Physical activity patterns and clusters in 1001 patients with COPD

SUPPLEMENTARY MATERIAL

MATERIALS AND METHODS

Details of Data Sources

The objectively assessed physical activity data used in the current analysis were collected as part of previous studies which were developed in 10 different countries (i.e., United Kingdom, Ireland, the Netherlands, Germany, Switzerland, Italy, Spain, the United States of America, Brazil, and Australia). The research groups that contributed to the current study were conveniently selected from recent publications (articles in peer-reviewed journals and abstracts presented at major respiratory congresses) using the SenseWear Armband to assess physical activity in patients with COPD. A detailed description of the sources of the data included in the current analysis is provided in e-Table 1.

e-Table 1 Sources of the data included in the current analysis

Study registration number	Study type	Main publications (first authors[ref.])*	Sites of recruitment	Period of data collection	Number of subjects included in the current analysis
ISRCTN35501175	Interventional†	Mitchell[1]	UK: Leicester	September 2009 to September 2012	3
No registration	Observational	Shrikrishna[2] Maddocks, Shrikrishna[3] Patel[4]	UK: London	August 2009 to February 2012	198
NCT00292552	Observational	Waschki, Spruit[5]	UK: Liverpool	August 2009 to August 2010	36
			The Netherlands: Horn	May 2009 to September 2009	52
NCT01471171	Interventional†	Beeh, Watz[6]	UK: London	November 2011 to June 2012	3
			Germany: Wiesbaden, Hamburg, Berlin, Lübeck, Hannover, Grosshansdorf, and Frankfurt	November 2011 to June 2012	77
			Spain: Alicante, Madrid, and Barcelona	November 2011 to June 2012	16
NCT01530412 and NCT01112943	Interventional†	Egan, Deering[7] Deering[8]	Ireland: Dublin	June 2007 to July 2010	37
NCT01067248	Observational	Romme[9] Romme[10]	The Netherlands: Eindhoven	February 2010 to September 2011	45
No registration	Observational	Waschki[11]	Germany: Grosshansdorf	July 2008 to October 2009	110
No registration	Observational	Dürr, Zogg[12] Zogg, Dürr[13]	Switzerland: Basel	July 2011 to January 2012	58
No registration	Observational	van Gestel[14]	Switzerland: Zurich	January 2010 to August 2011	66
Not applicable	Data from a pulmonary	No publication	Italy: Pisa	January 2011 to June 2013	23

	rehabilitation programme developed in the Cardio-Thoracic and Vascular Department, University of Pisa†				
No registration	Observational	Garcia-Aymerich[15] Garcia-Aymerich[16] Donaire-Gonzalez[17] Donaire-Gonzalez[18]	Spain: Catalonia, Euskadi and Balearic regions	January 2004 to March 2006	77
NCT01583595	Observational	DePew[19] Karpman[20]	USA: Rochester, MN	July 2012 to July 2013	65
NCT01537627	Interventional†	Rodrigues[21]	Brazil: Londrina, PR	February 2012 to September 2013	27
ACTRN12609000472279	Interventional†	Wootton[22] Wootton[23]	Australia: Sydney and Perth	May 2009 to February 2012	108

*: full papers published in peer-reviewed journals; †: only the baseline data were used for analysis, which means that subjects were not undergoing any specific intervention by the time of assessment. UK: United Kingdom; USA: United States of America.

Assessment of Demographics, Anthropometrics, Lung Function, and Clinical Data

Age, sex, body mass index (BMI), post-bronchodilator forced expiratory volume in the first 1 second (FEV_1, % of predicted), post-bronchodilator FEV_1 / forced vital capacity (FVC) ratio, diffusion capacity of the lung for carbon monoxide (D_{LCO}, % of predicted), symptoms of dyspnoea by the modified Medical Research Council (mMRC) dyspnoea grade[24], and use of long-term oxygen therapy (LTOT, yes/no) were measured. In addition, the age, dyspnoea, and airflow obstruction (ADO) index was calculated, which predicts COPD mortality[25], and participants were stratified by BMI (underweight, <18.5 $kg \cdot m^{-2}$; normal weight, 18.5 to 24.99 $kg \cdot m^{-2}$; pre-obese, 25 to 29.99 $kg \cdot m^{-2}$; or obese, $\geq$ 30 $kg \cdot m^{-2}$) and by Global Initiative for Chronic Obstructive Lung Disease (GOLD) classifications (2007, 1 to 4[26]; and 2011, A to D[27]). GOLD 2011 classification (A to D) was based on the degree of airflow limitation (GOLD grades 1 to 4) and symptoms (mMRC dyspnoea grades 0 to 4).

Selection of Waking Hour Recordings

Firstly, the data collected with the SenseWear Armband devices were exported in the form of Microsoft Excel spreadsheets with one minute resolution. The data contains information about the sleeping time and, in particular, each minute assessed is marked by the SenseWear software as "sleeping" or "not sleeping"[28]. Then, in order to reduce the variability of the data, only minutes coded as "not sleeping" were selected for analysis. If a minute was coded as "sleeping" but had an intensity value higher than 2.0 metabolic equivalents of task (METs), which is compatible with light intensity, this minute was considered as "not sleeping" since it is very unlikely that a subject present such a high intensity whilst sleeping.

Features used in the cluster analysis

e-Table 2 presents the 180 features used for cluster analysis.

e-Table 2 Features used for cluster analysis

Number	Feature	Number	Feature
1	Daily time in moderate-to-vigorous intensity before midday (min·day^{-1})	91	Daily average duration of 2-min bouts of light intensity before midday (min·bout^{-1})
2	Daily time in moderate-to-vigorous intensity after midday (min·day^{-1})	92	Daily average duration of 2-min bouts of light intensity after midday (min·bout^{-1})
3	Daily time in moderate-to-vigorous intensity (min·day^{-1})	93	Daily average duration of 2-min bouts of light intensity (min·bout^{-1})
4	Daily time in moderate-to-vigorous intensity before midday (% of total assessment time)	94	Daily time in 10-min bouts of light intensity before midday (min·day^{-1})
5	Daily time in moderate-to-vigorous intensity after midday (% of total assessment time)	95	Daily time in 10-min bouts of light intensity after midday (min·day^{-1})
6	Daily time in moderate-to-vigorous intensity (% of total assessment time)	96	Daily time in 10-min bouts of light intensity (min·day^{-1})
7	Daily average intensity in moderate-to-vigorous intensity	97	Daily time in 10-min bouts of light intensity before

	before midday (METs)		midday (% of total assessment time)
8	Daily average intensity in moderate-to-vigorous intensity after midday (METs)	98	Daily time in 10-min bouts of light intensity after midday (% of total assessment time)
9	Daily average intensity in moderate-to-vigorous intensity (METs)	99	Daily time in 10-min bouts of light intensity (% of total assessment time)
10	Daily EE in moderate-to-vigorous intensity before midday (METs-min·day^{-1})	100	Daily average intensity of 10-min bouts of light intensity before midday (METs)
11	Daily EE in moderate-to-vigorous intensity after midday (METs-min·day^{-1})	101	Daily average intensity of 10-min bouts of light intensity after midday (METs)
12	Daily EE in moderate-to-vigorous intensity (METs-min·day^{-1})	102	Daily average intensity of 10-min bouts of light intensity (METs)
13	Daily EE in moderate-to-vigorous intensity before midday (% of total EE)	103	Daily EE of 10-min bouts of light intensity before midday (METs-min·day^{-1})
14	Daily EE in moderate-to-vigorous intensity after midday (% of total EE)	104	Daily EE of 10-min bouts of light intensity after midday (METs-min·day^{-1})

