspecified
F51.09	Other insomnia not due to a substance or known physiological condition
F51.03	Paradoxical insomnia
780.51	Insomnia with sleep apnea, unspecified
327.09	Other organic insomnia
G47.0	Insomnia

327.0	Organic disorders of initiating and maintaining sleep [Organic insomnia]
<b>RLS/PLMD</b>	
ICD code*	Diagnosis
333.94	Restless legs syndrome
G47.61, 327.51	Periodic limb movement disorder

Obstructive sleep apnea, OSA; Central sleep apnea, CSA; Restless legs syndrome, RLS; Periodic limb movement disorder, PLMD. International Classification of Disease; ICD. \*Both ICD 9 and 10 codes queried.

**Table S2:** Descriptive characteristics of 572 hospitalized patients with COVID-19 patients by sleep disorder status (CSA, Hypoventilation, RLS).

Characteristic	Overall (n=572)	CSA			Hypoventilation			RLS/PLMD		
		Yes(n=4)	No (n=568)	P	Yes (n=5)	No (n=567)	P	Yes (n=22)	No (n=550)	P
Age (years), median (IQR)	63.0 (50.0 to 73.5) (n=572)	69.0 (49.0 to 82.0) (n=4)	63.0 (50.0 to 73.0) (n=568)	0.54	56.0 (46.0 to 60.0) (n=5)	63.0 (50.0 to 74.0) (n=567)	0.33	64.5 (56.0 to 71.0) (n=22)	63.0 (50.0 to 74.0) (n=550)	0.73
Female, n (%)	252 (44)	1 (25)	251 (44)	<0.001	4 (80)	248 (44)	0.45	11 (50)	241 (44)	0.83
Race, n (%)				0.09			0.03			0.02
Black	160 (28)	0 (0)	160 (28)		4 (80)	156 (28)		2 (9)	158 (29)	
Other	81 (14)	2 (50)	79 (14)			81 (14)		1 (5)	80 (15)	
White	331 (58)	2 (50)	329 (58)		1 (20)	330 (58)		19 (86)	312 (57)	
BMI (kg/m <sup>2</sup> ), median (IQR)	31.0 (25.5 to 37.8) (n=537)	27.0 (22.1 to 34.5) (n=3)	31.1 (25.5 to 37.9) (n=534)	0.39	43.7 (41.9 to 44.8) (n=5)	30.9 (25.5 to 37.4) (n=532)	0.004	29.5 (26.8 to 34.0) (n=22)	31.1 (25.4 to 37.9) (n=515)	0.52
Temperature (°Fahrenheit), median (IQR)	98.8 (98.2 to 99.9) (n=569)	99.1 (98.3 to 100.0) (n=4)	98.8 (98.2 to 99.9) (n=565)	0.85	99.0 (98.3 to 102.6) (n=5)	98.8 (98.2 to 99.9) (n=564)	0.44	98.5 (98.1 to 99.0) (n=22)	98.8 (98.2 to 99.9) (n=547)	0.29
Absolute lymphocyte count (10 <sup>9</sup> /L)	0.9 (0.6 to 1.3) (n=551)	0.8 (0.6 to 1.2) (n=4)	0.9 (0.6 to 1.3) (n=547)	0.61	1.3 (1.1 to 1.8) (n=5)	0.9 (0.6 to 1.3) (n=546)	0.07	0.7 (0.4 to 0.9) (n=22)	0.9 (0.6 to 1.3) (n=529)	0.01
Alkaline phosphatase (IU/L), median (IQR)	78.0 (60.0 to 104.0) (n=539)	72.5 (69.0 to 94.0) (n=4)	78.0 (60.0 to 104.0) (n=535)	0.96	82.0 (73.0 to 93.0) (n=5)	78.0 (60.0 to 104.0) (n=534)	0.69	90.5 (68.5 to 112.5) (n=20)	78.0 (59.0 to 104.0) (n=519)	0.15
