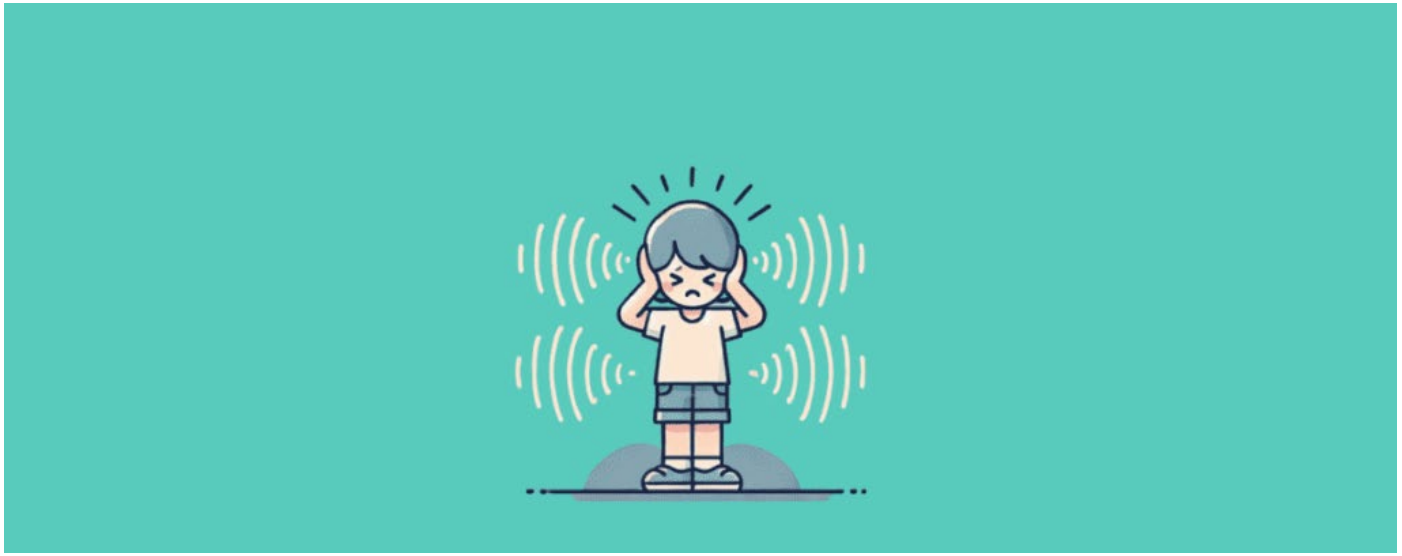
UNIT 26

Health problems caused by physical pollutants. Noise and radiation.



Julio Madrigal Matute (julio.madrigal@uv.es)
Ramón & Cajal Researcher. Group Leader, Onconutrition Lab.

Thanks for the survey

What did you like most about this first semester?

What did you like least?

What would you change or improve for the next part of the course?

What would you change or improve for the next part of the course?

Outside speaker? Would people come to class?

Prepare yourselves for a class?

Join this Wooclap event

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Event code
YBAHHI

Enable answers by SMS

WHAT DO I NEED TO LEARN FROM THIS TOPIC?

- ✓ The concept of environmental contamination
- ✓ The concept of non-ionising radiation
- ✓ Health effects of UV
  - ➢ Measures to control the UV harm
- ✓ Health effects of noise
  - ➢ Measures to control the noise harm

45 min

OVERVIEW

- ✓ **Environmental physical contamination:**
  - a. **Non- ionising radiation**
    - **UV**
  - b. **Noise**

- ✓ **Conclusions**

OVERVIEW

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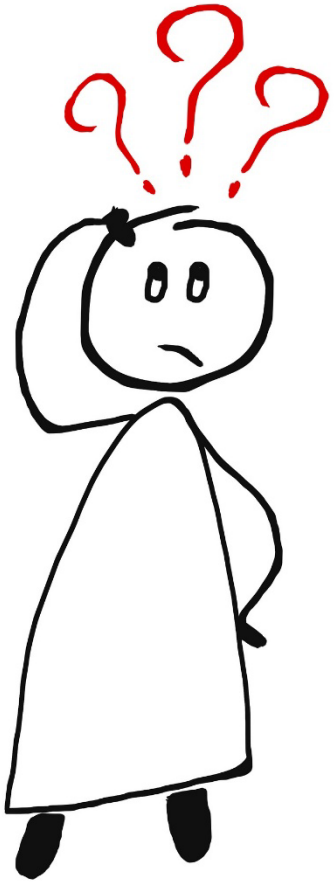
ENVIRONMENTAL CONTAMINATION



ENVIRONMENTAL CONTAMINATION

Environment

From old French: ‘state of being environed’ (see environ (v.) + -ment); meaning the ‘aggregate of the conditions in which a person or thing lives’.

Contamination

contaminacioun, ‘infection’, from Medieval Latin contaminationem (nominative contaminatio). ‘to defile, to corrupt, to deteriorate by mingling’, originally ‘to bring into contact’, from contamen ‘contact’.

ONLINE ETYMOLOGY DICTIONARY

ENVIRONMENTAL CONTAMINATION

Substances that cause high risk to both the **environment** and **human health**.

ENVIRONMENTAL CONTAMINATION

Pressures on the environment may occur through:

- chemical
- **physical**
- biological agents

Physical:

- radiation and electromagnetic fields (ionising and **non-ionising**)
- acoustic fields (**noise** and vibrations)

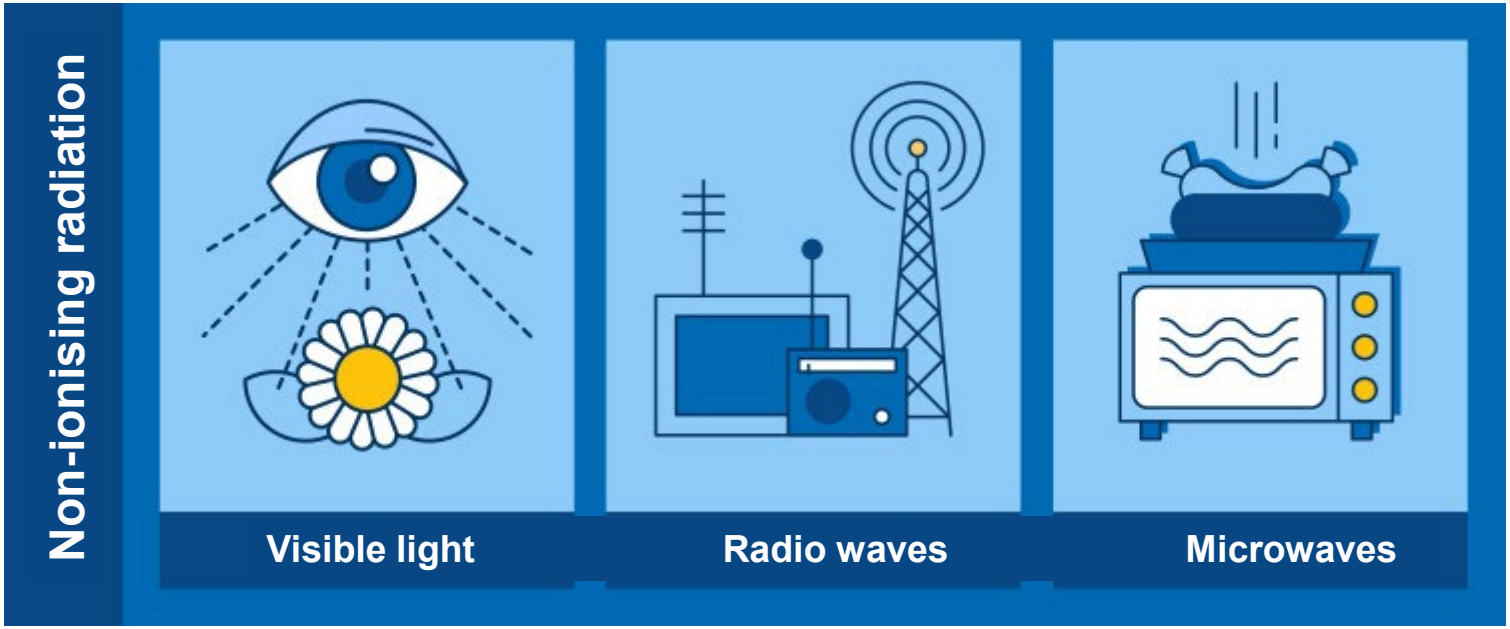
OVERVIEW

- ✓ **Environmental physical contamination:**
  - a. **Non-ionising radiation**
    - UV
  - b. Noise
- ✓ Conclusions

ENVIRONMENTAL PHYSICAL CONTAMINATION

Non-ionising radiation

- ✓ **Does not have enough energy** to produce ionisation, that is, it cannot remove electrons from atoms or molecules.



