

Supporting Information

Real-time Monitoring of the Effects of Personal Temperature Exposure on Blood Oxygen Saturation Level in Elderly People With and Without Chronic Obstructive Pulmonary Disease: A Panel Study in Hong Kong

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Table S1 Description for individual Characteristics for three subgroups of participants

Variable	Total	Healthy men	Healthy women	Male COPD patients
Number of participants, N	40	8	12	18
Number of measurements, n	25,192	5,102	6,750	12,043
SpO₂ (%)^a, mean±SD	92.0 ± 5.3	94.4 ± 4.0	93.0 ± 4.7	90.7 ± 5.6
Oxygen desaturation, (%)	28.6	12.3	22.1	37.6
Physical activity^b				
VM (cpm)^a, median (IQR)	919 (1,693)	841 (1,725)	1,323 (2,475)	856 (1,416)
Mild, (%)	33.3	34.8	25.4	34.9
Medium, (%)	33.3	33.0	29.9	35.8
Intense, (%)	33.3	32.1	44.7	29.3

Abbreviations: SpO₂, pulse oxygen saturation; VM, vector magnitude; cpm, counts per minute; IQR, interquartile range; SD, standard deviation.

a: SpO₂ were real-time monitored by sensors, calculated from 25,192 repeated measurements for 20 patients with COPD and 20 healthy participants.

b: VM is the indicator of physical activity; three physical activity levels (mild, medium and intense) were categorized using the 33.3 and 66.7 percentiles as the cut-off points (548.8 and 1571.4 VM cpm, respectively).

Table S2 Description for SpO₂, the personal exposure to ambient temperature and environmental factors for three subgroups of participants *

	Mean	SD	Min	P ₂₅	Median	P ₇₅	Max	IQR
Healthy men (n=5,102)								
SpO ₂ (%)	94.4	4.0	69.0	92.8	95.3	97.2	100	4.4
Temperature (°C)	28.8	2.3	23.8	26.7	29.2	31.0	33.3	4.3
PM _{2.5} (µg/m ³)	15.9	12.8	0	5.4	15.4	23.4	156.1	18
CO (ppm)	0.48	0.14	0.23	0.38	0.46	0.57	0.9	0.19
Air pressure (hPa)	1007.7	5.1	987.1	1005	1008.5	1010.2	1020.7	5.2
Relative humidity (%)	58.6	9.3	30.8	53.4	61.2	65.5	80.4	12.1
Healthy women (n=6,750)								
SpO ₂ (%)	93.0	4.7	69.0	90.5	94.0	96.4	100	5.9
Temperature (°C)	28.5	2.8	18.2	26.9	28.8	30.9	34.2	4
PM _{2.5} (µg/m ³)	23.3	20.1	0	11.5	16.8	31.2	184.8	19.7
CO (ppm)	0.48	0.12	0.25	0.41	0.46	0.53	0.96	0.12
Air pressure (hPa)	1008.6	4.4	996.1	1006.6	1008.6	1011.8	1017.5	5.2
Relative humidity (%)	55.5	9.4	33.8	48.5	55.3	62.9	85.5	14.4
Male COPD patients (n=12,043)								
SpO ₂ (%)	90.7	5.6	69.0	87.7	91.8	95.0	100	7.3
Temperature (°C)	27.6	3.8	16.8	25.9	28.6	30.3	33.7	4.4
PM _{2.5} (µg/m ³)	27.3	21.8	1.5	13.5	21.2	33.7	185.6	20.2
CO (ppm)	0.48	0.15	0.19	0.36	0.47	0.59	1.13	0.23
Air pressure (hPa)	1011.3	6.2	1000.1	1006.7	1010.8	1014.5	1029.3	7.8
Relative humidity (%)	52.8	10.0	17.6	46.8	53.3	59.2	82.5	12.4

*: Data of SpO₂, PM_{2.5}, temperature and relative humidity were real-time monitoring by sensors, averaged from 13,340 repeated measurements for 20 patients with COPD and 11,852 repeated measurements for 20 healthy participants. Abbreviations: SpO₂, pulse oxygen saturation; SD, standard deviation; P₂₅, the 25th percentile; P₇₅, the 75th percentile; IQR, interquartile range.