15	Daily EE in moderate-to-vigorous intensity (% of total EE)	105	Daily EE of 10-min bouts of light intensity (METs-min·day^{-1})
16	Daily time in 2-min bouts of moderate-to-vigorous intensity before midday (min·day^{-1})	106	Daily EE of 10-min bouts of light intensity before midday (% of total EE)
17	Daily time in 2-min bouts of moderate-to-vigorous intensity after midday (min·day^{-1})	107	Daily EE of 10-min bouts of light intensity after midday (% of total EE)
18	Daily time in 2-min bouts of moderate-to-vigorous intensity (min·day^{-1})	108	Daily EE of 10-min bouts of light intensity (% of total EE)
19	Daily time in 2-min bouts of moderate-to-vigorous intensity before midday (% of total assessment time)	109	Daily frequency of 10-min bouts of light intensity before midday (bouts·day^{-1})
20	Daily time in 2-min bouts of moderate-to-vigorous intensity after midday (% of total assessment time)	110	Daily frequency of 10-min bouts of light intensity after midday (bouts·day^{-1})
21	Daily time in 2-min bouts of moderate-to-vigorous intensity (% of total assessment time)	111	Daily frequency of 10-min bouts of light intensity (bouts·day^{-1})
22	Daily average intensity of 2-min bouts of moderate-to-	112	Daily average duration of 10-min bouts of light intensity

	vigorous intensity before midday (METs)		before midday (min·bout^{-1})
23	Daily average intensity of 2-min bouts of moderate-to-vigorous intensity after midday (METs)	113	Daily average duration of 10-min bouts of light intensity after midday (min·bout^{-1})
24	Daily average intensity of 2-min bouts of moderate-to-vigorous intensity (METs)	114	Daily average duration of 10-min bouts of light intensity (min·bout^{-1})
25	Daily EE of 2-min bouts of moderate-to-vigorous intensity before midday (METs-min·day^{-1})	115	Daily time in very light intensity before midday (min·day^{-1})
26	Daily EE of 2-min bouts of moderate-to-vigorous intensity after midday (METs-min·day^{-1})	116	Daily time in very light intensity after midday (min·day^{-1})
27	Daily EE of 2-min bouts of moderate-to-vigorous intensity (METs-min·day^{-1})	117	Daily time in very light intensity (min·day^{-1})
28	Daily EE of 2-min bouts of moderate-to-vigorous intensity before midday (% of total EE)	118	Daily time in very light intensity before midday (% of total assessment time)
29	Daily EE of 2-min bouts of moderate-to-vigorous intensity after midday (% of total EE)	119	Daily time in very light intensity after midday (% of total assessment time)

30	Daily EE of 2-min bouts of moderate-to-vigorous intensity (% of total EE)	120	Daily time in very light intensity (% of total assessment time)
31	Daily frequency of 2-min bouts of moderate-to-vigorous intensity before midday (bouts·day^{-1})	121	Daily average intensity in very light intensity before midday (METs)
32	Daily frequency of 2-min bouts of moderate-to-vigorous intensity after midday (bouts·day^{-1})	122	Daily average intensity in very light intensity after midday (METs)
33	Daily frequency of 2-min bouts of moderate-to-vigorous intensity (bouts·day^{-1})	123	Daily average intensity in very light intensity (METs)
34	Daily average duration of 2-min bouts of moderate-to-vigorous intensity before midday (min·bout^{-1})	124	Daily EE in very light intensity before midday (METs-min·day^{-1})
35	Daily average duration of 2-min bouts of moderate-to-vigorous intensity after midday (min·bout^{-1})	125	Daily EE in very light intensity after midday (METs-min·day^{-1})
36	Daily average duration of 2-min bouts of moderate-to-vigorous intensity (min·bout^{-1})	126	Daily EE in very light intensity (METs-min·day^{-1})
37	Daily time in 10-min bouts of moderate-to-vigorous intensity	127	Daily EE in very light intensity before midday (% of total

	before midday (min·day^{-1})		EE)
38	Daily time in 10-min bouts of moderate-to-vigorous intensity after midday (min·day^{-1})	128	Daily EE in very light intensity after midday (% of total EE)
39	Daily time in 10-min bouts of moderate-to-vigorous intensity (min·day^{-1})	129	Daily EE in very light intensity (% of total EE)
40	Daily time in 10-min bouts of moderate-to-vigorous intensity before midday (% of total assessment time)	130	Daily time in 2-min bouts of very light intensity before midday (min·day^{-1})
41	Daily time in 10-min bouts of moderate-to-vigorous intensity after midday (% of total assessment time)	131	Daily time in 2-min bouts of very light intensity after midday (min·day^{-1})
42	Daily time in 10-min bouts of moderate-to-vigorous intensity (% of total assessment time)	132	Daily time in 2-min bouts of very light intensity (min·day^{-1})
43	Daily average intensity of 10-min bouts of moderate-to-vigorous intensity before midday (METs)	133	Daily time in 2-min bouts of very light intensity before midday (% of total assessment time)
44	Daily average intensity of 10-min bouts of moderate-to-vigorous intensity after midday (METs)	134	Daily time in 2-min bouts of very light intensity after midday (% of total assessment time)

45	Daily average intensity of 10-min bouts of moderate-to-vigorous intensity (METs)	135	Daily time in 2-min bouts of very light intensity (% of total assessment time)
46	Daily EE of 10-min bouts of moderate-to-vigorous intensity before midday (METs-min·day^{-1})	136	Daily average intensity of 2-min bouts of very light intensity before midday (METs)
47	Daily EE of 10-min bouts of moderate-to-vigorous intensity after midday (METs-min·day^{-1})	137	Daily average intensity of 2-min bouts of very light intensity after midday (METs)
48	Daily EE of 10-min bouts of moderate-to-vigorous intensity (METs-min·day^{-1})	138	Daily average intensity of 2-min bouts of very light intensity (METs)
49	Daily EE of 10-min bouts of moderate-to-vigorous intensity before midday (% of total EE)	139	Daily EE of 2-min bouts of very light intensity before midday (METs-min·day^{-1})
50	Daily EE of 10-min bouts of moderate-to-vigorous intensity after midday (% of total EE)	140	Daily EE of 2-min bouts of very light intensity after midday (METs-min·day^{-1})
51	Daily EE of 10-min bouts of moderate-to-vigorous intensity (% of total EE)	141	Daily EE of 2-min bouts of very light intensity (METs-min·day^{-1})
52	Daily frequency of 10-min bouts of moderate-to-vigorous	142	Daily EE of 2-min bouts of very light intensity before

	intensity before midday (bouts·day^{-1})		midday (% of total EE)
53	Daily frequency of 10-min bouts of moderate-to-vigorous intensity after midday (bouts·day^{-1})	143	Daily EE of 2-min bouts of very light intensity after midday (% of total EE)
54	Daily frequency of 10-min bouts of moderate-to-vigorous intensity (bouts·day^{-1})	144	Daily EE of 2-min bouts of very light intensity (% of total EE)
55	Daily average duration of 10-min bouts of moderate-to-vigorous intensity before midday (min·bout^{-1})	145	Daily frequency of 2-min bouts of very light intensity before midday (bouts·day^{-1})
56	Daily average duration of 10-min bouts of moderate-to-vigorous intensity after midday (min·bout^{-1})	146	Daily frequency of 2-min bouts of very light intensity after midday (bouts·day^{-1})
57	Daily average duration of 10-min bouts of moderate-to-vigorous intensity (min·bout^{-1})	147	Daily frequency of 2-min bouts of very light intensity (bouts·day^{-1})
58	Daily time in light intensity before midday (min·day^{-1})	148	Daily average duration of 2-min bouts of very light intensity before midday (min·bout^{-1})
59	Daily time in light intensity after midday (min·day^{-1})	149	Daily average duration of 2-min bouts of very light intensity after midday (min·bout^{-1})

60	Daily time in light intensity (min·day^{-1})	150	Daily average duration of 2-min bouts of very light intensity (min·bout^{-1})
61	Daily time in light intensity before midday (% total assessment time)	151	Daily time in 10-min bouts of very light intensity before midday (min·day^{-1})
62	Daily time in light intensity after midday (% total assessment time)	152	Daily time in 10-min bouts of very light intensity after midday (min·day^{-1})
63	Daily time in light intensity (% total assessment time)	153	Daily time in 10-min bouts of very light intensity (min·day^{-1})
64	Daily average intensity in light intensity before midday (METs)	154	Daily time in 10-min bouts of very light intensity before midday (% of total assessment time)
65	Daily average intensity in light intensity after midday (METs)	155	Daily time in 10-min bouts of very light intensity after midday (% of total assessment time)
66	Daily average intensity in light intensity (METs)	156	Daily time in 10-min bouts of very light intensity (% of total assessment time)
67	Daily EE in light intensity before midday (METs-min·day^{-1})	157	Daily average intensity of 10-min bouts of very light

			intensity before midday (METs)
68	Daily EE in light intensity after midday (METs-min·day^{-1})	158	Daily average intensity of 10-min bouts of very light intensity after midday (METs)
69	Daily EE in light intensity (METs-min·day^{-1})	159	Daily average intensity of 10-min bouts of very light intensity (METs)
70	Daily EE in light intensity before midday (% of total EE)	160	Daily EE of 10-min bouts of very light intensity before midday (METs-min·day^{-1})
71	Daily EE in light intensity after midday (% of total EE)	161	Daily EE of 10-min bouts of very light intensity after midday (METs-min·day^{-1})
72	Daily EE in light intensity (% of total EE)	162	Daily EE of 10-min bouts of very light intensity (METs-min·day^{-1})
73	Daily time in 2-min bouts of light intensity before midday (min·day^{-1})	163	Daily EE of 10-min bouts of very light intensity before midday (% of total EE)
74	Daily time in 2-min bouts of light intensity after midday (min·day^{-1})	164	Daily EE of 10-min bouts of very light intensity after midday (% of total EE)