ENVIRONMENTAL PHYSICAL CONTAMINATION

Non-ionising radiation

- ✓ Non-ionising radiation (NIR) **does not have enough energy** to produce ionisation; that is, it cannot remove electrons from atoms or molecules.

- ✓ These electromagnetic radiations encompass a **very broad energy** range (**SPECTRUM**).

ENVIRONMENTAL PHYSICAL CONTAMINATION

Non-ionising radiation

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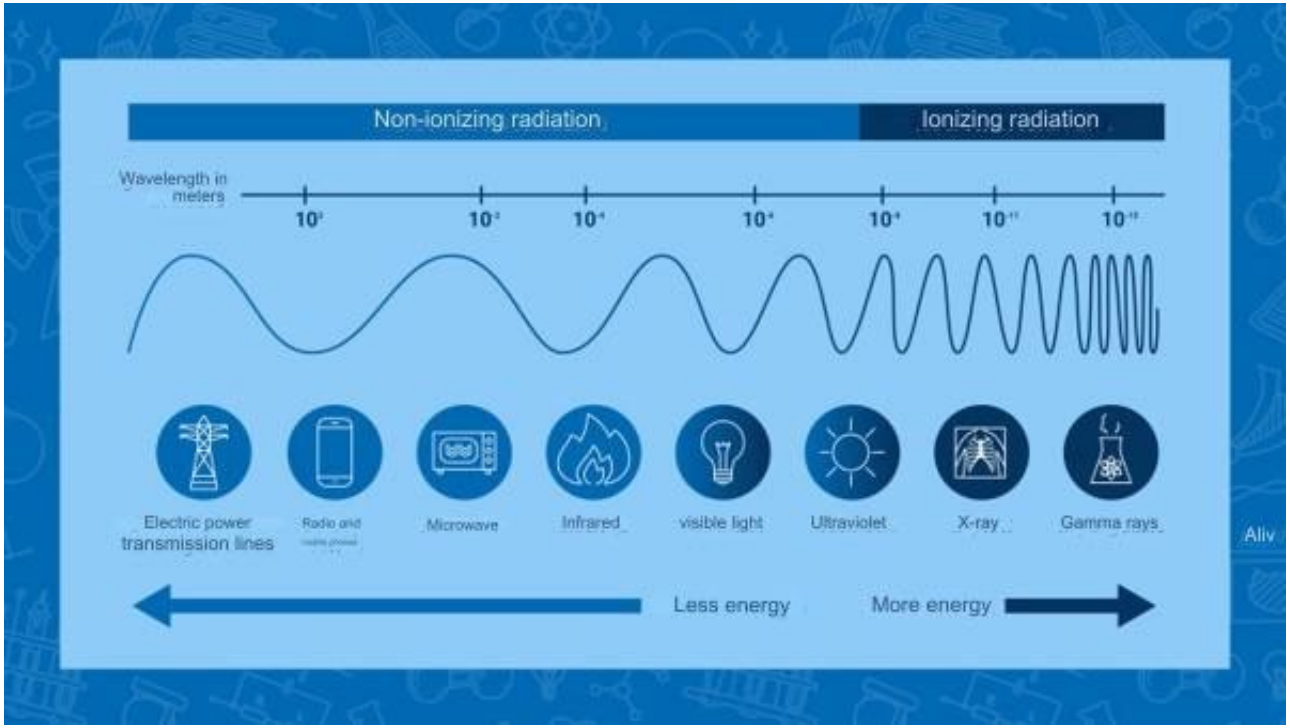


ENVIRONMENTAL PHYSICAL CONTAMINATION

Non-ionising radiation

- ✓ Non-ionising radiation (NIR) **does not have enough energy** to produce ionisation, that is, it cannot remove electrons from atoms or molecules.
- ✓ These electromagnetic radiations encompass a **very broad energy** range (**SPECTRUM**).
- ✓ These radiations affect health according to the frequency of the wave and the temporal exposition.
- ✓ **Classification** depends on its energy.

ENVIRONMENTAL PHYSICAL CONTAMINATION

INR classification

FREQUENCY

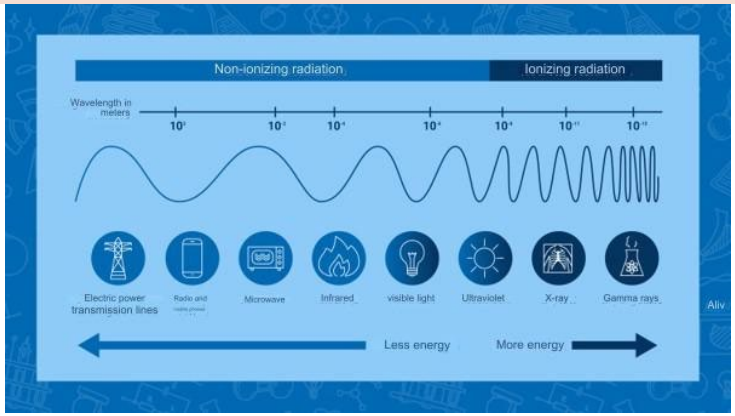
ULTRAVIOLET ……. 3000 - 750THZ

VISIBLE …… 750 - 385THZ

INFRARED …… 385 - 0.3THZ

MICROWAVE …….. 300 - 0.3GHZ

RADIO FREQUENCY …… 300 - 0.1 MHZ



OVERVIEW

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ENVIRONMENTAL PHYSICAL CONTAMINATION

RNI - Ultraviolet

Depending on its wavelength, several subtypes of UV are identified:

Name	Abbreviation	Wavelength (nm)	Energy per photon (EV)
Ultraviolet A (long wave)	UVA	400 – 315	3.10 – 3.94
Near ultraviolet	NUV	400 – 300	3.10 – 4.13
Ultraviolet B (medium wave)	UVB	315 – 280	3.94 – 4.43
Medium ultraviolet	MUV	300 – 200	4.13 – 6.20
Ultraviolet C (short wave)	UVC	280 – 100	4.43 – 12.40
Far ultraviolet	F.U.V.	200 – 122	6:20 – 10:16
vacuum ultraviolet	VUV	200 – 10	6.20 – 124
Lyman-alpha line	H Lyman-α /Ly-α	122 – 121	10.16 – 10.25
Extreme ultraviolet	EUV	121 – 10	10.25 – 124

ENVIRONMENTAL PHYSICAL CONTAMINATION

RNI – Ultraviolet: sources

- The UV radiation that **most concerns us is UV-B**, as it has the greatest impact on the skin and is one of the **most harmful**.
- The UV radiation that affects us the most on a daily basis is **UV-A**.
- In terms of danger, the order is: UV-C > UV-B > UV-A.

ENVIRONMENTAL PHYSICAL CONTAMINATION

RNI – Ultraviolet: sources

- **Sun source:** UV-C, UV-B, and UV-A reach the Earth.
  - ✓ UV-C is absorbed in the atmosphere (ozone layer).
  - ✓ UV-B is partially absorbed (90%).
  - ✓ UV-A has a high penetrance capacity and reaches the surface.

