Supplementary Material

Indoor Environmental Quality in Portuguese Office Buildings: Influencing Factors and Impact of an Intervention Study

Fátima Felgueiras [1,2], Zenaida Mourão [3], André Moreira [2,4] and Marta F. Gabriel [1,*]

[1] LAETA-INEGI, Associated Laboratory for Energy and Aeronautics-Institute of Science and Innovation in Mechanical and Industrial Engineering, Rua Dr. Roberto Frias 400, 4200-465 Porto, Portugal; ffelgueiras@inegi.up.pt

[2] Laboratory for Integrative and Translational Research in Population Health (ITR), EPIUnit, Institute of Public Health, University of Porto, Rua das Taipas 135, 4050-600 Porto, Portugal; andremoreira.fmup@gmail.com

[3] INESC TEC, Institute for Systems and Computer Engineering, Technology and Science, Rua Dr. Roberto Frias, 4200-465 Porto, Portugal; zenaida.mourao@inesctec.pt

[4] Serviço de Imunoalergologia, Centro Hospitalar Universitário São João and Basic and Clinical Immunology Unit, Department of Pathology, Faculty of Medicine, University of Porto, Al. Prof. Hernâni Monteiro, 4200-319 Porto, Portugal

* Correspondence: mgabriel@inegi.up.pt; Tel.: +351-229578626

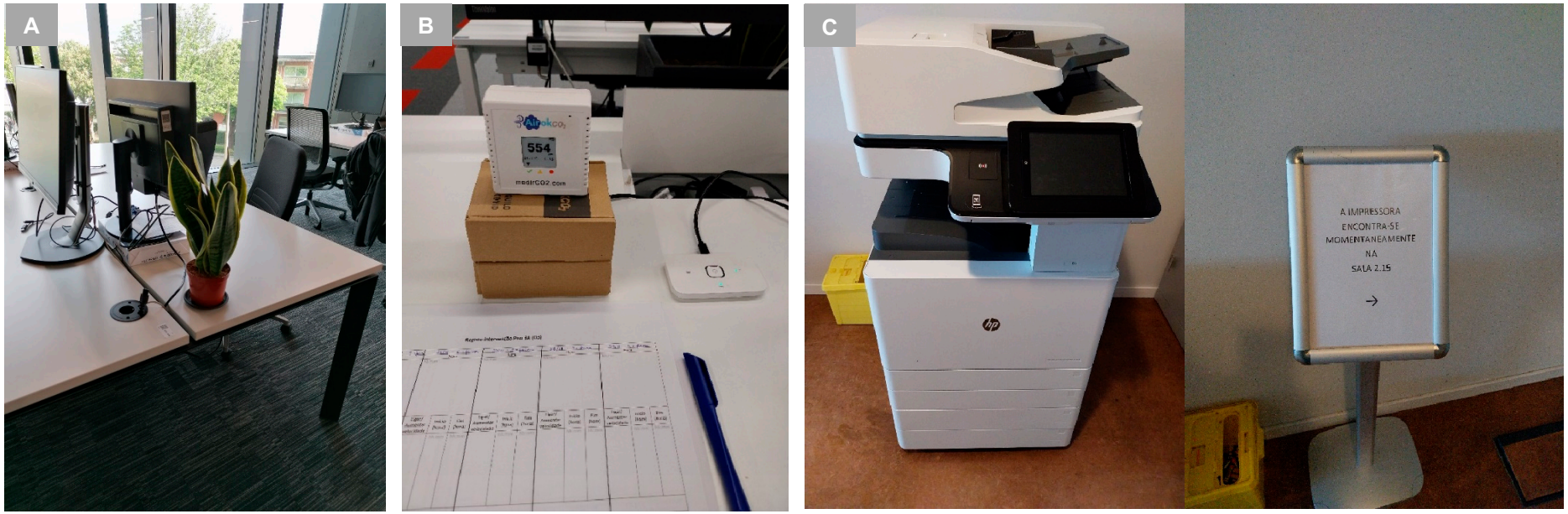

Figure S1. Implementation of the environmental intervention program: A) introduction of indoor plants, B) CO_2 sensors, and C) source control (printer removal).