Table S3 Changes in SpO₂ (%) and OR of oxygen desaturation associated with 1°C increase of real-time personal temperature exposure at different lag periods by season *

Temperature	Whole year (n=25,192)	Warm season ^a (n=17,932)	Cool season ^a (n=7,260)	P-value ^b
Changes in SpO ₂				
Lag 0 (5min)	-0.27 (-0.32 , -0.22)	-0.25 (-0.30 , -0.19)	-0.35 (-0.51 , -0.18)	0.0246
Lag 0-30m	-0.25 (-0.30 , -0.20)	-0.22 (-0.28 , -0.17)	-0.35 (-0.52 , -0.19)	0.0084
Lag 0-1h	-0.23 (-0.29 , -0.18)	-0.20 (-0.25 , -0.15)	-0.37 (-0.54 , -0.20)	0.0018
Lag 0-3h	-0.18 (-0.23 , -0.12)	-0.15 (-0.20 , -0.09)	-0.42 (-0.60 , -0.25)	0.0049
Lag 0-5h	-0.11 (-0.17 , -0.06)	-0.11 (-0.17 , -0.05)	-0.32 (-0.53 , -0.11)	0.0522
Lag 0-8h	-0.06 (-0.12 , 0.01)	-0.07 (-0.14 , 0.00)	-0.26 (-0.49 , -0.03)	0.1213
Oxygen desaturation ^c				
Lag 0 (5min)	1.14 (1.10 , 1.18)	1.11 (1.06 , 1.15)	1.28 (1.17 , 1.40)	0.0026
Lag 0-30m	1.12 (1.09 , 1.16)	1.09 (1.05 , 1.13)	1.28 (1.17 , 1.40)	0.0014
Lag 0-1h	1.11 (1.08 , 1.15)	1.08 (1.04 , 1.12)	1.28 (1.16 , 1.41)	0.0010
Lag 0-3h	1.06 (1.03 , 1.10)	1.04 (1.00 , 1.08)	1.18 (1.07 , 1.30)	0.0172
Lag 0-5h	1.03 (0.99 , 1.07)	1.02 (0.98 , 1.07)	1.11 (1.01 , 1.23)	0.1223
Lag 0-8h	0.99 (0.95 , 1.03)	0.98 (0.93 , 1.03)	1.08 (0.97 , 1.21)	0.1235

*: Temperature at different lag exposure window was included in the GAMM model one at a time, adjusting for seasonality, personal exposure to PM_{2.5} and relative humidity at lag 0-1h, ambient CO, air pressure, and individual characteristics.

^a: We defined the warm season when data measured between April and September while the other months as the cool season.

^b: P-values were got from the significance test when comparing between seasons for temperature exposure at the same lags.

^c: Oxygen desaturation was defined as SpO₂ < 90%.

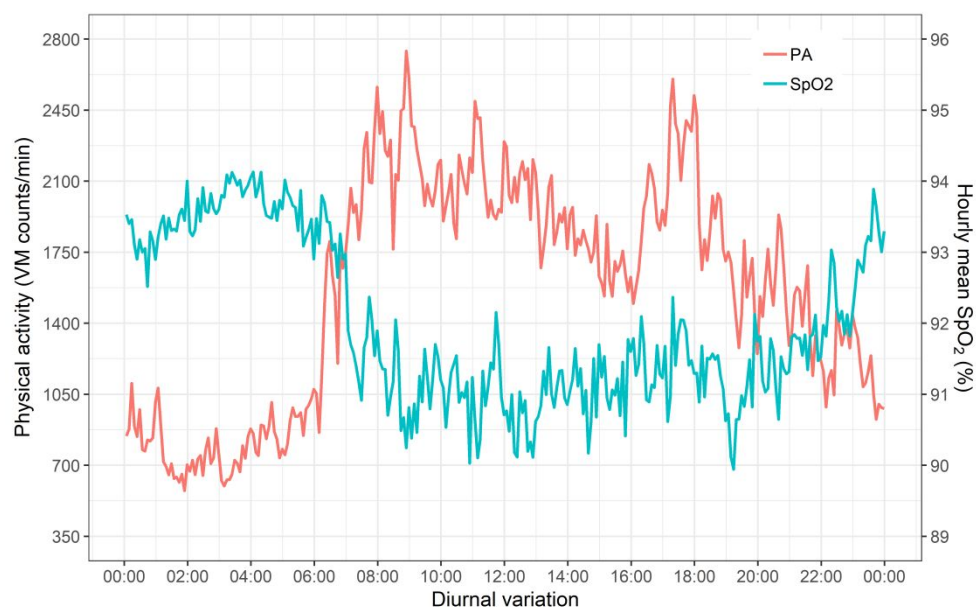


Figure S1: Diurnal variation of personal physical activity and SpO₂ levels averaged from all participants