✓ **Other sources:** Solar lamps, tanning beds, and germicidal lamps

ENVIRONMENTAL PHYSICAL CONTAMINATION

RNI – Ultraviolet: prevention

- ✓ Eye protection
- ✓ Legislation
- ✓ Fight against pollution (ozone layer)
- ✓ Research
- ✓ Skin protection
  - Behaviour
  - Genetics (skin colour and sun sensitivity)
  - Culture (clothing)

UV Index

Exposure Category	UV Range
Low	< 2
Moderate	3 to 5
High	6 to 7
Very High	8 to 10
Extreme	11 +

ENVIRONMENTAL PHYSICAL CONTAMINATION

Exposure Category	Index Number	Sun Protection Messages	Location
LOW	<2	You can safely enjoy being outside. Wear sunglasses on bright days. If you burn easily, cover up and use sunscreen SPF 15+. In winter, reflection off snow can nearly double UV strength.	Polar regions. Cloudy days or during the early morning and evening hours in most regions of the world

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MODERATE	3-5	Take precautions if you will be outside, such as wearing a hat and sunglasses and using sunscreen SPF 30+. Reduce your exposure to the sun's most intense UV radiation by seeking shade during midday hours.	Temperate zones during autumn or spring. Partly cloudy or lightly foggy days

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HIGH	6-7	Protection against sun damage is needed. Wear a wide-brimmed hat and sunglasses, use sunscreen SPF 30+ and wear a long-sleeved shirt and pants when practical. Reduce your exposure to the sun's most intense UV radiation by seeking shade during midday hours.	Beaches in the summer (Mediterranean). Midday with clear skies and at moderate altitudes

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ENVIRONMENTAL PHYSICAL CONTAMINATION

Ultraviolet radiation

Data and numbers

- **Skin cancers** are primarily caused by **exposure to ultraviolet radiation**, either from the sun or from artificial sources such **as tanning beds**.

- **In 2020, more than 1.5 million cases of skin cancer** were diagnosed worldwide, and more than 120,000 associated deaths from this cause were recorded.

- It is estimated that in the world there are **15 million people who have gone blind** due to cataracts, and **that 10% of these cases** may be due to **exposure to ultraviolet radiation.**

https://www.who.int/en/news-room/fact-sheets/detail/ultraviolet-radiation **WHO, 2022**

ENVIRONMENTAL PHYSICAL CONTAMINATION

Ultraviolet radiation

Data and numbers

- **Excessive sun exposure in children and adolescents** can contribute to **skin cancer** in adulthood.
- We need some exposure to ultraviolet rays, particularly to **make vitamin D**.
- There are simple and effective prevention measures. It is recommended to **protect yourself** from the sun when the **ultraviolet index is 3 or higher**.

https://www.who.int/en/news-room/fact-sheets/detail/ultraviolet-radiation

WHO, 2022

ENVIRONMENTAL PHYSICAL CONTAMINATION

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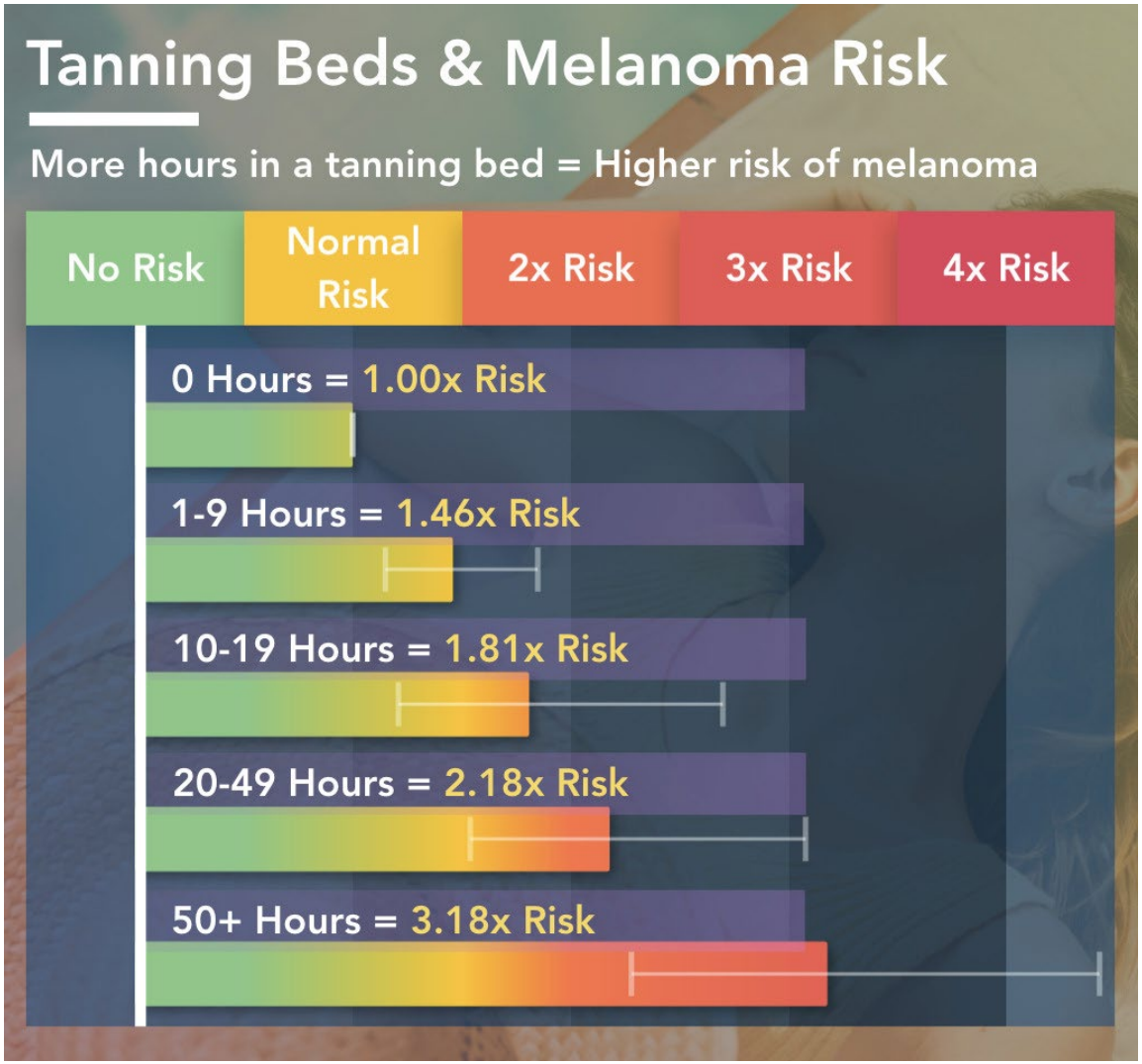


OVERVIEW

- ✓ **Environmental physical contamination:**
  - a. Non- ionising radiation
    - UV
  - **b. Noise**

- ✓ Conclusions

ENVIRONMENTAL PHYSICAL CONTAMINATION

Noise:

Unwanted sound. Annoying or unpleasant auditory sensation.

WHO: Considered the **most important environmental nuisance in industrialised** countries.

LITTLE ATTENTION given because of:

- Location
- Non-immediate danger
- Society progress

ENVIRONMENTAL PHYSICAL CONTAMINATION

Noise

Sources:

- **TRAFFIC:** road, aircraft, rail
- **INDUSTRY:** most frequent occupational risk factor
- **DOMESTIC OTHERS:** sirens, alarms

ENVIRONMENTAL PHYSICAL CONTAMINATION

EL PAÍS Science / Matter

GRANDSTAND

Noise makes people sick and is a public health problem

One in four people in Spain are exposed to high levels of noise pollution

MAPA ESTRATÉGICO DE RUIDO DE VALÈNCIA 2017

What is a noise map?