Alanine aminotransferase (IU/L), median (IQR)	32.0 (21.0 to 54.0) (n=542)	27.0 (23.0 to 50.0) (n=4)	32.0 (21.0 to 54.0) (n=538)	0.91	20.0 (17.0 to 40.0) (n=5)	32.0 (21.0 to 54.0) (n=537)	0.34	27.0 (19.0 to 37.0) (n=20)	32.0 (21.0 to 54.0) (n=522)	0.19
Aspartate aminotransferase (IU/L), median	43.5 (30.0 to 66.0) (n=542)	35.0 (27.0 to 82.0) (n=4)	44.0 (30.0 to 66.0) (n=538)	0.74	34.0 (32.0 to 43.0) (n=5)	44.0 (30.0 to 67.0) (n=537)	0.27	42.0 (29.0 to 58.5) (n=20)	44.0 (30.0 to 67.0) (n=522)	0.52
Albumin (g/dL), median (IQR)	3.7 (3.4 to 4.0) (n=539)	3.5 (3.2 to 4.0) (n=4)	3.7 (3.4 to 4.0) (n=535)	0.58	3.9 (3.5 to 4.1) (n=5)	3.7 (3.4 to 4.0) (n=534)	0.51	3.8 (3.5 to 4.1) (n=20)	3.7 (3.4 to 4.0) (n=519)	0.46
eGFR (ml/min/1.73m <sup>2</sup> ), median (IQR)	70.0 (45.4 to 90.9) (n=557)	52.9 (45.3 to 60.5) (n=2)	70.3 (45.4 to 91.1) (n=555)	0.38	75.5 (8.5 to 81.0) (n=5)	70.0 (45.4 to 91.0) (n=552)	0.51	67.6 (59.5 to 84.3) (n=21)	70.1 (45.3 to 91.1) (n=536)	0.97
Total bilirubin (mg/dl), median (IQR)	0.6 (0.4 to 0.9) (n=539)	0.5 (0.5 to 0.6) (n=4)	0.6 (0.4 to 0.9) (n=535)	0.54	0.3 (0.2 to 0.3) (n=5)	0.6 (0.4 to 0.9) (n=534)	0.03	0.5 (0.4 to 0.8) (n=20)	0.6 (0.4 to 0.9) (n=519)	0.29
C-reactive protein (mg/L), median (IQR)	7.6 (3.8 to 15.1) (n=438)	7.2 (1.6 to 27.2) (n=3)	7.6 (3.8 to 15.1) (n=435)	0.98	2.8 (2.6 to 7.1) (n=3)	7.7 (3.8 to 15.2) (n=435)	0.18	5.9 (2.4 to 8.7) (n=13)	7.7 (3.8 to 15.2) (n=425)	0.28
D-Dimer (mg/dL), median (IQR)	1.0 (0.6 to 1.9) (n=410)	0.9 (0.4 to 1.4) (n=2)	1.0 (0.6 to 1.9) (n=408)	0.46	1.1 (0.5 to 4.1) (n=4)	1.0 (0.6 to 1.9) (n=406)	0.87	0.9 (0.5 to 2.1) (n=15)	1.0 (0.6 to 1.9) (n=395)	0.43
Ferritin (ng/mL), median (IQR)	611.1 (249.8 to 1350.2) (n=450)	1285.5 (53.3 to 1849.5) (n=3)	607.1 (249.8 to 1350.2) (n=447)	0.77	388.9 (160.7 to 617.0) (n=2)	611.1 (251.9 to 1358.5) (n=448)	0.41	360.2 (133.0 to 1366.7) (n=13)	615.7 (256.3 to 1320.2) (n=437)	0.24
Lactate dehydrogenase (IU/L), median (IQR)	348.0 (258.0 to 486.0) (n=401)	210.0 (92.0 to 274.0) (n=3)	351.0 (260.0 to 487.0) (n=398)	0.04	239.0 (201.0 to 277.0) (n=2)	349.0 (258.0 to 487.0) (n=399)	0.16	306.5 (236.0 to 432.0) (n=10)	349.0 (258.0 to 490.0) (n=391)	0.45
White blood cell count (10 <sup>9</sup> /L), median (IQR)	7.0 (5.1 to 9.9) (n=569)	5.4 (4.7 to 6.6) (n=4)	7.0 (5.1 to 10.0) (n=565)	0.20	9.5 (6.7 to 9.6) (n=5)	7.0 (5.1 to 10.0) (n=564)	0.51	7.5 (4.7 to 13.1) (n=22)	7.0 (5.1 to 9.8) (n=547)	0.79

