ESCOLA SUPERIOR DE TECNOLOGIA DA SAÚDE DE LISBOA
INSTITUTO POLITÉCNICO DE LISBOA

HTRC Health and Technology Research Center

IDI&CA INVESTIGAÇÃO, DESENVOLVIMENTO, INOVAÇÃO E CRIAÇÃO ARTÍSTICA POLITÉCNICO DE LISBOA

C²TN

Is the sleep structure vulnerable to indoor air contaminants?

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What do we Know?

1. Sleep has a vital role in human welfare [1]
2. Low ventilation rates [2]
3. Breathing zone closer to potential sources of pollutants [3]
4. Lack of studies about indoor exposure during sleep

1. Assefa, S. Z et al. “The functions of sleep.” 2015
2. Canha, N. et al. “Impact of biomass home heating, Cooking Styles, and Bread Toasting on the Indoor Air Quality at Portuguese Dwellings: A Case Study.” 2018
3. Spilak, M.P., et al. “Impact of bedding arrangements, pillows, and blankets on particle resuspension in the sleep microenvironment.” 2014

Principal aim

The present study aimed to assess IAQ during sleep along with sleep's quality in order to evaluate the associations between IAQ and sleep parameters.

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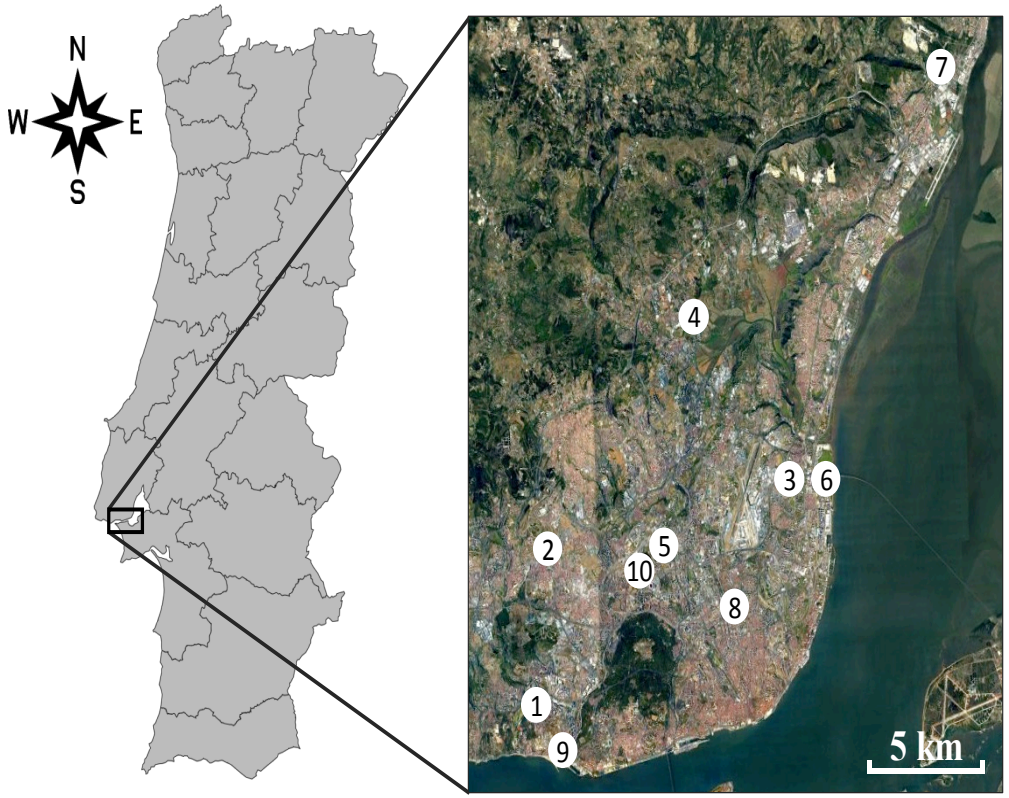
Study Design

- Ten volunteers men
- Healthy, non-smokers, aged between 25 – 45 years old (self-reported)
- With no history of sleep disturbances or medication that could interfere with sleep (self-reported)
- Without children that could interfere with parent´s sleep quality

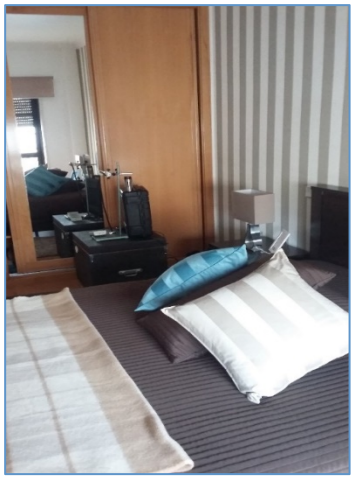
Study design



- Dwellings were located in Lisbon urban area
- Data collection was performed during the cold season (2017)