In accordance with the definitions and objectives in the **Act 37/2003 (November 17) on noise.**

Noise maps have, among others, the following objectives:

a) Enable **overall exposure assessment** to noise pollution in a given area

b) Enable **global predictions** for that area

c) Enable **action plans** in terms of noise pollution and, in general, of the **corrective measures** that are suitable.

ENVIRONMENTAL PHYSICAL CONTAMINATION

NOISE INDEX AND NOISE SOURCES

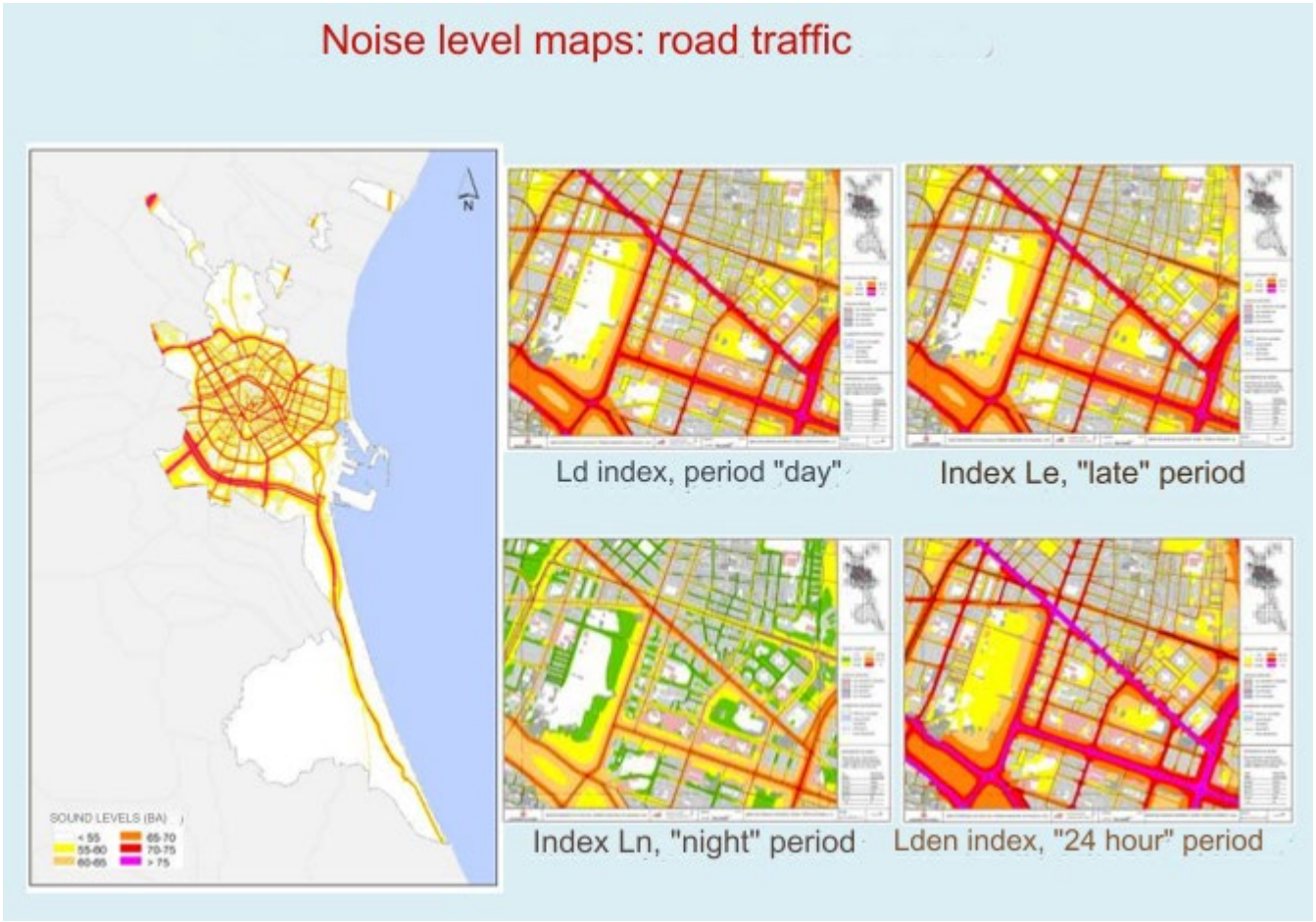
In the preparation of the **Strategic Noise Map of Valencia**, the following **sources of environmental noise** included in Royal Decree 1513/2005 were taken into account:

- Road traffic
- Rail traffic
- Places of industrial activity, including ports

For each noise source, maps corresponded to the following acoustic index:

- ✓ Lden = sound level day-evening-night
- ✓ Ld = equivalent sound level for the day (7 am to 7 pm)
- ✓ Le = equivalent sound level for the afternoon (7 pm to 11 pm)
- ✓ Ln = equivalent sound level for the night (11 pm to 7 am)