75	Daily time in 2-min bouts of light intensity (min·day^{-1})	165	Daily EE of 10-min bouts of very light intensity (% of total EE)
76	Daily time in 2-min bouts of light intensity before midday (% total assessment time)	166	Daily frequency of 10-min bouts of very light intensity before midday (bouts·day^{-1})
77	Daily time in 2-min bouts of light intensity after midday (% total assessment time)	167	Daily frequency of 10-min bouts of very light intensity after midday (bouts·day^{-1})
78	Daily time in 2-min bouts of light intensity (% total assessment time)	168	Daily frequency of 10-min bouts of very light intensity (bouts·day^{-1})
79	Daily average intensity of 2-min bouts of light intensity before midday (METs)	169	Daily average duration of 10-min bouts of very light intensity before midday (min·bout^{-1})
80	Daily average intensity of 2-min bouts of light intensity after midday (METs)	170	Daily average duration of 10-min bouts of very light intensity after midday (min·bout^{-1})
81	Daily average intensity of 2-min bouts of light intensity (METs)	171	Daily average duration of 10-min bouts of very light intensity (min·bout^{-1})
82	Daily EE of 2-min bouts of light intensity before midday	172	Daily average intensity of breaks in very light intensity

	(METs-min·day^{-1})		before midday (METs)
83	Daily EE of 2-min bouts of light intensity after midday (METs-min·day^{-1})	173	Daily average intensity of breaks in very light intensity after midday (METs)
84	Daily EE of 2-min bouts of light intensity (METs-min·day^{-1})	174	Daily average intensity of breaks in very light intensity (METs)
85	Daily EE of 2-min bouts of light intensity before midday (% of total EE)	175	Daily frequency of breaks in very light intensity before midday (breaks·day^{-1})
86	Daily EE of 2-min bouts of light intensity after midday (% of total EE)	176	Daily frequency of breaks in very light intensity after midday (breaks·day^{-1})
87	Daily EE of 2-min bouts of light intensity (% of total EE)	177	Daily frequency of breaks in very light intensity (breaks·day^{-1})
88	Daily frequency of 2-min bouts of light intensity before midday (bouts·day^{-1})	178	Daily average duration of breaks in very light intensity before midday (min·break^{-1})
89	Daily frequency of 2-min bouts of light intensity after midday (bouts·day^{-1})	179	Daily average duration of breaks in very light intensity after midday (min·break^{-1})

90	Daily frequency of 2-min bouts of light intensity (bouts·day^{-1})	180	Daily average duration of breaks in very light intensity (min·break^{-1})

See Table 1 for definition of abbreviations.

Sample Size Calculation

The main analysis in our study was the identification of clusters based on physical activity data. To the best of our knowledge, currently there are no sample size calculation formulas for cluster analysis as performed in our study. Some authors have suggested that the minimal sample size to include in studies using cluster analysis should be no less than 2^k cases, preferably 5 x 2^k, with K being the number of variables considered for analysis[29, 30]. In our study, only 3 variables (i.e., the 3 components from the principal component analysis) were used for clustering. Therefore, the minimal sample size in our study should be 40 subjects, which is actually far below the actual number of participants included (i.e., 1001 subjects). Furthermore, our sample size is much larger than that of most previous studies using cluster analysis in COPD, which were still able to identify heterogeneous groups amongst different samples of patients with COPD[16, 31-34].

Daily Physical Activity Measures after Stratification for Seasons of the Year

Daily physical activity measures after stratification for seasons of the year can be found in e-Table 3.

e-Table 3 Daily physical activity measures after stratification for seasons of the year

Measure	Winter	Spring	Summer	Autumn	*P*-value
N	229	175	264	333	-
Physical activity measures in very light intensity					
Time, min·day^{-1}	797 (715 – 892)	816 (705 – 927)	802 (707 – 896)	801 (715 – 910)	0.72
EE, METs-min·day^{-1}	993 (800 – 1224)	976 (807 – 1219)	1062 (830 – 1464)*	1064 (834 – 1509)*	0.002
Physical activity measures in light intensity					
Time, min·day^{-1}	138 (93 – 200)	138 (82 – 200)	148 (101 – 196)	141 (91 – 184)	0.82
EE, METs-min·day^{-1}	420 (275 – 577)	433 (272 – 588)	486 (308 – 725)*	432 (293 – 711)	0.01
Physical activity measures in moderate-to-vigorous intensity					
Time, min·day^{-1}	57 (26 – 105)	49 (25 – 93)	55 (28 – 95)	49 (25 – 102)	0.59
EE, METs-min·day^{-1}	260 (129 – 481)	241 (129 – 454)	309 (152 – 649)	266 (123 – 600)	0.10
Time in ≥10-min bouts, min·day^{-1}	8 (0 – 27)	6 (0 – 20)	7 (0 – 22)	6 (0 – 23)	0.41

Data expressed as median (interquartile range). See Table 1 for definition of abbreviations. *$P<0.05$ vs Winter.

RESULTS

Characteristics after Stratification for Country of Assessment

General characteristics and physical activity measures after stratification per country of assessment are presented in e-Table 4.

57 **e-Table 4** General characteristics and daily physical activity measures after stratification for country of assessment

Measure	The United Kingdom (UK)	Ireland	The Netherlands	Germany	Switzerland	Italy	Spain	The United States of America (USA)	Brazil	Australia	*P*-value
N	240	37	97	187	124	23	93	65	27	108	-
General characteristics											
Age, yrs	66 (61 – 72)[†]	68 (62 – 74)	65 (60 – 69)	64 (59 – 69)	65 (57 – 70)[§,‖]	71 (65 – 75)[†]	71 (63 – 75)[‡,†]	69 (62 – 75)[†]	65 (60 – 74)	70 (64 – 75)[‡,†]	<0.0001
Male, %	60	49	64	69	59	74	94	55	63	65	<0.0001
BMI, $kg \cdot m^{-2}$	24.8 (21.6 – 28.9)[¶]	26.9 (22.9 – 32.5)	26.6 (22.6 – 29.9)	25.6 (22.5 – 28.3)[¶]	25.2 (21.8 – 29.2)[¶]	25.9 (23.0 – 32.1)	26.8 (24.5 – 29.7)	29.6 (24.3 – 33.1)	24.1 (19.9 – 28.8)[¶]	25.4 (22.0 – 29.4)[¶]	<0.0001
FEV_1, % predicted	46 (30 – 62)[†]	43 (33 – 52)	48 (34 – 63)	55 (43 – 68)	57 (31 – 76)[‖]	52 (40 – 60)	52 (42 – 60)	43 (34 – 59)[†]	46 (26 – 65)	43 (32 – 55)[†]	<0.0001
mMRC dyspnoea grade, points[*]	2 (1 – 3)[†,‡,**]	2 (1 – 3)[†,‡,**]	1 (0 – 2)	1 (0 – 3)	2 (1 – 2)	1 (1 – 1)	2 (1 – 3)[‡,**]	2 (1 – 3)	3 (1 – 3)[†,‡,**]	1 (1 – 2)	<0.0001
ADO index[*]	4 (3 – 6)[‡]	5 (4 – 6)[‡]	4 (3 – 4)	4 (2 – 5)[§]	4 (2 – 5)[¶,§]	4 (3 – 5)	5 (4 – 6)[‡]	5 (4 – 6)[‡]	5 (3 – 6)[‡]	4 (3 – 5)[‡]	<0.0001
GOLD 2007 classification 1 / 2 / 3 / 4, %	13/30/33/24	5/30/54/11	8/35/40/17	11/51/28/10	16/40/24/20	9/43/39/9	3/56/31/10	3/42/35/20	4/40/26/30	1/31/47/21	0.19
Care setting Primary / Secondary / Tertiary, %[¶¶]	12/1/87	0/0/100	0/46/54	0/0/100	0/53/47	0/0/100	0/0/100	0/0/100	0/0/100	0/0/100	0.46
GOLD 2011 classification A / B / C / D, %[*]	26/16/14/44	16/19/11/54	34/9/25/32	40/13/14/33	37/18/9/36	39/13/39/9	28/25/17/30	25/20/15/40	19/26/7/48	21/10/33/36	0.08
Physical activity measures in very light intensity											
Time, $min \cdot day^{-1}$	820	862	810	771	773	831	760	817	762	823	<0.0001