Chronic pulmonary disease, n (%)	88 (15)	0 (0)	88 (15)	0.39	2 (40)	86 (15)	0.13	6 (27)	82 (15)	0.12
Chronic cardiac disease, n (%)	163 (28)	4 (100)	159 (28)	0.001	2 (40)	161 (28)	0.57	9 (41)	154 (28)	0.19
Chronic kidney disease, n (%)	140 (24)	2 (50)	138 (24)	0.23	2 (40)	138 (24)	0.42	7 (32)	133 (24)	0.41
Asthma, n (%)	88 (15)	1 (25)	87 (15)	0.59	4 (80)	84 (15)	<0.001	5 (23)	83 (15)	0.33
Hypertension, n (%)	357 (62)	4 (100)	353 (62)	0.12	4 (80)	353 (62)	0.41	15 (68)	342 (62)	0.57
Diabetes, n (%)	204 (36)	3 (75)	201 (35)	0.10	4 (80)	200 (35)	0.04	6 (27)	198 (36)	0.40

Central sleep apnea, CSA; Restless legs syndrome, RLS; Periodic limb movement disorder; PLMD.

**Table S3.** Comparison of descriptive characteristics of non-transfers vs. transfers.

Characteristic	Non-transfers (n=572)	Transfers (n=321)	P
Age (years), median (IQR)	63.0 (50.0 to 73.5) (n=572)	56.0 (43.0 to 66.0) (n=321)	<0.001
Female, n (%)	252 (44)	131 (41)	0.76
Race, n (%)			<0.001
Black	160 (28)	125 (39)	
Other	81 (14)	68 (21)	
White	331 (58)	128 (40)	
BMI (kg/m <sup>2</sup> ), median (IQR)	31.0 (25.5 to 37.8) (n=537)	31.5 (26.8 to 38.9) (n=309)	0.04
Temperature (°Fahrenheit), median (IQR)	98.8 (98.2 to 99.9) (n=569)	98.6 (98.1 to 99.3) (n=317)	0.02
Absolute lymphocyte count (10 <sup>9</sup> /L)	0.9 (0.6 to 1.3) (n=551)	0.8 (0.6 to 1.2) (n=272)	0.06
Alkaline phosphatase (IU/L), median (IQR)	78.0 (60.0 to 104.0) (n=539)	74.0 (57.0 to 107.5) (n=296)	0.69
Alanine aminotransferase (IU/L), median	32.0 (21.0 to 54.0) (n=542)	38.0 (24.5 to 69.0) (n=296)	<0.001
Aspartate aminotransferase (IU/L), median	43.5 (30.0 to 66.0) (n=542)	51.5 (33.5 to 86.5) (n=296)	<0.001
Albumin (g/dL), median (IQR)	3.7 (3.4 to 4.0) (n=539)	3.4 (3.0 to 3.8) (n=298)	<0.001
eGFR (ml/min/1.73m <sup>2</sup> ), median (IQR)	70.0 (45.4 to 90.9) (n=557)	64.0 (29.4 to 91.0) (n=313)	0.04
Total bilirubin (mg/dl), median (IQR)	0.6 (0.4 to 0.9) (n=539)	0.6 (0.4 to 0.8) (n=296)	0.70
C-reactive protein (mg/L), median (IQR)	7.6 (3.8 to 15.1) (n=438)	12.8 (5.1 to 23.3) (n=261)	<0.001
D-Dimer (mg/dL ), median (IQR)	1.0 (0.6 to 1.9) (n=410)	2.1 (1.0 to 6.4) (n=250)	<0.001
Ferritin (ng/mL), median (IQR)	611.1 (249.8 to 1350.2) (n=450)	1007.1 (413.9 to 1593.9) (n=258)	<0.001
Lactate dehydrogenase (IU/L), median (IQR)	348.0 (258.0 to 486.0) (n=401)	494.0 (323.0 to 635.0) (n=239)	<0.001
White blood cell count (10 <sup>9</sup> /L), m	7.0 (5.1 to 9.9) (n=569)	10.1 (6.6 to 14.9) (n=318)	<0.001
Chronic pulmonary disease, n (%)	88 (15)	46 (14)	0.67
Chronic cardiac disease, n (%)	163 (28)	66 (21)	0.01
Chronic kidney disease, n (%)	140 (24)	67 (21)	0.22
Asthma, n (%)	88 (15)	73 (23)	0.01
Hypertension, n (%)	357 (62)	184 (57)	0.14
Diabetes, n (%)	204 (36)	117 (36)	0.81
OSA	113 (20)	47 (15)	0.06
CSA	4 (1)	4 (1)	0.41
Hypovent	5 (1)	1 (1)	0.32
Insomnia	63 (11)	26 (8)	0.16
RLS	22 (4)	6 (2)	0.10
Vent, n (%)	109 (19)	173 (54)	<0.001
Death, n (%)	72 (13)	68 (21)	0.001
Vasopressors treatment, n (%)	102 (18)	158 (49)	<0.001
Length of Stay (days), median (IQR)	8.0 (3.0 to 30.0) (n=566)	24.0 (8.0 to 76.0) (n=317)	<0.001