ENVIRONMENTAL PHYSICAL CONTAMINATION



ENVIRONMENTAL PHYSICAL CONTAMINATION

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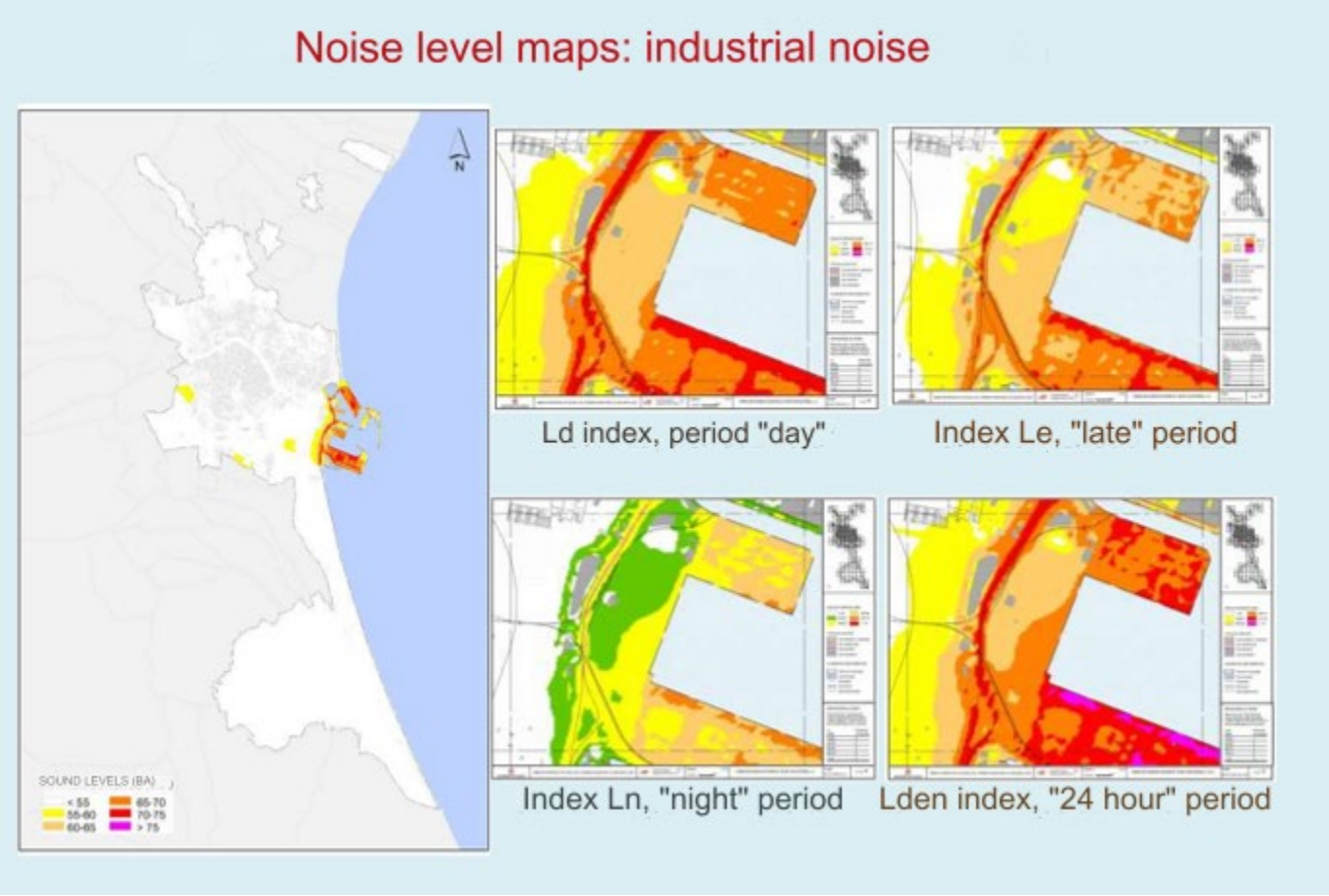
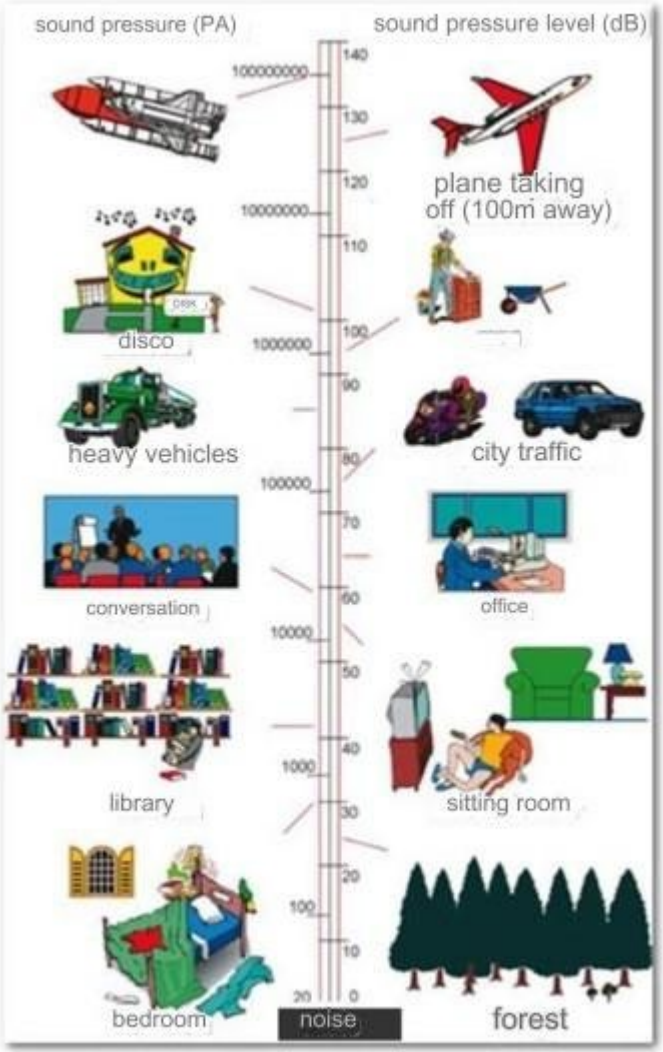


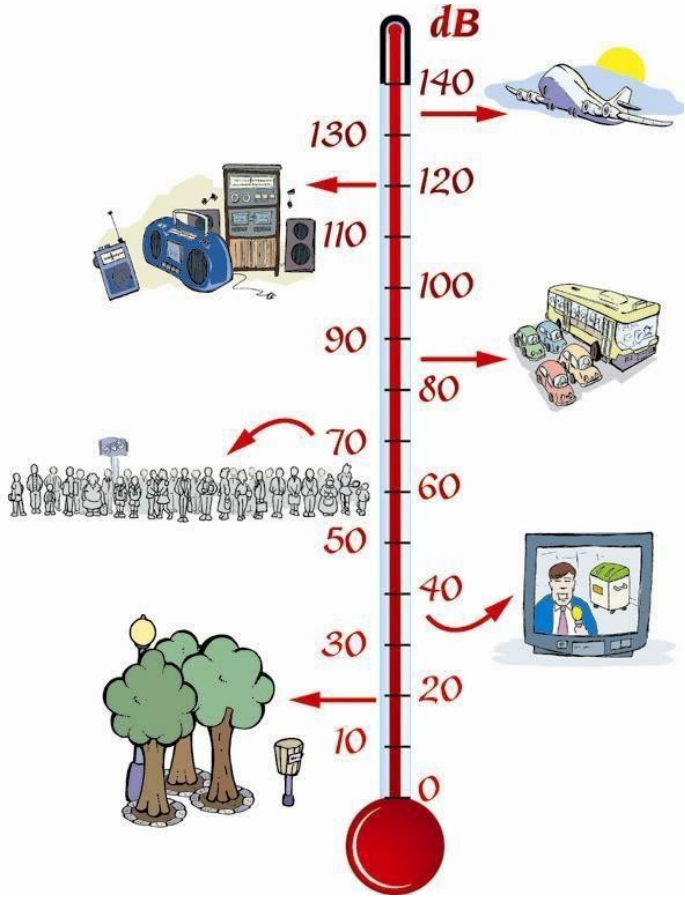
ENVIRONMENTAL PHYSICAL CONTAMINATION

ENVIRONMENTAL PHYSICAL CONTAMINATION

Noise thermometer



Source: Ministry of Agriculture, Food and Environment



ENVIRONMENTAL PHYSICAL CONTAMINATION

Noise auditory effects

- **Hearing loss**: temporary hearing loss (55-65 DbA), acute acoustic trauma (>150 Db), acoustic hearing loss (the most frequent irreversible occupational injury in the world) .
  - Acoustic trauma: if you listen to a noise for a long time, there comes a time when you no longer hear the sounds of those hertz.
- **Tinnitus:** (quality of life affectation) after extreme auditory stimulus (concerts, discos)
- **Cochlear recruitment**: abnormal perception of sound levels.

- 61,000 years of healthy life were lost in the EU due to disability (DALY-disability-adjusted life year).

ENVIRONMENTAL PHYSICAL CONTAMINATION

hear-it.org

ENVIRONMENTAL PHYSICAL CONTAMINATION

Effects of noise

ALT. SOCIAL BEHAVIOR — Annoyance, irritability, agitation. Aggressiveness, impotence, anxiety, depression. Changes in **sleep** (difficulty sleeping, interruption, lower sleep quality).