	(726 – 917)	(755 – 970)[†]	(735 – 922)	(684 – 869)	(676 – 882)	(734 – 1007)	(691 – 883)	(675 – 885)	(637 – 859)	(752 – 927)[†]	
EE, METs-min·day^{-1}	913 (781 – 1170)[¶,††]	1052 (743 – 1299)[¶,††]	1046 (877 – 1207)[¶,††]	975 (800 – 1191)[¶,††]	1753 (993 – 3989)[¶]	1027 (783 – 1308)[¶,††]	950 (790 – 1139)[¶,††]	4543 (3294 – 5473)	850 (656 – 1076)[¶,††]	1001 (822 – 1225)[¶,††]	<0.0001
Physical activity measures in light intensity											
Time, min·day^{-1}	133 (86 – 184)[§§]	80 (53 – 158)[§§]	147 (98 – 194)	155 (109 – 198)[‡‡]	156 (90 – 203)[‡‡]	142 (85 – 201)	147 (101 – 209)[‡‡]	112 (60 – 167)[§§]	208 (135 – 248)	140 (98 – 187)[‡‡]	<0.0001
EE, METs-min·day^{-1}	356 (252 – 500)[¶,†,††]	224 (159 – 373)[¶]	412 (299 – 584)[¶,‡‡,††]	446 (322 – 612)[¶,‡‡,††]	839 (376 – 1914)[¶,‡‡]	400 (183 – 586)[¶,††]	433 (272 – 594)[¶,‡‡,††]	1469 (928 – 2136)	484 (307 – 687)[¶,‡‡]	415 (268 – 552)[¶,‡‡,††]	<0.0001
Physical activity measures in moderate-to-vigorous intensity											
Time, min·day^{-1}	47 (23 – 96)[‡‡,§]	26 (15 – 46)	54 (27 – 101)[‡‡]	68 (33 – 123)[‡‡,ǀ]	51 (26 – 118)[‡‡]	45 (23 – 67)	77 (48 – 126)[‡‡,ǀ]	35 (19 – 74)[†,§]	69 (37 – 122)[‡‡]	45 (19 – 121)	<0.0001
EE, METs-min·day^{-1}	217 (102 – 405)[¶]	114 (73 – 198)[¶,ǁ]	262 (131 – 451)[¶,‡‡,††]	312 (152 – 589)[¶,ǁ,‡‡]	491 (169 – 1362)[ǁ,‡‡]	241 (72 – 563)[¶]	334 (197 – 566)[¶,ǁ,‡‡]	747 (367 – 1427)	304 (159 – 611)[¶]	190 (92 – 307)[¶,†,††,§]	<0.0001
Time in ≥10-min bouts, min·day^{-1}	6 (0 – 22)	0 (0 – 8)	7 (0 – 22)	14 (3 – 33)[ǁ,‡‡]	4 (0 – 27)	0 (0 – 20)	15 (3 – 40)[ǁ,‡‡]	7 (1 – 19)	12 (0 – 41)	3 (0 – 9)[†,§]	<0.0001

Data expressed as absolute/relative frequency, or median (interquartile range). See Table 1 for definition of abbreviations. [*]Data available for 219 subjects in the United Kingdom, 110 in Germany, 118 in Switzerland, and 64 in Spain; [¶¶]Data available for 237 subjects in the United Kingdom, 110 in Germany, and 77 in Spain; [†]P<0.05 vs Germany; [‡]P<0.05 vs the Netherlands; [§]P<0.05 vs Spain; [ǀ]P<0.05 vs Australia; [¶]P<0.05 vs the United States of America; [**]P<0.05 vs Italy; [††]P<0.05 vs Switzerland; [‡‡]P<0.05 vs Ireland; [§§]P<0.05 vs Brazil; [ǁ]P<0.05 vs the United Kingdom.

Daily Physical Activity Measures and Hourly Patterns after Stratification for Clinical Characteristics

Daily physical activity measures after stratification for clinical characteristics can be found in e-Tables 5-13. e-Figure 1 presents the daily physical activity hourly patterns after stratification for age groups, sex, long-term oxygen therapy use, diffusion capacity of the lung for carbon monoxide (D_{LCO}) groups, and age, dyspnoea, and airflow obstruction (ADO) index groups.

e-Table 5 Daily physical activity measures after stratification for age groups

Measure	< median (67 years)	≥ median (67 years)	*P*-value
N	495	504	
Physical activity measures in very light intensity			
Time, min·day^{-1}	792 (697 – 891)	813 (730 – 908)	0.01
EE, METs-min·day^{-1}	1020 (807 – 1341)	1040 (832 – 1308)	0.53
Physical activity measures in light intensity			
Time, min·day^{-1}	148 (97 – 203)	137 (87 – 184)	0.003
EE, METs-min·day^{-1}	457 (311 – 689)	417 (264 – 621)	0.03
Physical activity measures in moderate-to-vigorous intensity			
Time, min·day^{-1}	58 (32 – 121)	45 (23 – 81)	<0.0001
EE, METs-min·day^{-1}	308 (153 – 638)	241 (114 – 448)	<0.0001
Time in ≥10-min bouts, min·day^{-1}	7 (0 – 30)	6 (0 – 19)	0.04

Data expressed as median (interquartile range). See Table 1 for definition of abbreviations.

e-Table 6 Daily physical activity measures after stratification for sex

Measure	Male	Female	*P*-value
N	654	347	
Physical activity measures in very light intensity			
Time, min·day^{-1}	807 (711 – 911)	790 (706 – 879)	0.09
EE, METs-min·day^{-1}	1091 (877 – 1358)	875 (737 – 1258)	<0.0001
Physical activity measures in light intensity			
Time, min·day^{-1}	137 (89 – 185)	155 (102 – 205)	0.002
EE, METs-min·day^{-1}	443 (294 – 652)	420 (276 – 663)	0.36
Physical activity measures in moderate-to-vigorous intensity			
Time, min·day^{-1}	53 (27 – 106)	48 (23 – 87)	0.07
EE, METs-min·day^{-1}	297 (147 – 600)	235 (100 – 448)	<0.0001
Time in ≥10-min bouts, min·day^{-1}	8 (0 – 26)	5 (0 – 19)	0.004

Data expressed as median (interquartile range). See Table 1 for definition of abbreviations.

e-Table 7 Daily physical activity measures after stratification for body mass index classification

Measure	Underweight	Normal weight	Pre-obese	Obese	*P*-value
N	68	366	342	225	
Physical activity measures in very light intensity					
Time, min·day^{-1}	739 (668 – 816)	769 (688 – 863)	789 (704 – 881)*	891 (812 – 974)*,†,‡	<0.0001
EE, METs-min·day^{-1}	716 (616 – 806)	857 (736 – 1036)*	1057 (904 – 1256)*,†	1438 (1223 – 1753)*,†,‡	<0.0001
Physical activity measures in light intensity					
Time, min·day^{-1}	159 (110 – 183)	166 (116 – 212)	147 (105 – 200)†	88 (45 – 140)*,†,‡	<0.0001
EE, METs-min·day^{-1}	440 (230 – 441)	444 (310 – 615)*	489 (334 – 714)*	391 (200 – 636)‡	<0.0001
Physical activity measures in moderate-to-vigorous intensity					
Time, min·day^{-1}	123 (54 – 183)	63 (30 – 119)*	53 (31 – 88)*	32 (15 – 63)*,†,‡	<0.0001
EE, METs-min·day^{-1}	379 (151 – 675)	258 (121 – 534)	277 (155 – 556)	237 (99 – 536)*	0.02
Time in ≥10-min bouts, min·day^{-1}	22 (4 – 65)	11 (0 – 35)	6 (0 – 18)*,†	3 (0 – 13)*,†,‡	<0.0001

Data expressed as median (interquartile range). See Table 1 for definition of abbreviations. $^{*}P<0.05$ vs Underweight; $^{\dagger}P<0.05$ vs Normal weight; $^{\ddagger}P<0.05$ vs Pre-obese.

e-Table 8 Daily physical activity measures after stratification for modified Medical Research Council (mMRC) grades[*]