**Table S4.** Sleep disorders among 893 (transfers and non-transfers) COVID-19 hospitalized patients: prevalence and unadjusted association with mechanical ventilation, vasopressor requirement, death and length of stay.

Sleep diagnosis	All [N=893] N(%)	Mechanical ventilation [N=282] N(%)	OR [95% CI]	Vasopressor requirement [N=260] N(%)	OR [95% CI]	Death [N=140] N(%)	OR [95% CI]	LOS [N=893] median (IQR)	HR to discharge [95% CI]
<b>OSA</b>	160 (17.9%)	42 (14.9%)	0.73[0.50, 1.07]	39 (15.0%)	0.75 [0.50, 1.11]	21 (15.0%)	0.78 [0.47, 1.28]	10 (3, 43)	1.08 [0.90, 1.30]
<b>Insomnia</b>	89 (10.0%)	21 (7.5%)	0.64 [0.39, 1.07]	23 (8.9)	0.84 [0.51, 1.37]	15 (10.7%)	1.10 [0.61, 1.98]	12 (4, 68)	0.98 [0.77, 1.25]
<b>RLS/PLMD</b>	28 (3.1%)	2 (0.7%)	0.16 [0.04, 0.68]	3 (1.1)	0.28 [0.09, 0.95]	4 (2.9%)	0.9 [0.31, 2.62]	9.5 (4.5, 40)	1.08 [0.72, 1.62]

Length of stay (LOS); Obstructive sleep apnea, OSA; Central sleep apnea, CSA; Restless legs syndrome, RLS; Periodic limb movement disorder, PLMD.