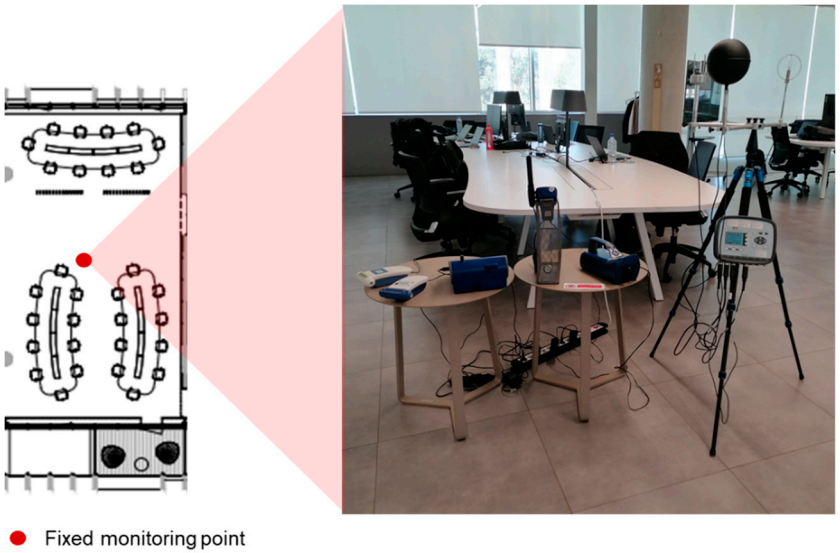

Figure S2. Example of the equipment position in the office space.

Table S1. Specifications of the nondispersive infrared AirokCO2 sensor.

Parameters	**Range of operation**	**Accuracy**
CO_2	400 to 5000 ppm	30 ppm or 3% reading
Temperature	0 to 50°C	± 0.5 °C
RH	0 to 85%	± 3 %
Pressure	300 to 1000 hPa,	± 1 hPa

CO_2, carbon dioxide; RH, relative humidity.

Table S2. Specifications of the equipment used in the IEQ assessments.

Parameters	Equipment (model, brand, country)	Range of operation	Accuracy
Indoor air quality			
$PM_{2.5}$, PM_{10}	DustTrak DRX aerosol monitor (8533, TSI, USA)	0.001 to 150 mg/m^3	±0.1% of reading or 0.001 mg/m^3 [a]
UFP	P-Trak portable condensation particle counter (8525, TSI, USA)	0.02 to 1 µm at a concentration range from 0 to 5 × 10^5 pt/cm^3	n.p.
CO_2, CO	IAQ-CALC monitor (7545, TSI, USA)	CO_2: 0 to 5 000 ppm CO: 0 to 500 ppm	CO_2: ±3% of reading or ±50 ppm[a] CO: ±3% of reading or ±3 ppm[a]
O_3	Aeroqual instrument, gas-sensitive semiconductor sensor (Series 500 IAQ, New Zealand)	0 to 0.15 ppm	<±0.005 ppm
VOC	Aeroqual instrument, VOC photoionization detector (Series 500 IAQ, New Zealand)*	0 to 30 ppm	<±0.02 ppm + 10%
Thermal comfort			
T_a, RH	IAQ-CALC monitor (7545, TSI, USA)	T_a: 0 to 60°C RH: 5 to 95%	T_a: ±0.6°C RH: ±3.0%
T_a, RH, T_g, T_w, V_a [b]	Thermal microclimate data logger (HD 32.1, Delta OHM, Italy)	T_a: -40 to 100°C RH: 0 to 100% T_g: -10 to 100°C T_w: 4 to 80°C V_a: 0.1 to 5 m/s	T_a: 1/3 DIN RH: ±1.5% (0 to 90%) ±2% (90 to 100%) T_g:1/3 DIN T_w: class A V_a: ± 0.2 m/s (0.1 to 1 m/s) ± 0.3 m/s (1 to 5 m/s)
Lighting conditions			
Illuminance	Lux meter (545, Testo, Germany)	0 to 100 000 lux	±3%
Acoustic conditions			
LAeq, LCpeak	Sound level meter (Solo, 01dB, France), MCE 212 microphone	30-137 dB(A)	According to IEC 61672-1

CO, carbon dioxide; CO_2, carbon dioxide; LAeq, A-weighted sound level (average); LCpeak, C-weighted peak sound level; n.p., not provided; O_3, ozone; PM, particulate matter; RH, relative humidity; T_a, air temperature; T_g, globe temperature; T_w, wet bulb temperature; UFP, ultrafine particles; V_a, air velocity; VOC, volatile organic compounds.

[a] Whichever is greater; [b] To calculate PMV, predicted mean vote and PPD, predicted percentage of dissatisfied.

*VOC sensor's response factor (RF) provided a sensitivity measure relative to isobutylene (RF=1).