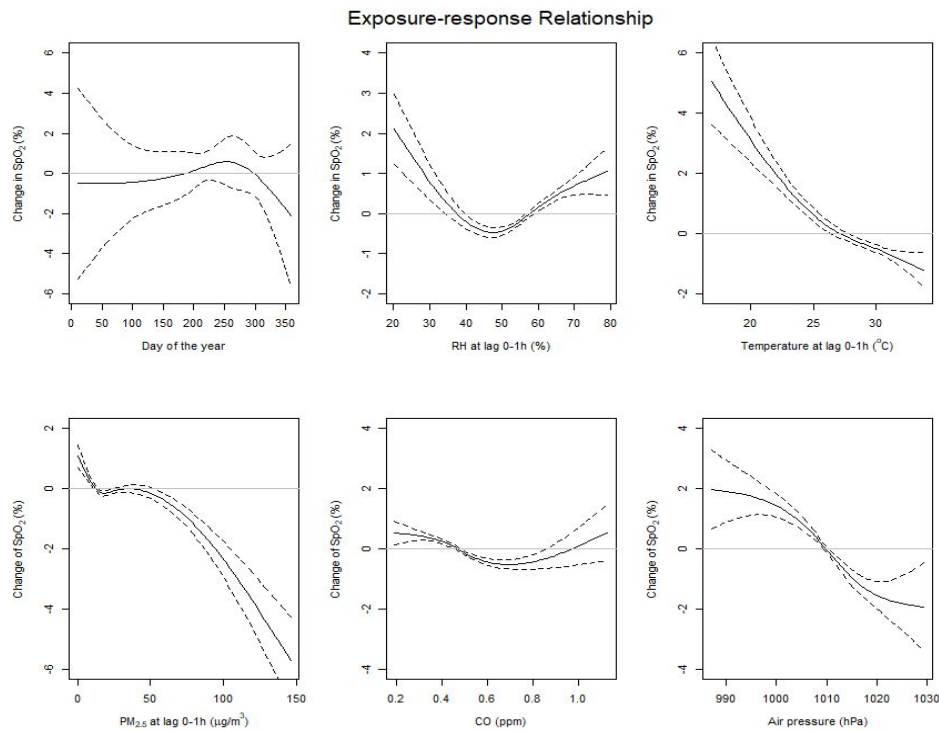


Figure-s2 Exposure-response relationships between the change in SpO₂ and each environmental exposure

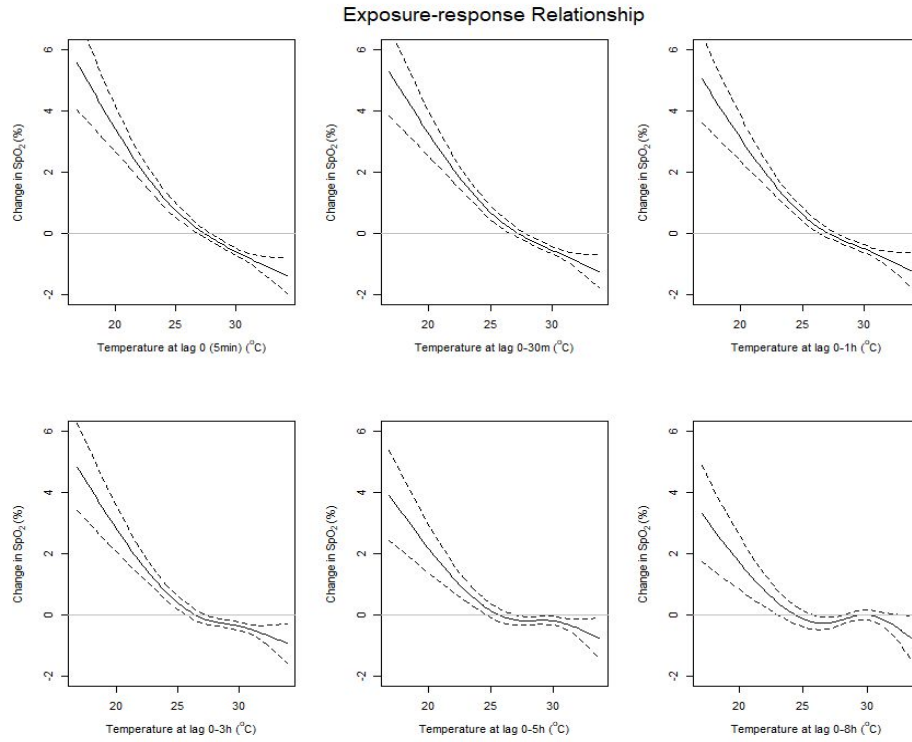


Figure S3 Exposure-response relationships between the change in SpO₂ and personal temperature exposure at different lags