**Table S5.** Multivariable logistic and Cox-proportional hazards regression.

Characteristic	Mechanical ventilation OR [95% CI]	Vasopressor requirement OR [95% CI]	Death OR [95% CI]	HR to discharge [95% CI]
<b>OSA</b>	0.75 [0.48, 1.18]	0.75 [0.48, 1.19]	0.97 [0.54, 1.72]	1.02 [0.83, 1.25]
<b>Age*</b>	1.04 [0.94, 1.15]	1.06 [0.96, 1.17]	1.82 [1.57, 2.13]	0.87 [0.84, 0.91]
<b>Sex</b>	1.57 [1.13, 2.17]	1.65 [1.19, 2.30]	1.29 [0.85, 1.94]	0.85 [0.73, 0.99]
<b>Race (black vs. white)</b>	0.97 [0.76, 1.22]	0.97 [0.77, 1.24]	0.78 [0.57, 1.05]	1.00 [0.84, 1.18]
<b>Race (other vs. white)</b>	1.32 [0.99, 1.76]	1.24 [0.93, 1.66]	1.44 [1.02, 2.04]	0.82 [0.65, 1.04]
<b>BMI**</b>	1.06 [0.97, 1.15]	1.07 [0.98, 1.17]	0.94 [0.83, 1.07]	1.03 [0.99, 1.08]
<b>Transfer vs. non-transfer</b>	4.64 [3.35, 6.42]	4.29 [3.08, 5.96]	2.86 [1.86, 4.39]	30.59 [19.94, 41.25]
<b>Insomnia</b>	0.86 [0.49, 1.52]	1.12 [0.65, 1.94]	1.00 [0.52, 1.92]	1.01 [0.78, 1.31]
<b>Age*</b>	1.04 [0.95, 1.15]	1.06 [0.96, 1.17]	1.82 [1.57, 2.13]	0.87 [0.84, 0.91]
<b>Sex</b>	1.56 [1.13, 2.17]	1.67 [1.20, 2.33]	1.29 [0.85, 1.94]	0.85 [0.73, 0.99]
<b>Race (black vs. white)</b>	0.97 [0.77, 1.23]	0.98 [0.77, 1.24]	0.78 [0.57, 1.05]	0.99 [0.84, 1.18]
<b>Race (other vs. white)</b>	1.33 [0.99, 1.77]	1.27 [0.95, 1.70]	1.44 [1.02, 2.05]	0.82 [0.65, 1.04]
<b>BMI**</b>	1.04 [0.96, 1.13]	1.06 [0.97, 1.15]	0.94 [0.83, 1.06]	1.03 [0.99, 1.08]
<b>Transfer vs. non-transfer</b>	4.69 [3.39, 6.49]	4.33 [3.12, 6.02]	2.86 [1.86, 4.40]	30.54 [19.92, 41.17]
<b>RLS/PLMD</b>	0.25 [0.06, 1.09]	0.43 [0.12, 1.53]	1.30 [0.41, 4.06]	0.96 [0.63, 1.49]
<b>Age*</b>	1.04 [0.94, 1.14]	1.06 [0.96, 1.17]	1.83 [1.57, 2.13]	0.87 [0.84, 0.91]
<b>Sex</b>	1.55 [1.12, 2.15]	1.65 [1.19, 2.29]	1.29 [0.86, 1.94]	0.85 [0.73, 0.99]
<b>Race (black vs. white)</b>	0.96 [0.76, 1.21]	0.97 [0.76, 1.23]	0.78 [0.57, 1.06]	0.99 [0.84, 1.17]
<b>Race (other vs. white)</b>	1.31 [0.99, 1.75]	1.25 [0.93, 1.66]	1.45 [1.02, 2.05]	0.82 [0.65, 1.03]
<b>BMI**</b>	1.04 [0.96, 1.13]	1.06 [0.97, 1.15]	0.94 [0.83, 1.06]	1.03 [0.99, 1.08]
<b>Transfer vs. non-transfer</b>	4.65 [3.36, 6.44]	4.30 [3.09, 5.97]	2.88 [1.87, 4.43]	30.58 [19.95, 41.22]

Obstructive sleep apnea, OSA; Restless legs syndrome, RLS; Periodic limb movement disorder, PLMD; Body mass index, BMI. \*Age per 10 years. \*\*BMI in 5 kg/m<sup>2</sup> increments.