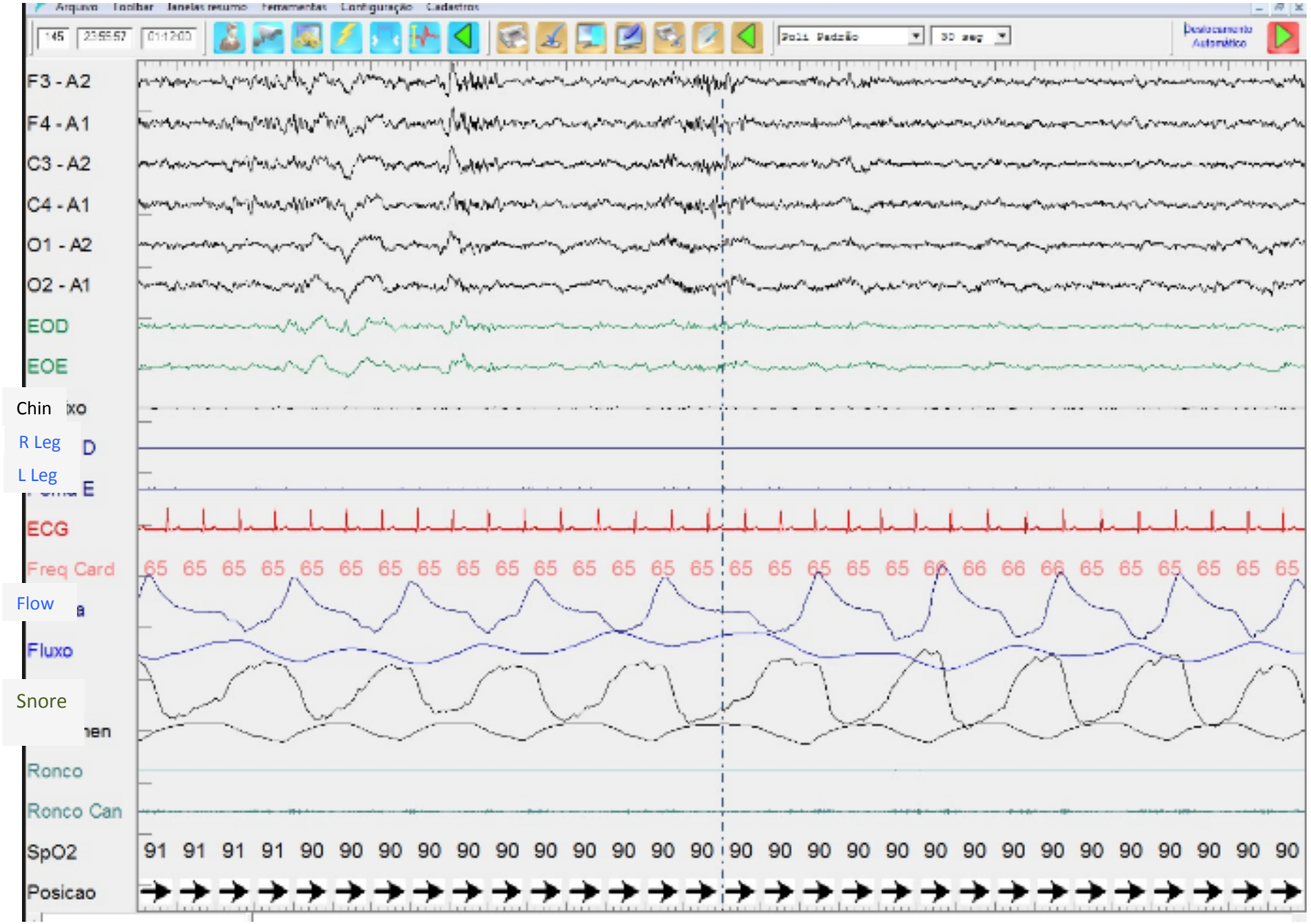
Study Design

- Bedroom IAQ Monitoring:
  - Three weeknights in a row
  - Multi-pollutant assessment:
    - Physical: temperature and relative humidity
    - Chemical: carbon dioxide, carbon monoxide, formaldehyde, volatile organic compounds, particulate matter – PM_{10} and $PM_{2.5}$
    - Microbiological: fungi and bacteria