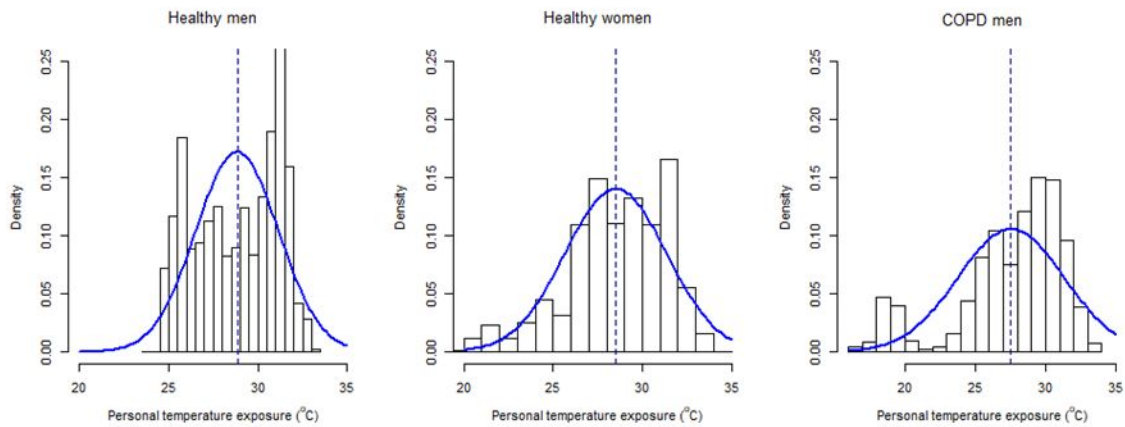


Figure S4 Distribution of personal temperature exposure among healthy men, women and COPD men, respectively. (The vertical dotted line is the mean value of temperature)

Questionnaire on Medical history and Medication

Medical history

- Have a doctor or other medical staff ever said that you had the following diseases?

Diabetes Mellitus?	<input type="radio"/> Yes	<input type="radio"/> No
High thyroid hormone, Graves' disease (exophthalmopathy) or overactive thyroid?	<input type="radio"/> Yes	<input type="radio"/> No
Low thyroid hormone or inactive thyroid?	<input type="radio"/> Yes	<input type="radio"/> No
Stroke, ischemia or hemorrhage?	<input type="radio"/> Yes	<input type="radio"/> No
Parkinson's disease?	<input type="radio"/> Yes	<input type="radio"/> No
Hypertension?	<input type="radio"/> Yes	<input type="radio"/> No
Heart attack, coronary or myocardial infarction?	<input type="radio"/> Yes	<input type="radio"/> No
Angina pectoris?	<input type="radio"/> Yes	<input type="radio"/> No
Congestive heart failure or enlarged heart?	<input type="radio"/> Yes	<input type="radio"/> No
COPD, chronic bronchitis, asthma or emphysema?	<input type="radio"/> Yes	<input type="radio"/> No
Glaucoma?	<input type="radio"/> Yes	<input type="radio"/> No
Cataract?	<input type="radio"/> Yes	<input type="radio"/> No

Medication or Supplements

- Do you take medicines or other healthy foods such as vitamins, supplements, or Chinese herbal medicines every day?

Please list the medicines and supplements:

Drugs/Chinese herbs/Supplements	Prescribed by a doctor?	How long to take?
a.	<input type="radio"/> Yes <input type="radio"/> No	
b.	<input type="radio"/> Yes <input type="radio"/> No	
c.	<input type="radio"/> Yes <input type="radio"/> No	
d.	<input type="radio"/> Yes <input type="radio"/> No	
e.	<input type="radio"/> Yes <input type="radio"/> No	
f.	<input type="radio"/> Yes <input type="radio"/> No	
g.	<input type="radio"/> Yes <input type="radio"/> No	
h.	<input type="radio"/> Yes <input type="radio"/> No	
i.	<input type="radio"/> Yes <input type="radio"/> No	
j.	<input type="radio"/> Yes <input type="radio"/> No	