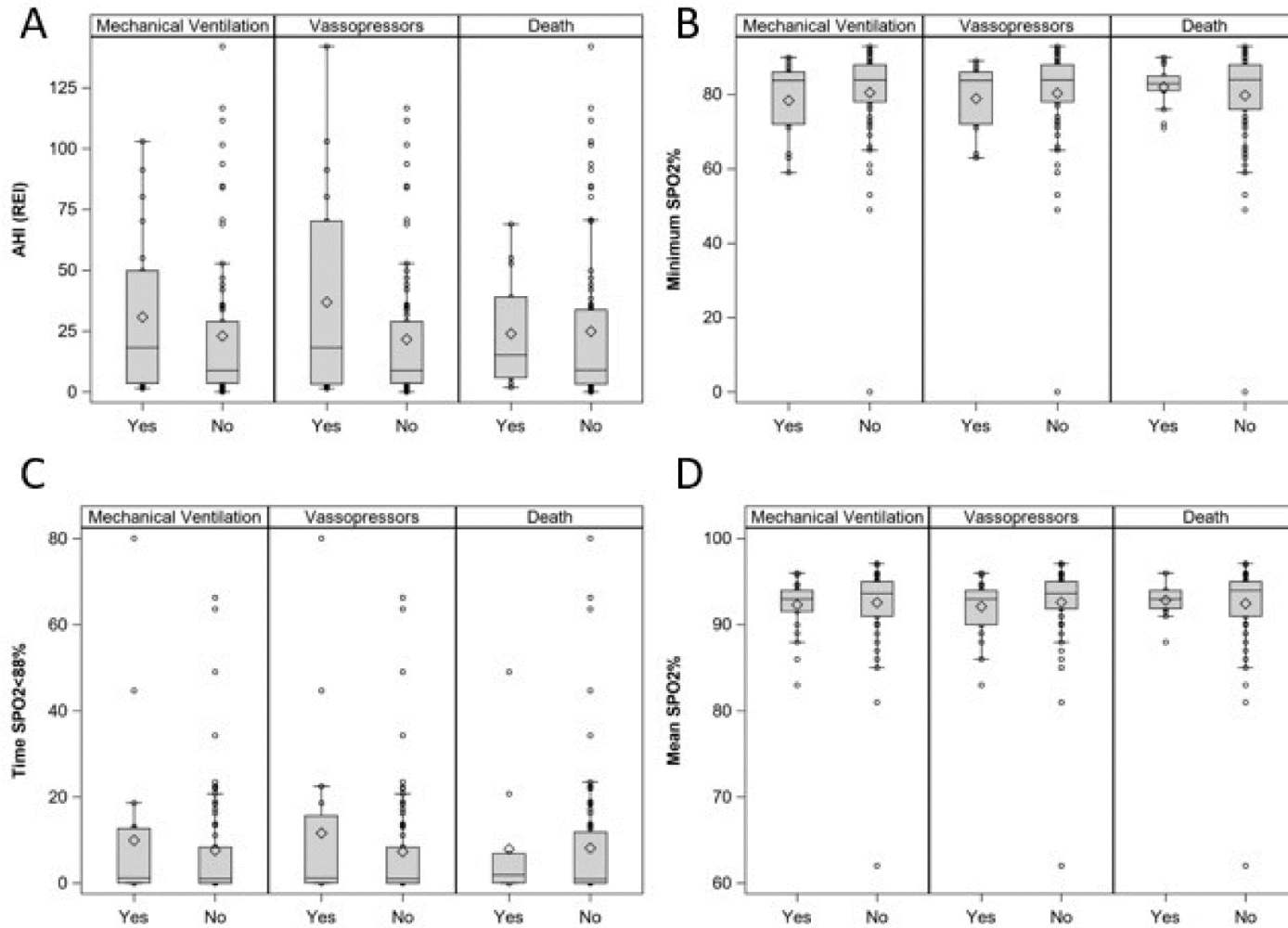
**Table S6.** HST or PSG parameters in 100 patients with available diagnostic sleep study data.