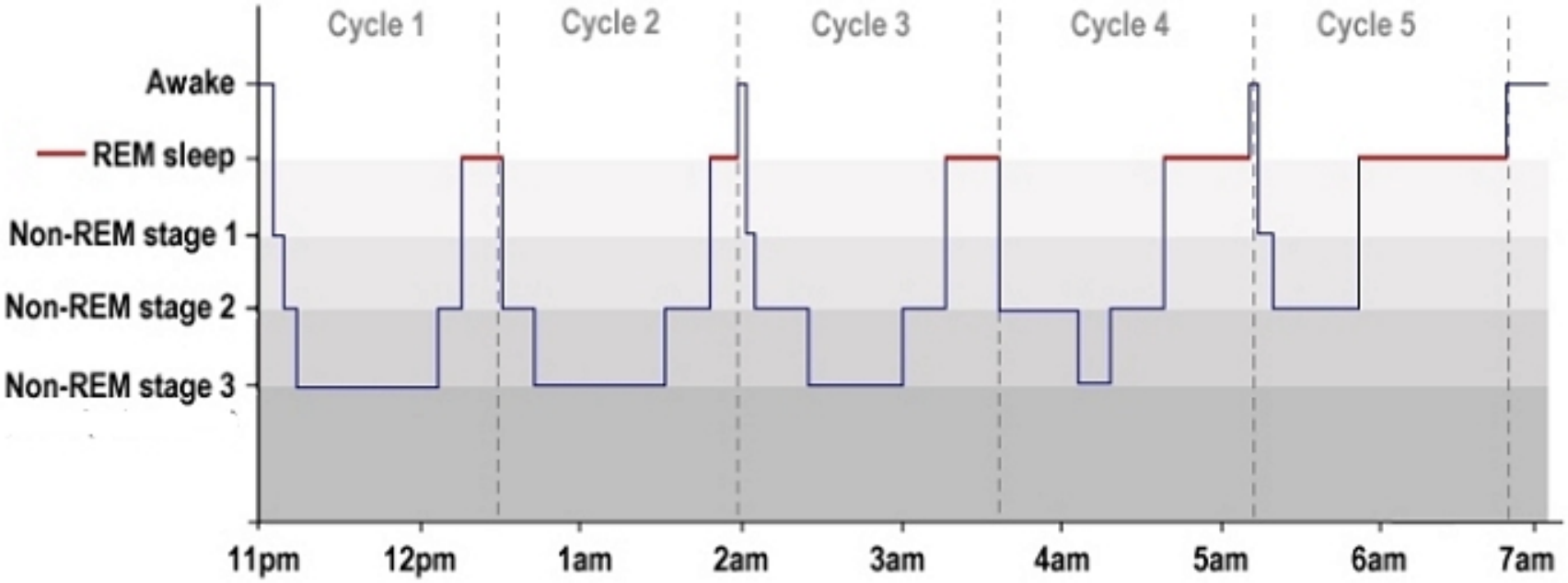


Study Design

- Sleep Monitoring
  - Self-reported questionnaires
    - Berlim Questionnaire − Sleep Apnea screening
    - Pittsburgh Sleep Quality Index − Identify subjects with “good” or “bad” sleep quality
  - Sleep Poligraphy (Two weeknights in a row) − a multi-physiological exam that allow us to asses:
    - Sleep structure
    - Respiratory events
    - Moviment events
    - Cardiac events


F3 - A2
F4 - A1
C3 - A2
C4 - A1
O1 - A2
O2 - A1
EOD
EOE
Chin
R Leg
L Leg
ECG
Freq Card
Flow
Fluxo
Snore
Ronco
Ronco Can
SpO2
Posicao