Measure	0	1	2	3	4	*P*-value
N	137	268	221	181	61	
Physical activity measures in very light intensity						
Time, min·day^{-1}	743 (675 – 853)	804 (714 – 895)[†]	819 (718 – 886)[†]	847 (760 – 934)[†,‡,§]	884 (756 – 1001)[†,‡,§]	<0.0001
EE, METs-min·day^{-1}	1027 (829 – 1325)	1045 (822 – 1349)	1028 (822 – 1464)	1063 (852 – 1580)	1092 (777 – 1268)	0.49
Physical activity measures in light intensity						
Time, min·day^{-1}	167 (124 – 211)	141 (94 – 199)[†]	138 (92 – 188)[†]	127 (71 – 174)[†,‡]	104 (62 – 170)[†,‡]	<0.0001
EE, METs-min·day^{-1}	549 (394 – 762)	478 (307 – 691)	410 (272 – 676)[†]	373 (246 – 575)[†,‡]	275 (163 – 391)[†,‡,§,ǀ]	<0.0001
Physical activity measures in moderate-to-vigorous intensity						
Time, min·day^{-1}	74 (43 – 134)	53 (31 – 93)[†]	45 (26 – 82)[†]	33 (17 – 76)[†,‡]	21 (11 – 72)[†,‡]	<0.0001
EE, METs-min·day^{-1}	374 (211 – 751)	293 (165 – 542)[†]	224 (122 – 478)[†]	209 (78 – 451)[†,‡]	108 (47 – 317)[†,‡,§]	<0.0001
Time in ≥10-min bouts, min·day^{-1}	13 (3 – 43)	7 (0 – 19)[†]	5 (0 – 19)[†]	3 (0 – 14)[†,‡]	0 (0 – 12)[†,‡]	<0.0001

Data expressed as median (interquartile range). See Table 1 for definition of abbreviations. [*]Data available for 868 subjects; [†]$P<0.05$ vs mMRC0; [‡]$P<0.05$ vs mMRC1; [§]$P<0.05$ vs mMRC2; [ǀ]$P<0.05$ vs mMRC3.

e-Table 9 Daily physical activity measures after stratification for long-term oxygen therapy use*

Measure	Yes	No	*P*-value
N	67	640	
Physical activity measures in very light intensity			
Time, min·day^{-1}	836 (749 – 925)	804 (711 – 896)	0.04
EE, METs-min·day^{-1}	1082 (845 – 1308)	1051 (836 – 1434)	0.65
Physical activity measures in light intensity			
Time, min·day^{-1}	113 (65 – 171)	141 (93 – 196)	0.01
EE, METs-min·day^{-1}	341 (196 – 605)	453 (299 – 699)	0.02
Physical activity measures in moderate-to-vigorous intensity			
Time, min·day^{-1}	37 (17 – 68)	53 (28 – 95)	0.005
EE, METs-min·day^{-1}	176 (79 – 400)	298 (149 – 577)	0.004
Time in ≥10-min bouts, min·day^{-1}	2 (0 – 9)	7 (0 – 22)	<0.0001

Data expressed as median (interquartile range). See Table 1 for definition of abbreviations. *Data available for 707 subjects.

e-Table 10 Daily physical activity measures after stratification for diffusion capacity of the lung for carbon monoxide (D_{LCO}) groups*

Measure	< median (51 % predicted)	≥ median (51 % predicted)	*P*-value
N	241	264	
Physical activity measures in very light intensity			
Time, min·day^{-1}	819 (735 – 919)	802 (708 – 886)	0.05
EE, METs-min·day^{-1}	944 (788 – 1198)	1112 (902 – 1455)	<0.0001
Physical activity measures in light intensity			
Time, min·day^{-1}	139 (88 – 187)	146 (94 – 197)	0.34
EE, METs-min·day^{-1}	390 (260 – 540)	512 (342 – 712)	<0.0001
Physical activity measures in moderate-to-vigorous intensity			
Time, min·day^{-1}	42 (23 – 81)	59 (35 – 98)	<0.0001
EE, METs-min·day^{-1}	196 (93 – 395)	347 (212 – 601)	<0.0001
Time in ≥10-min bouts, min·day^{-1}	4 (0 – 19)	9 (2 – 24)	0.002

Data expressed as median (interquartile range). See Table 1 for definition of abbreviations. *Data available for 505 subjects.

89 **e-Table 11** Daily physical activity measures after stratification for ADO index groups

Measure	< median (4 points)	≥ median (4 points)	*P*-value
N	317	551	
Physical activity measures in very light intensity			
Time, min·day^{-1}	783 (690 – 879)	827 (739 – 922)	<0.0001
EE, METs-min·day^{-1}	1079 (835 – 1415)	1047 (823 – 1344)	0.38
Physical activity measures in light intensity			
Time, min·day^{-1}	156 (108 – 204)	132 (82 – 182)	<0.0001
EE, METs-min·day^{-1}	517 (333 – 734)	393 (252 – 579)	<0.0001
Physical activity measures in moderate-to-vigorous intensity			
Time, min·day^{-1}	62 (36 – 115)	42 (20 – 78)	<0.0001
EE, METs-min·day^{-1}	348 (191 – 687)	215 (89 – 425)	<0.0001
Time in ≥10-min bouts, min·day^{-1}	9 (0 – 31)	4 (0 – 16)	<0.0001

90 Data expressed as median (interquartile range). See Table 1 for definition of abbreviations. *Data available for 868 subjects.

91

e-Table 12 Daily physical activity measures after stratification for Global Initiative for Chronic Obstructive Lung Disease (GOLD) 2007 classification

Measure	1	2	3	4	*P*-value
N	91	395	340	175	
Physical activity measures in very light intensity					
Time, min·day^{-1}	751 (680 – 846)	791 (706 – 882)	817 (731 – 922)*	822 (720 – 929)*	0.0004
EE, METs-min·day^{-1}	1019 (800 – 1405)	1079 (845 – 1409)	1027 (824 – 1308)	960 (759 – 1181)†	0.008
Physical activity measures in light intensity					
Time, min·day^{-1}	181 (117 – 230)	147 (105 – 198)*	132 (80 – 182)*,†	137 (88 – 184)*	<0.0001
EE, METs-min·day^{-1}	578 (416 – 843)	505 (328 – 727)	389 (253 – 564)*,†	374 (237 – 519)*,†	<0.0001
Physical activity measures in moderate-to-vigorous intensity					
Time, min·day^{-1}	75 (44 – 117)	59 (33 – 108)	44 (21 – 78)*,†	39 (18 – 105)*,†	<0.0001
EE, METs-min·day^{-1}	364 (225 – 684)	328 (183 – 644)	209 (89 – 450)*,†	164 (70 – 450)*,†	<0.0001
Time in ≥10-min bouts, min·day^{-1}	12 (3 – 31)	11 (3 – 28)	4 (0 – 17)*,†	3 (0 – 18)*,†	<0.0001

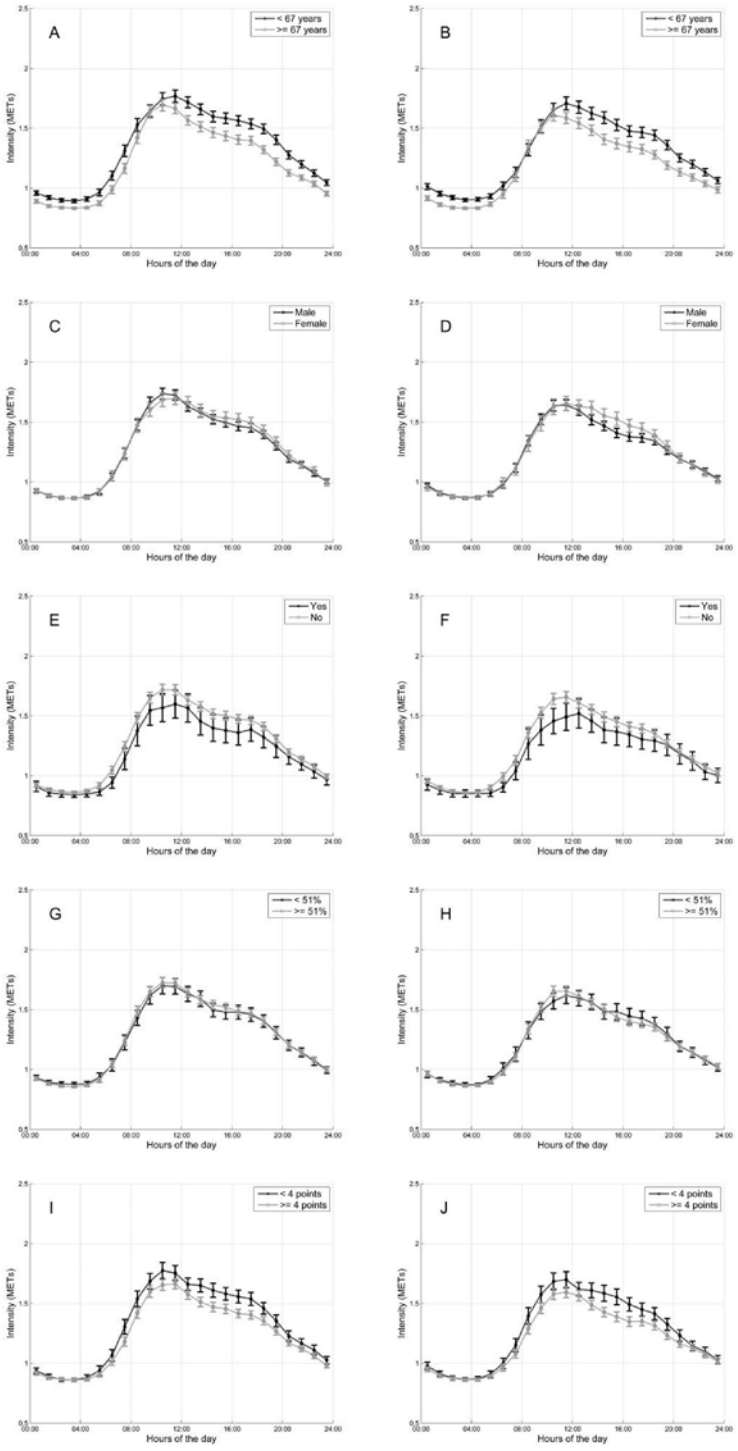
Data expressed as median (interquartile range). See Table 1 for definition of abbreviations. $^{*}P<0.05$ vs 1; $^{\dagger}P<0.05$ vs 2; $^{\ddagger}P<0.05$ vs 3.