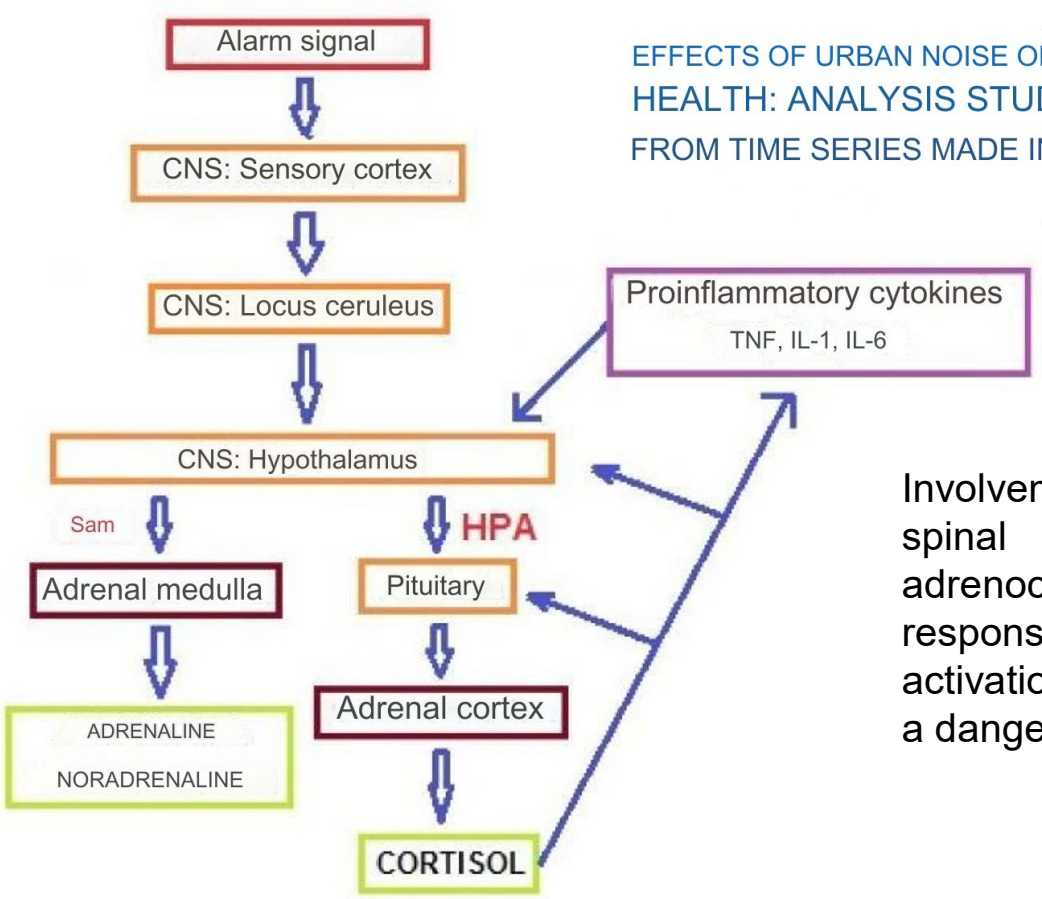
PHYSIOLOGICAL STRESS

- BP increase
- Increased cardiac function capacity (Fc)
- Vasoconstriction
- Increased blood viscosity (higher coagulation)
- Increased lipidemia and glycemia

- Immune system involvement. Cardiovascular effects (HTN, DM, AMI, stroke). Respiratory diseases (for **increased cortisol** → weakening of immune system for people over 65)

ENVIRONMENTAL PHYSICAL CONTAMINATION

GOBIERNO DE ESPAÑA | MINISTERIO DE ECONOMÍA Y COMPETITIVIDAD | Instituto de Salud Carlos III | ENSO Escuela Nacional de Sanidad



EFFECTS OF URBAN NOISE ON
HEALTH: ANALYSIS STUDIES
FROM TIME SERIES MADE IN MADRID

Involvement of the sympathetic-adrenal-spinal cord and hypothalamic-pituitary-adrenocortical axes in the physiological response to acute psychic stress, from the activation of the central nervous system to a danger or alarm signal

Recio-Martin et al., 2016

ENVIRONMENTAL PHYSICAL CONTAMINATION

Noise control / prevention:

- ✓ **Information and training**
- ✓ **Workplace evaluation**
- ✓ **Emitting focus:** spacing, coating, insulators, shock absorbers, machine lubrication, and scheduling
- ✓ **Transmission medium:** absorbent linings, screens, shields, booths
- ✓ **Receiver:** individual protection equipment, dosimeters, alarms, exposure time, early diagnosis, medical controls
- ✓ **Regulations ZAS zones** (acoustically saturated zones)

ENVIRONMENTAL PHYSICAL CONTAMINATION

Noise control

AJUNTAMENT DE VALENCIA

NEIGHBOURHOOD BEHAVIOR RULES

What noise levels do we not tolerate from our neighbours?

• We should not tolerate loud voices or shouting from our neighbors. We should not tolerate high levels of noise from radios and televisions.

• If our neighbors have pets, they must take the necessary measures to prevent disturbances to other neighbors.

• These disturbances are considered serious if they occur between the hours of 22 (10 pm) and 8 (8 am).

ENVIRONMENTAL PHYSICAL CONTAMINATION

Noise control

AJUNTAMENT DE VALENCIA

NEIGHBOURHOOD BEHAVIOUR RULES

Prohibitions

•It is strictly prohibited to carry out work and repairs that may cause noise and vibrations from Sunday to Thursday between 22 (10 pm) and 8 (8 am), and on Fridays, Saturdays, and the eves of public holidays from 22 (10 pm) to 9:30 (9.30 am).

ENVIRONMENTAL PHYSICAL CONTAMINATION

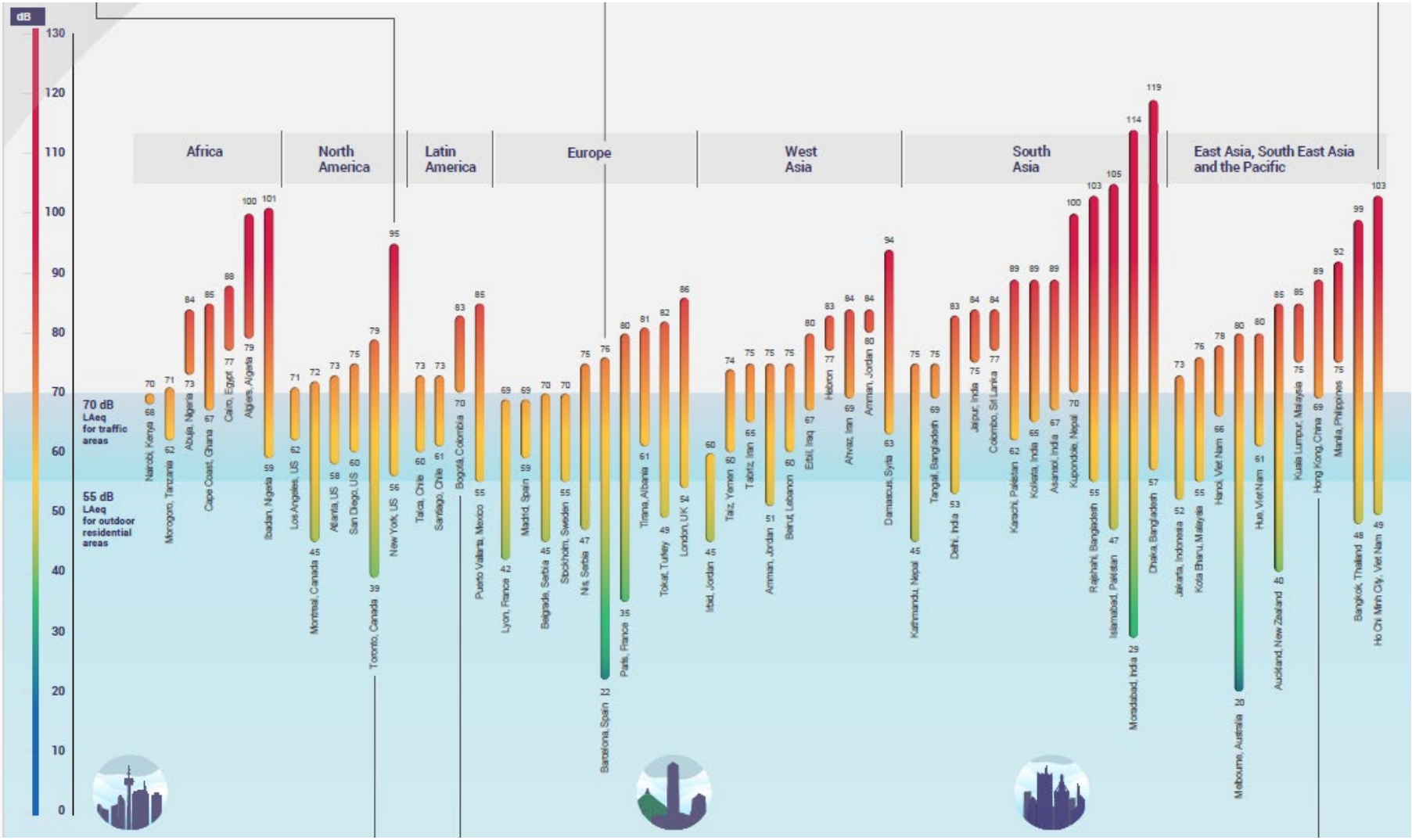
Noise control

The noisiest cities on the planet 11 May, 2017

- The European Environment Agency (EEA) states that noise in the European Union (EU) causes at least 10,000 premature deaths annually.
- Its harmful effects are mainly due to the stress reaction it provokes in the human body, which can also occur while sleeping.
- These effects can lead to premature death, cardiovascular diseases, cognitive impairment, sleep disorders, hypertension, and, at the very least, discomfort.