Normal sleep structure



Non-REM Stage 1 – 5% of the total of sleep time; superficial sleep

Non-REM Stage 2 – 50% of the total of sleep time; restorative function

Non-REM Stage 3 – 15%-20% of the total of sleep time; deep sleep

REM Stage –25% of the total of sleep time; active sleep

NREM sleep and REM sleep

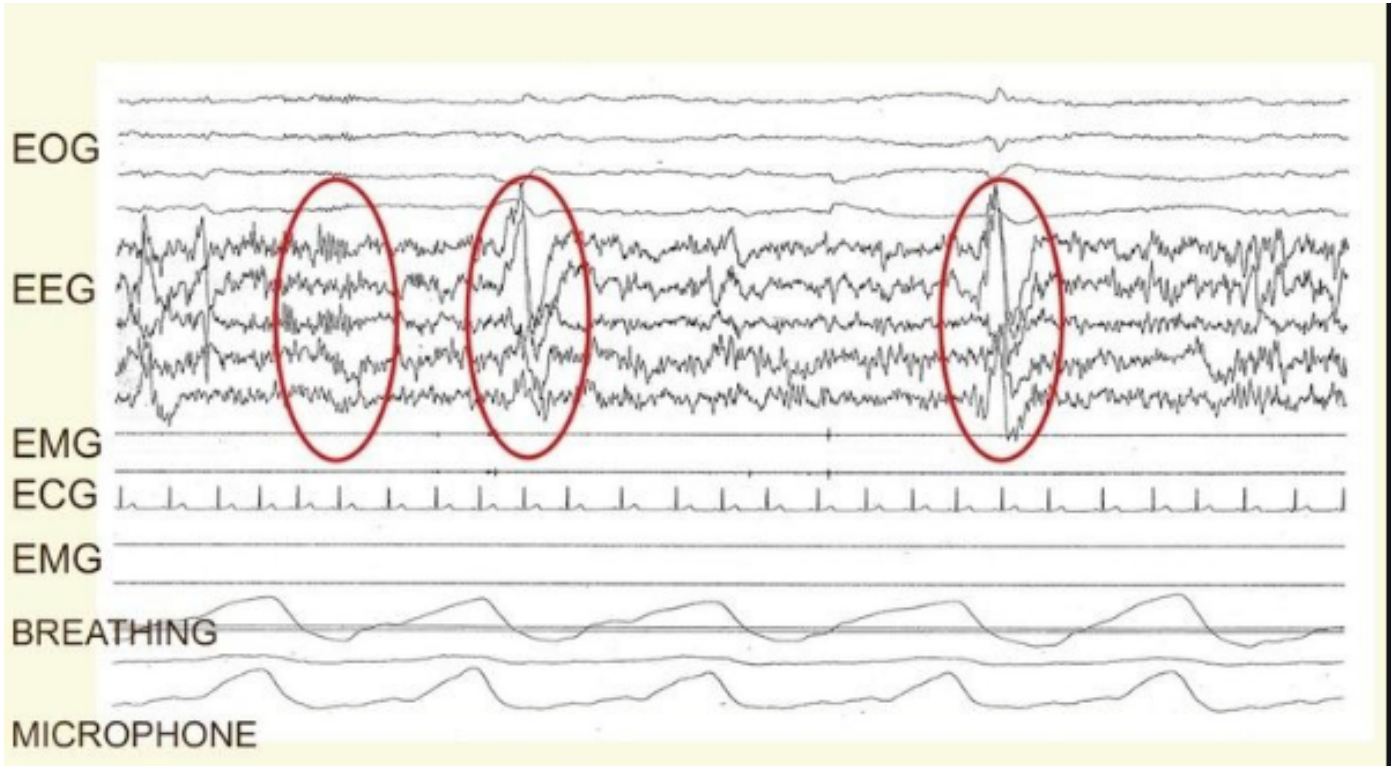
- NREM
  - Decrease of heart rate, breath frequency and arterial pressure (parasympathetic nervous system)

- REM
  - More variability of heart rate, breath frequency and arterial pressure (sympathetic nervous system)

Results - Associations

Sleep parameter		IAQ parameter	Association
Standard deviation of **Heart Rate Frequency (HRF)** mean		PM_{10}	rs=.583; p=.099
		$PM_{2.5}$	rs=.600; p=.088
HRF Acceleration Index	REM Sleep	CO	rs=.643; p=.085
	N-REM Sleep	CO	rs=.627; p=.096
Respiratory Rate	REM Sleep	**Relative Humidity**	rs =-.816; p<.05
		Temperature	rs =.680; p=.093
	N-REM Sleep	**Relative Humidity**	rs =-.678; p<.05

Neurophysiological features



K-complex: K-complex is an evoque potencial, as a response of an external stimulus

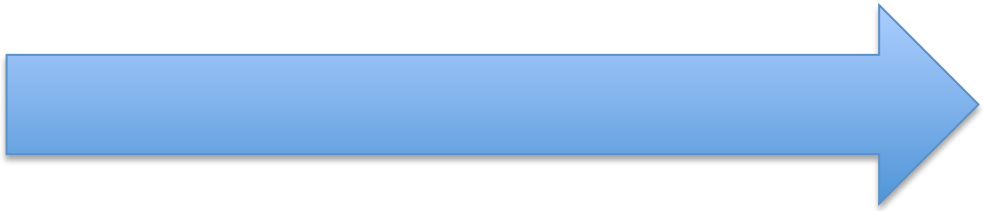
Results - Associations

Sleep parameter		IAQ parameter	Association
Sleep Structure	Stage 2 NREM Sleep	Fungi	rs = -.753; p<.050
	K complex	Fungi	rs = 833; p<.05
		Bacteria	rs = .752; p<.050

Final consideration

- Does the exposure to some pollutants really contributes to increase the influence sympathetic nervous system during sleep?

- Does the microbiological agents contribute to the impairment of sleep structure?



Future research project

- Funding from IPL
- Students from a student resident
- Goal: 40 volunteers

THANK YOU FOR YOUR ATENTION