e-Table 13 Daily physical activity measures after stratification for Global Initiative for Chronic Obstructive Lung Disease (GOLD) 2011 classification*

Measure	A	B	C	D	*P*-value
N	255	137	150	326	
Physical activity measures in very light intensity					
Time, min·day^{-1}	775 (694 – 869)	830 (746 – 899)†	799 (700 – 899)	832 (738 – 937)†,§	<0.0001
EE, METs-min·day^{-1}	1104 (841 – 1369)	1213 (912 – 1803)	1000 (789 – 1236)‡	1005 (800 – 1299)‡	<0.0001
Physical activity measures in light intensity					
Time, min·day^{-1}	156 (113 – 206)	136 (77 – 190)†	149 (90 – 197)	128 (79 – 174)†	<0.0001
EE, METs-min·day^{-1}	536 (367 – 758)	480 (275 – 813)	429 (288 – 617)†	352 (226 – 518)†,‡,§	<0.0001
Physical activity measures in moderate-to-vigorous intensity					
Time, min·day^{-1}	64 (37 – 104)	44 (23 – 80)†	51 (30 – 105)	37 (18 – 77)†,§	<0.0001
EE, METs-min·day^{-1}	348 (206 – 664)	296 (141 – 591)	243 (140 – 515)†	175 (75 – 378)†,‡,§	<0.0001
Time in ≥10-min bouts, min·day^{-1}	10 (3 – 25)	6 (0 – 19)	5 (0 – 21)	3 (0 – 14)†,§	<0.0001

Data expressed as median (interquartile range). See Table 1 for definition of abbreviations. *Data available for 868 subjects; $^{\dagger}P<0.05$ vs A; $^{\ddagger}P<0.05$ vs B; $^{\S}P<0.05$ vs C.

e-Figure 1 Daily physical activity hourly patterns of the patients with chronic obstructive pulmonary disease after stratification for: A and B – age groups (< or ≥ median, 67 years); C and D – sex; E and F – long-term oxygen therapy (LTOT) use (yes or no), data available for 707 subjects only; G and H – diffusion capacity of the lung for carbon monoxide (D_{LCO}) groups (< or ≥ median, 51% predicted), data available for 505 subjects; and I and J – age, dyspnoea, and airflow obstruction (ADO) index groups(< or ≥ median, 4 points). Figures A, C, E, G, and I represent weekdays, whilst figures B, D, F, H, and J represent weekend days. Data pooled per hour as mean (95% confidence intervals).


A
< 67 years
>= 67 years
B
< 67 years
>= 67 years
C
Male
Female
D
Male
Female
E
Yes
No
F
Yes
No
G
< 51%
>= 51%
H
< 51%
>= 51%
I
< 4 points
>= 4 points
J
< 4 points
>= 4 points
Intensity (METs)
Hours of the day

108

Area Under the Curve (AUC) from Daily Physical Activity Hourly Patterns

e-Table 14 presents the AUC-values with their 95% confidence intervals from daily physical activity hourly patterns.

112 **e-Table 14** Area under the curve from daily physical activity hourly patterns

Figure	Period under analysis	Parameter	Category/Group	AUC (95% CI)
Figure 1				
A	Weekdays	mMRC		
			0	0.32 (95% CI 0.31 to 0.33)
			1	0.29 (95% CI 0.29 to 0.30)
			2	0.29 (95% CI 0.28 to 0.30)
			3	0.28 (95% CI 0.27 to 0.29)
			4	0.28 (95% CI 0.26 to 0.29)
B	Weekend days	mMRC		
			0	0.31 (95% CI 0.30 to 0.32)
			1	0.28 (95% CI 0.28 to 0.29)
			2	0.28 (95% CI 0.27 to 0.29)
			3	0.28 (95% CI 0.27 to 0.28)
			4	0.27 (95% CI 0.26 to 0.28)

C	Weekdays	BMI		
			Underweight	0.36 (95% CI 0.35 to 0.38)
			Normal weight	0.31 (95% CI 0.31 to 0.32)
			Pre-obese	0.29 (95% CI 0.29 to 0.30)
			Obese	0.26 (95% CI 0.25 to 0.26)
D	Weekend days	BMI		
			Underweight	0.36 (95% CI 0.34 to 0.37)
			Normal weight	0.30 (95% CI 0.30 to 0.31)
			Pre-obese	0.28 (95% CI 0.27 to 0.28)
			Obese	0.25 (95% CI 0.24 to 0.25)
E	Weekdays	GOLD grades		
			1	0.31 (95% CI 0.30 to 0.32)
			2	0.30 (95% CI 0.29 to 0.30)
			3	0.29 (95% CI 0.28 to 0.29)
			4	0.30 (95% CI 0.29 to 0.31)

F	Weekend days	GOLD grades		
			1	0.30 (95% CI 0.29 to 0.31)
			2	0.28 (95% CI 0.28 to 0.29)
			3	0.28 (95% CI 0.27 to 0.29)
			4	0.30 (95% CI 0.29 to 0.31)
G	Weekdays	GOLD groups		
			A	0.30 (95% CI 0.29 to 0.31)
			B	0.28 (95% CI 0.27 to 0.29)
			C	0.30 (95% CI 0.29 to 0.31)
			D	0.29 (95% CI 0.29 to 0.31)
H	Weekend days	GOLD groups		
			A	0.29 (95% CI 0.28 to 0.30)
			B	0.27 (95% CI 0.26 to 0.28)
			C	0.29 (95% CI 0.28 to 0.30)
			D	0.28 (95% CI 0.28 to 0.29)

e-Figure 1				
A	Weekdays	Age	<67 years	0.31 (95% CI 0.30 to 0.31)
			≥67 years	0.28 (95% CI 0.28 to 0.29)
B	Weekend days	Age	<67 years	0.30 (95% CI 0.29 to 0.30)
			≥67 years	0.27 (95% CI 0.27 to 0.28)
C	Weekdays	Sex	Male	0.29 (95% CI 0.29 to 0.30)
			Female	0.30 (95% CI 0.29 to 0.30)
D	Weekend days	Sex	Male	0.28 (95% CI 0.28 to 0.29)
			Female	0.29 (95% CI 0.28 to 0.30)
E	Weekdays	LTOT use	Yes	0.28 (95% CI 0.27 to 0.29)
			No	0.29 (95% CI 0.29 to 0.30)
F	Weekend days	LTOT use	Yes	0.27 (95% CI 0.26 to 0.28)
			No	0.29 (95% CI 0.28 to 0.30)
G	Weekdays	D_{LCO}	<51%	0.29 (95% CI 0.29 to 0.30)
			≥51%	0.30 (95% CI 0.29 to 0.30)

H	Weekend days	D_{LCO}	<51%	0.29 (95% CI 0.28 to 0.29)
			≥51%	0.29 (95% CI 0.28 to 0.29)
I	Weekdays	ADO index	<4 points	0.31 (95% CI 0.30 to 0.31)
			≥4 points	0.28 (95% CI 0.28 to 0.29)
J	Weekend days	ADO index	<4 points	0.30 (95% CI 0.29 to 0.30)
			≥4 points	0.28 (95% CI 0.27 to 0.28)
Figure 4				
A	Weekdays	Clusters	'Couch Potatoes'	0.23 (95% CI 0.23 to 0.23)
			'Highly Sedentary'	0.28 (95% CI 0.28 to 0.28)
			'Sedentary Movers'	0.32 (95% CI 0.32 to 0.33)
			'Sedentary Exercisers'	0.36 (95% CI 0.36 to 0.37)
			'Busy Bees'	0.50 (95% CI 0.47 to 0.52)
B	Weekend days	Clusters	'Couch Potatoes'	0.23 (95% CI 0.23 to 0.23)
			'Highly Sedentary'	0.27 (95% CI 0.27 to 0.28)
			'Sedentary Movers'	0.31 (95% CI 0.30 to 0.32)