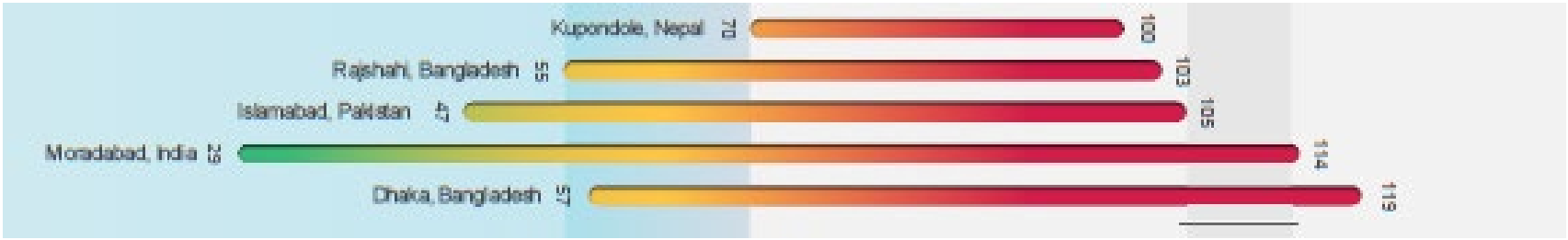
Noise causes at least **10,000 cases of premature deaths** annually in the EU

ENVIRONMENTAL PHYSICAL CONTAMINATION



ENVIRONMENTAL PHYSICAL CONTAMINATION

Noise control

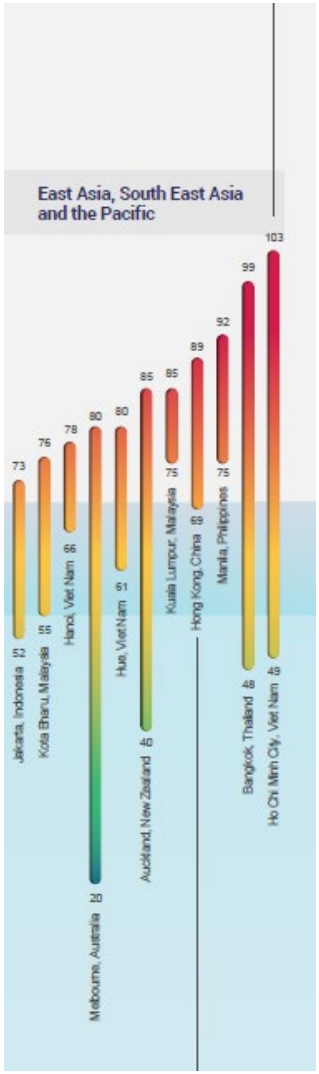


ENVIRONMENTAL PHYSICAL CONTAMINATION

Noise control

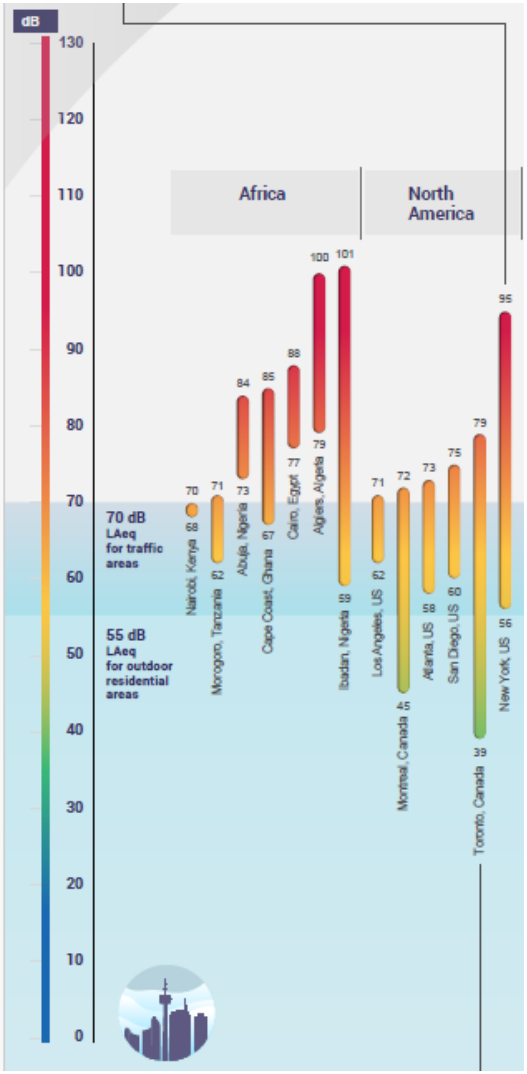
Ho Chi Minh City

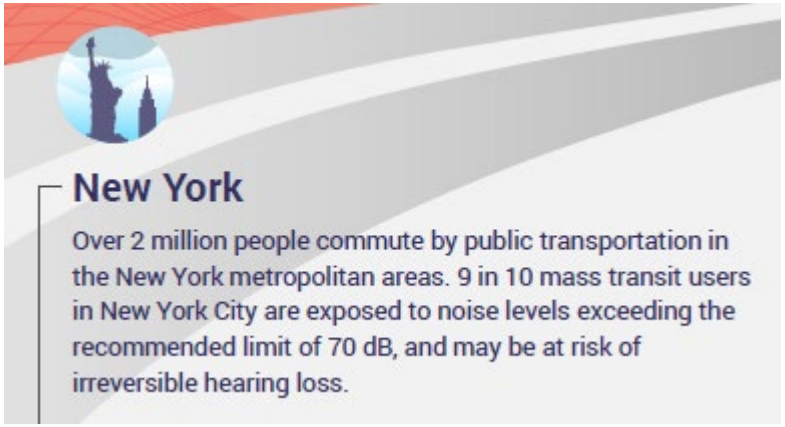
A study that followed cyclists riding over 1,000 km within the city showed that cyclists were exposed to noise levels of over 78 dB, which could damage hearing.