Sleep parameter	Mechanical ventilation		p-value	Vasopressor requirement		p-value	Death		p-value
	yes	no		yes	no		yes	no	
<b>AHI (REI)*</b>			0.24			0.20			0.40
N (missing)	21 (0)	74 (5)		19 (0)	76 (5)		13(0)	82(5)	
Median (IQR)	18.3 (3.7 to 49.8)	8.9 (3.6 to 28.9)		18.3 (3.2 to 70.3)	8.9 (3.6 to 29.0)		15.2 (5.9 to 39.1)	9.0 (3.2 to 33.8)	
Range	1.5 to 103.0	0.0 to 142.0		1.5 to 142.0	0.0 to 116.7		1.9 to 68.9	0.0 to 142.0	
<b>Mean SpO<sub>2</sub>%</b>			0.49			0.34			0.53
N (missing)	21 (0)	79 (0)		19 (0)	81 (0)		13(0)	87 (0)	
Median (IQR)	93.0 (91.6 to 94.0)	93.7 (91.0 to 95.0)		93.0 (90.0 to 94.0)	93.7 (91.8 to 95.0)		93.0 (91.9 to 94.0)	94.0 (91.0 to 95.0)	
Range	83.0 to 96.0	62.0 to 97.1		83.0 to 96.0	62.0 to 97.1		88.0 to 96.0	62.0 to 97.1	
<b>Minimum SpO<sub>2</sub>%</b>			0.20			<b>0.21</b>			0.87
N (missing)	21 (0)	79 (0)		19 (0)	81 (0)		13(0)	87 (0)	
Median (IQR)	83.7 (72.0 to 86.0)	83.9 (78.0 to 88.0)		83.7 (72.0 to 86.0)	83.9 (78.0 to 88.0)		83.0 (81.0 to 85.0)	84.0 (76.0 to 88.0)	
Range	59.0 to 90.0	0.0 to 92.9		63.0 to 89.0	0.0 to 92.9		71.0 to 90.0	0.0 to 92.9	
<b>Time SpO<sub>2</sub>&lt;88% (minutes)</b>			0.91			0.62			0.63
N (missing)	18 (3)	69 (10)		16 (3)	71 (10)		11(2)	76(11)	
Median (IQR)	1.2 (0.1 to 12.7)	1.0 (0.0 to 8.4)		1.2 (0.1 to 15.7)	1.0 (0.0 to 8.4)		1.9 (0.1 to 6.9)	1.0 (0.0 to 11.9)	
Range	0.0 to 80.1	0.0 to 66.3		0.0 to 80.1	0.0 to 66.3		0.0 to 49.1	0.0 to 80.1	
<b>PLM Index**</b>			0.83			0.80			0.21
N (missing)	20(1)	72 (7)		18 (1)	74 (7)		13(0)	79(8)	
Median (IQR)	0.0 (0.0 to 10.4)	0.1 (0.0 to 9.0)		0.9 (0.0 to 10.6)	0.0 (0.0 to 8.3)		3.3 (0.0 to 14.9)	0.0 (0.0 to 7.6)	
Range	0.0 to 71.0	0.0 to 129.9		0.0 to 71.0	0.0 to 129.9		0.0 to 129.9	0.0 to 71.0	

Apnea hypopnea index, AHI; Respiratory event index; REI; Periodic limb movement, PLM; Oxygen saturation, SpO<sub>2</sub>. \*Both AHI and REI were derived with use of 4% hypopnea scoring criteria to harmonize between data extracted from home sleep apnea tests (HST) and in lab polysomnogram (PSG). \*\*Missing in subjects with HST.



**Figure S1.** Respiratory parameters from polysomnogram and home sleep apnea test in the 100 individuals with diagnostic sleep study data.



Panel A-AHI (REI) Apnea hypopnea index, AHI; Respiratory event index; REI; Both AHI and REI were derived with use of 4% hypopnea scoring criteria to harmonize between data extracted from home sleep apnea tests (HST) and in lab polysomnogram (PSG). Panel B-Minimum oxygen saturation, SpO<sub>2</sub> (%); Panel C- Time with oxygen saturation, SpO<sub>2</sub>, <88% (minutes); Panel D- Mean oxygen saturation, SpO<sub>2</sub> (%).