			‘Sedentary Exercisers’	0.35 (95% CI 0.34 to 0.36)
			‘Busy Bees’	0.43 (95% CI 0.40 to 0.46)
e-Figure 3				
A	Weekdays	Clusters	‘Couch Potatoes’	0.16 (95% CI 0.16 to 0.17)
			‘Highly Sedentary’	0.21 (95% CI 0.20 to 0.21)
			‘Sedentary Movers’	0.25 (95% CI 0.24 to 0.25)
			‘Sedentary Exercisers’	0.28 (95% CI 0.28 to 0.29)
			‘Busy Bees’	0.41 (95% CI 0.38 to 0.44)
B	Weekend days	Clusters	‘Couch Potatoes’	0.16 (95% CI 0.16 to 0.16)
			‘Highly Sedentary’	0.19 (95% CI 0.19 to 0.20)
			‘Sedentary Movers’	0.23 (95% CI 0.23 to 0.24)
			‘Sedentary Exercisers’	0.26 (95% CI 0.25 to 0.27)
			‘Busy Bees’	0.33 (95% CI 0.30 to 0.36)

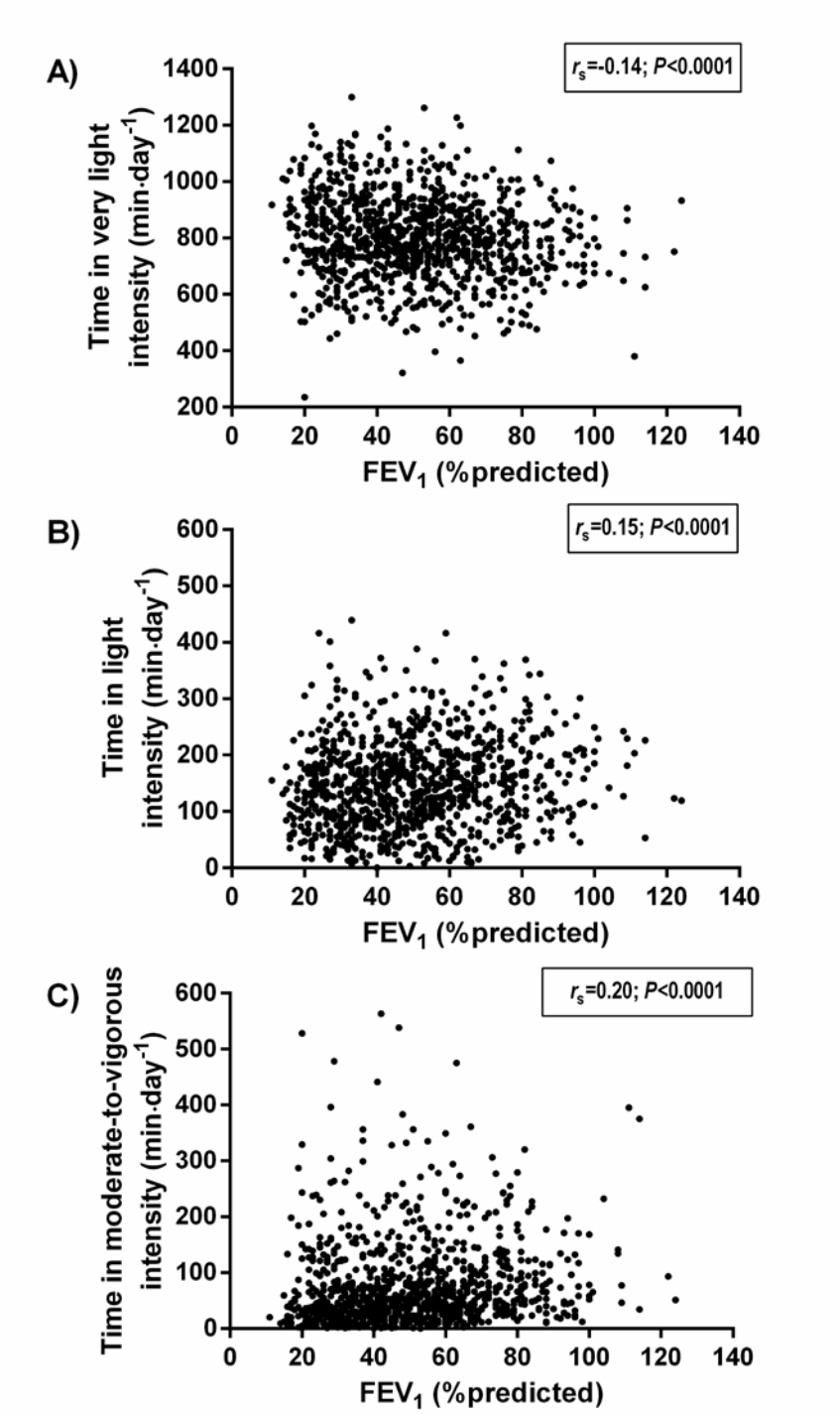
AUC: area under the curve; CI: confidence intervals; mMRC: modified Medical Research Council; BMI: body mass index; GOLD: Global Initiative for Chronic Obstructive Lung Disease; COPD: chronic obstructive pulmonary

disease; LTOT: long-term oxygen therapy; D_{LCO}: diffusion capacity of the lung for carbon monoxide; ADO: age, dyspnoea, and airflow obstruction index.

Association between Lung Function and Daily Physical Activity Measures

e-Figure 2 presents the correlation coefficients between forced expiratory volume in the first second (% predicted) and the daily time in activities of very light intensity, light intensity, and moderate-to-vigorous intensity.

e-Figure 2 Spearman's correlation between forced expiratory volume in the first second (% predicted) and the daily time in activities of very light intensity (A), light intensity (B), and moderate-to-vigorous intensity (C) for 1001 patients with chronic obstructive pulmonary disease.

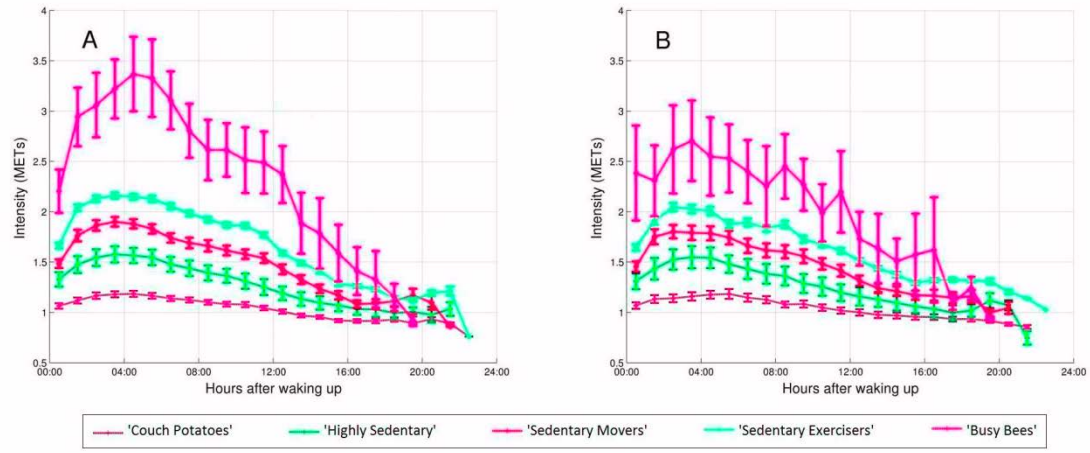

A)
r_s=-0.14; P<0.0001
Time in very light intensity (min·day^{-1})
1400
1200
1000
800
600
400
200
0
20
40
60
80
100
120
140
FEV$_1$ (%predicted)
B)
r_s=0.15; P<0.0001
Time in light intensity (min·day^{-1})
600
500
400
300
200
100
0
FEV$_1$ (%predicted)
C)
r_s=0.20; P<0.0001
Time in moderate-to-vigorous intensity (min·day^{-1})
FEV$_1$ (%predicted)

126

Daily Physical Activity Hourly Patterns of Clusters of Patients with COPD

e-Figure 3 presents the daily physical activity hourly pattern of the clusters of patients with chronic obstructive pulmonary disease after synchronisation of the waking up moment.

e-Figure 3 Daily physical activity hourly pattern of the clusters of patients with chronic obstructive pulmonary disease after synchronisation of the waking up moment during weekdays (A) and weekend days (B). Hourly patterns were presented before and after synchronisation to overcome the problem of subjects with different waking up times. Data pooled per hour as mean (95% confidence intervals).