ENVIRONMENTAL PHYSICAL CONTAMINATION

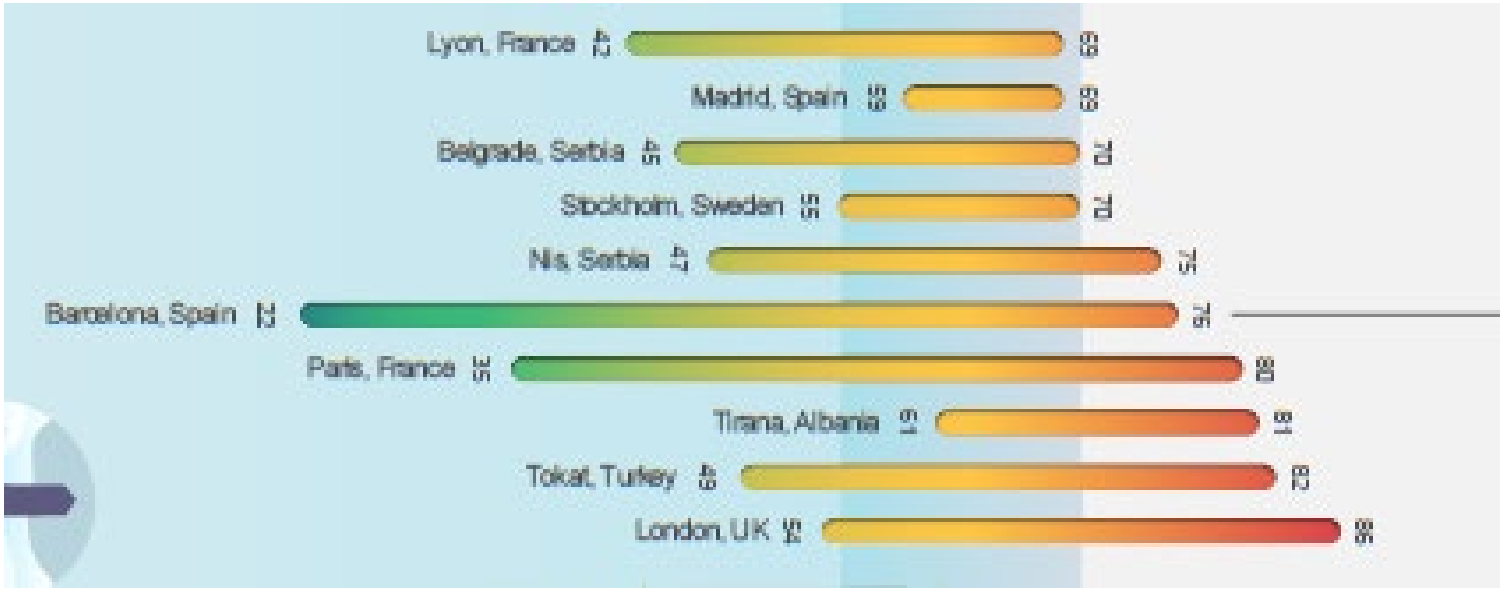
Noise control





ENVIRONMENTAL PHYSICAL CONTAMINATION

Noise control

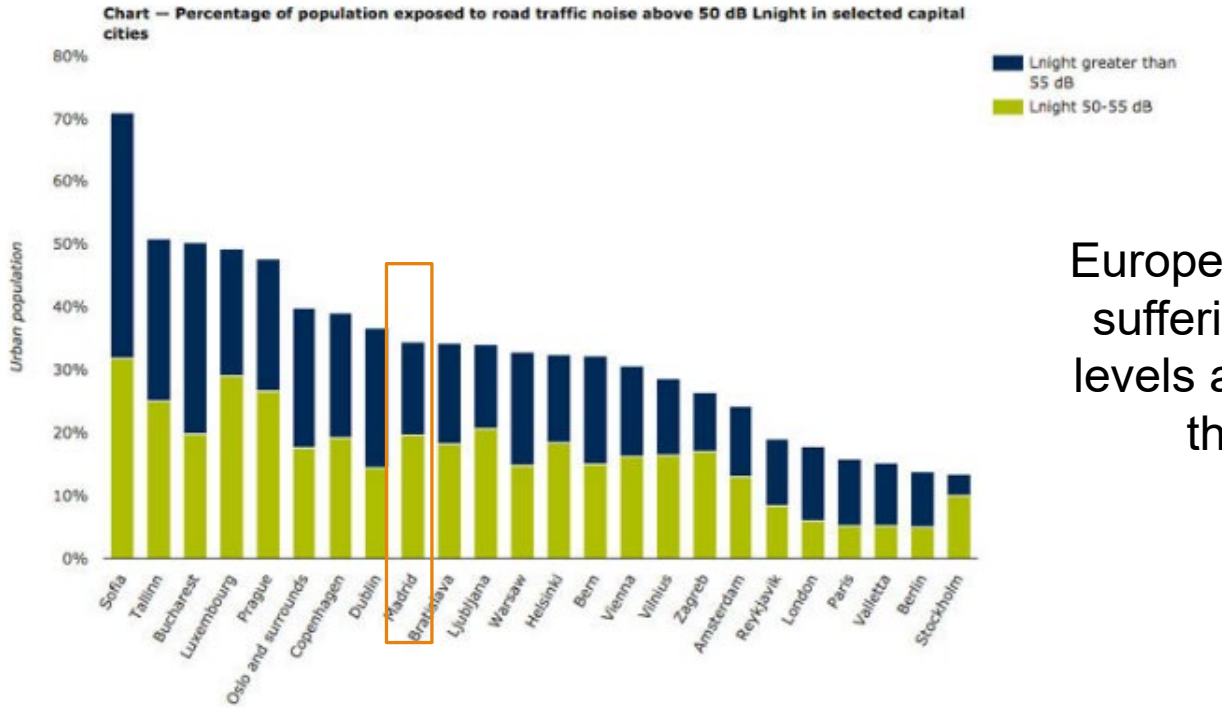


Barcelona

Over 72% of the city's residents are exposed to noise levels of over 55 dB. More than half of the residents of large European cities live in areas where noise levels may adversely affect their health and well-being.

ENVIRONMENTAL PHYSICAL CONTAMINATION

World Hearing Index



European populations suffering from noise levels at night greater than 50 dB

Imagen: AEMA

OVERVIEW

- ✓ **Environmental physical contamination:**
  a. Non- ionising radiation
     - UV
  b. Noise

- ✓ **Conclusions**

Conclusions

1. Non-ionising radiation (NIR)

- Does not have enough energy to ionize atoms, but can still cause health effects.
- UV radiation:

  UV-A: Reaches the Earth's surface most frequently and affects us daily.
  UV-B: Most harmful to the skin and is a major cause of skin damage and cancers.
  UV-C: Absorbed by the atmosphere and does not usually reach the Earth's surface.

2. Health impacts of UV radiation

- Leading cause of **skin cancer**, with over **1.5 million cases** diagnosed globally in 2020 and over **120,000 deaths**.
- **Cataracts** (potentially causing blindness)

3. Preventive measures against UV radiation

- Recommendations include protecting the skin, promoting research, and regulating exposure through legislation.

Conclusions

4. Noise pollution

Primary environmental issue, particularly in **industrialised nations**.

- **Sources of noise** include traffic (road, rail, air), industrial activities, and domestic sources like alarms and sirens.

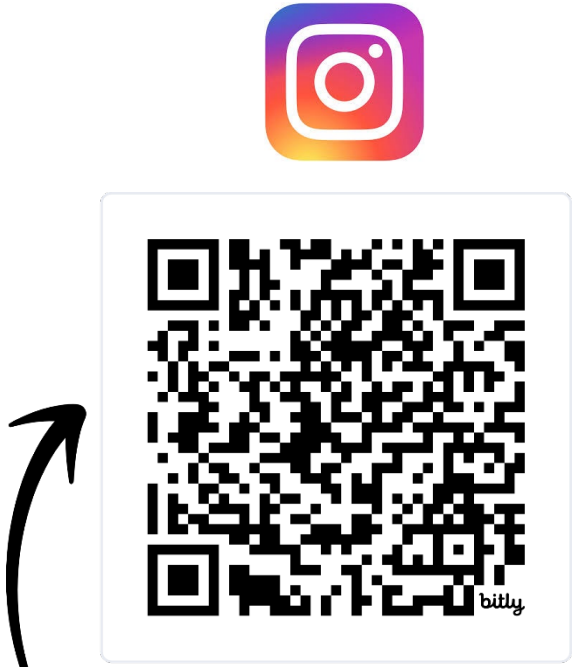
6. Health effects of noise

- **Hearing damage**, **cardiovascular, and physiological stress**.
- An estimated **10,000 premature deaths** annually in the EU.

7. Noise control and mitigation measures

- **Noise maps** and **strategic plans** are used to manage and reduce noise pollution in urban areas.

How was it?



UV Autophagy & Onconutrition Lab

Thanks a lot

Any questions?

Julio Madrigal Matute
Ramón & Cajal researcher

julio.madrigal@uv.es
Group Leader
Autophagy & Onconutrition Lab