Detailed Analyses of the Components Identified in the Principal Component Analysis (PCA)

A detailed analysis of the relationship between the three components identified by PCA and the five clusters identified from these components is provided in the following paragraphs.

The first component was clearly able to discriminate between 'Couch Potatoes' and 'Highly Sedentary' (the most inactive clusters) from the three other clusters ('Sedentary Movers', 'Sedentary Exercisers', and 'Busy Bees') (Figures 2B and 2C). The second component was not really useful to identify more inactive patients ('Couch Potatoes' and 'Highly Sedentary'), but was able to discriminate the most active cluster ('Busy Bees') from the rest (Figures 2B and 2D). To discriminate 'Sedentary Movers' and 'Sedentary Exercisers' from the others it is important to consider the combination of the three components. Indeed, if only the first component was considered, for instance, these clusters would be added to the most active cluster ('Busy Bees') (Figures 2B and 2C). On the other hand, if only the second component was considered these clusters would be added to the inactive clusters (i.e., 'Couch Potatoes' and 'Highly Sedentary') (Figures 2B and 2D).

Having a closer look at the most relevant features of each component we can notice that the first component is related to the time spent in bouts of very light intensity, whilst the second component is related to the total daily EE in activities of

159 moderate-to-vigorous intensity, mostly in bouts of physical activity. Therefore, it can be
160 suggested that the time in bouts of moderate-to-vigorous intensity can be a useful
161 marker to discriminate patients who are very active from the others.
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REFERENCES

1. Mitchell KE, Johnson-Warrington V, Apps LD, et al. A self-management programme for COPD: a randomised controlled trial. *Eur Respir J* 2014; 44: 1538-1547.
2. Shrikrishna D, Patel M, Tanner RJ, et al. Quadriceps wasting and physical inactivity in patients with COPD. *Eur Respir J* 2012; 40: 1115-1122.
3. Maddocks M, Shrikrishna D, Vitoriano S, et al. Skeletal muscle adiposity is associated with physical activity, exercise capacity and fibre shift in COPD. *Eur Respir J* 2014; 44: 1188-1198.
4. Patel MS, Mohan D, Andersson YM, et al. Phenotypic characteristics associated with reduced short physical performance battery score in COPD. *Chest* 2014; 145: 1016-1024.
5. Waschki B, Spruit MA, Watz H, et al. Physical activity monitoring in COPD: compliance and associations with clinical characteristics in a multicenter study. *Respir Med* 2012; 106: 522-530.
6. Beeh KM, Watz H, Puente-Maestu L, et al. Aclidinium improves exercise endurance, dyspnea, lung hyperinflation, and physical activity in patients with COPD: a randomized, placebo-controlled, crossover trial. *BMC Pulm Med* 2014; 14: 209.
7. Egan C, Deering BM, Blake C, et al. Short term and long term effects of pulmonary rehabilitation on physical activity in COPD. *Respir Med* 2012; 106: 1671-1679.
8. Deering BM, Fullen B, Egan C, et al. Acupuncture as an adjunct to pulmonary rehabilitation. *J Cardiopulm Rehabil Prev* 2011; 31: 392-399.
9. Romme EA, Murchison JT, Phang KF, et al. Bone attenuation on routine chest CT correlates with bone mineral density on DXA in patients with COPD. *J Bone Miner Res* 2012; 27: 2338-2343.
10. Romme EA, Rutten EP, Geusens P, et al. Bone stiffness and failure load are related with clinical parameters in men with chronic obstructive pulmonary disease. *J Bone Miner Res* 2013; 28: 2186-2193.
11. Waschki B, Kirsten AM, Holz O, et al. Disease Progression and Changes in Physical Activity in Patients with Chronic Obstructive Pulmonary Disease. *Am J Respir Crit Care Med* 2015; 192: 295-306.
12. Durr S, Zogg S, Miedinger D, et al. Daily physical activity, functional capacity and quality of life in patients with COPD. *COPD* 2014; 11: 689-696.
13. Zogg S, Durr S, Miedinger D, et al. Differences in classification of COPD patients into risk groups A-D: a cross-sectional study. *BMC Res Notes* 2014; 7: 562.
14. van Gestel AJ, Clarenbach CF, Stowhas AC, et al. Predicting daily physical activity in patients with chronic obstructive pulmonary disease. *PLoS One* 2012; 7: e48081.
15. Garcia-Aymerich J, Gomez FP and Anto JM. Phenotypic characterization and course of chronic obstructive pulmonary disease in the PAC-COPD Study: design and methods. *Arch Bronconeumol* 2009; 45: 4-11.

16. Garcia-Aymerich J, Gomez FP, Benet M, et al. Identification and prospective validation of clinically relevant chronic obstructive pulmonary disease (COPD) subtypes. *Thorax* 2011; 66: 430-437.
17. Donaire-Gonzalez D, Gimeno-Santos E, Balcells E, et al. Physical activity in COPD patients: patterns and bouts. *Eur Respir J* 2013; 42: 993-1002.
18. Donaire-Gonzalez D, Gimeno-Santos E, Balcells E, et al. Benefits of physical activity on COPD hospitalisation depend on intensity. *Eur Respir J* 2015; 46: 1281-1289.
19. Depew ZS, Karpman C, Novotny PJ, et al. Correlations between gait speed, 6-minute walk distance, physical activity, and self-efficacy in patients with severe chronic lung disease. *Respir Care* 2013; 58: 2113-2119.
20. Karpman C, Lebrasseur NK, Depew ZS, et al. Measuring gait speed in the out-patient clinic: methodology and feasibility. *Respir Care* 2014; 59: 531-537.
21. Rodrigues A, Di Martino M, Nellessen AG, et al. Is the six-minute walk test a useful tool to prescribe high-intensity exercise in patients with chronic obstructive pulmonary disease? *Heart Lung* 2016.
22. Wootton SL, Ng C, McKeough ZJ, et al. Estimating endurance shuttle walk test speed using the six-minute walk test in people with chronic obstructive pulmonary disease. *Chron Respir Dis* 2014; 11: 89-94.
23. Wootton SL, Ng LW, McKeough ZJ, et al. Ground-based walking training improves quality of life and exercise capacity in COPD. *Eur Respir J* 2014; 44: 885-894.
24. Bestall JC, Paul EA, Garrod R, et al. Usefulness of the Medical Research Council (MRC) dyspnoea scale as a measure of disability in patients with chronic obstructive pulmonary disease. *Thorax* 1999; 54: 581-586.
25. Puhan MA, Garcia-Aymerich J, Frey M, et al. Expansion of the prognostic assessment of patients with chronic obstructive pulmonary disease: the updated BODE index and the ADO index. *Lancet* 2009; 374: 704-711.
26. Rabe KF, Hurd S, Anzueto A, et al. Global strategy for the diagnosis, management, and prevention of chronic obstructive pulmonary disease: GOLD executive summary. *Am J Respir Crit Care Med* 2007; 176: 532-555.
27. Vestbo J, Hurd SS, Agusti AG, et al. Global strategy for the diagnosis, management, and prevention of chronic obstructive pulmonary disease: GOLD executive summary. *Am J Respir Crit Care Med* 2013; 187: 347-365.
28. Sharif MM and Bahammam AS. Sleep estimation using BodyMedia's SenseWear armband in patients with obstructive sleep apnea. *Ann Thorac Med* 2013; 8: 53-57.
29. Dolnicar SA. Review of unquestioned standards in using cluster analysis for data-driven market segmentation. *Proceedings of the Australian and New Zealand Marketing Academy Conference 2002 (ANZMAC 2002)*. Deakin University, Melbourne2002.
30. Formann AK. *Die latent-class-analyse: einführung in die theorie und anwendung*. Weinheim: Beltz, 1984.
31. Weatherall M, Travers J, Shirtcliffe PM, et al. Distinct clinical phenotypes of airways disease defined by cluster analysis. *Eur Respir J* 2009; 34: 812-818.

242 32. Burgel PR, Paillasseur JL, Caillaud D, et al. Clinical COPD phenotypes: a novel approach
243 using principal component and cluster analyses. *Eur Respir J* 2010; 36: 531-539.
244 33. Vanfleteren LE, Spruit MA, Groenen M, et al. Clusters of comorbidities based on
245 validated objective measurements and systemic inflammation in patients with chronic
246 obstructive pulmonary disease. *Am J Respir Crit Care Med* 2013; 187: 728-735.
247 34. Harrison SL, Robertson N, Graham CD, et al. Can we identify patients with different
248 illness schema following an acute exacerbation of COPD: a cluster analysis. *Respir Med* 2014;
249 108: 319-328.

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