Progetto Assegno ALOISI cofinanziato su PRIN

DURATA: 2 anni (12 mesi PRIN +12 mesi BIR)

**Titolo dell'assegno (in inglese):**

**Environmental and health impacts of air pollution: integrating the effects of aerosol exposure in a multiexposome study**

Breve descrizione dell'attività di ricerca (in inglese)

The World Health Organization (WHO) reports on the major air pollutants, namely particle matter (PM) pollution, carbon monoxide, sulfur oxides, and nitrogen oxides and about the serious threat to all living organisms and environment.

The particle matter produce toxic effects according to its chemical and physical properties and according to the living organism taken under examination. The components of PM10 and PM2.5 can be organic (polycyclic aromatic hydrocarbons, dioxins, benzene, 1-3 butadiene) or inorganic (carbon, chlorides, nitrates, sulfates, metals) in nature. PM is generally a complex and not homogeneous mixture containing also biological components (i.e. pollen grains, aeroallergens and spores) and uncharacterised components, usually derived by the entrance into the market of new materials. This is the case, for example, of graphene, graphene-like materials, and bidimensional nanomaterials (2D-Nms), the toxicity of which is still under evaluation.

Air pollutants may find their pathway to human exposure through multiple routes, including dermal contact and direct inhalation (direct exposure) as well as ingestion and ingestion of contaminated food (indirect exposure). All these routes account for the so-called “exposome”. The mechanisms for modelling and understanding the fate of air pollutants through atmospheric transport, deposition, bioaccumulation, and ultimate uptake by the human body are complex. Pollution prevention programs can be better engineered, pollution priorities can be identified, and greater environmental public health gains (attributable to pollution prevention) can be achieved by evaluating the exposome, as a single contaminant source often may represent only a fraction of a total pollutant burden.

The project aims to calculate the human dose contributions (both direct and indirect) by various pathways and to establish better techniques for health risk assessment. In particular:

1) Indirect exposure to PM will be studied in seed plants of agronomic interest. This research will be part to the PRIN 2D-NANO MAD PLANTS: Effects of 2D-nanomaterials on seed plants reproduction project. In detail, several 2D-Nms, possible future environmental pollutants, will be investigated for their potential cytotoxic effect. Plants will be used as biomarkers. Model and non-model seed plant species of high economic value (*Cannabis sativa, Corylus avellana, Nicotiana tabacum,* and *Zea mays*) will be tested for in vitro pollen germination and growth, pollen tube homeostasis of pH, ROS, and Ca2+, and pollen tube cytoskeleton in the presence of different concentrations of several 2D-Nms and PM. Moreover, the internalization of 2D-Nms by the pollen tube will also be investigated (WP1 of 2D-NANO MAD PLANTS). Finally, seeds derived from plants exposed to 2D-Nms will also be biochemically characterized in order to investigate this potential exposure pathway (WP3, Task 3.3 of 2D-NANO MAD PLANTS).

2) Direct exposure will be challenged by the development of an integrated wearable device for a continuous, integrated, and reliable health and environmental multiexposome monitoring. The project will implement a co-designed and co-developed wearable integrated array of devices and sensors combining external exposure and health data measurements for the detailed assessment of the personal exposome. The selection of sensors, hardware setup, evaluation metrics and inferences, and end user-specific applications are various stages to be tackled. Possibly, thanks to a collaboration with Sant’Orsola Hospital, clinical parameters, e.g. blood pressure, body temperature, plasma antioxidant level, and glucose levels will also be recorded through smart sensors, together with personal location (by GPS) in order to allow a continuous, real-time, real-world assessment of exposures.

3) Direct exposure will be challenged also by the design of a longitudinal cohort study, as it allows follow up of individuals and repeated sampling as well as monitoring during windows of increased sensitivity.

4) Protocol optimisation for the identification of reliable biomarkers in unconventional biological matrices and through non-invasive sample taking will be one of the goals of the project. A fundamental aspect of the exposome is to assess the occurrence and health impacts of environmental exposures through the identification of biomarkers, however the most existing evidence do not allow establishing a clear relationship between air exposure, intermediate effect biomarkers and NCDs. The solution herein tackled is to identify biomarkers in biological matrices that can be taken through non-invasive sampling, such as saliva, exhaled breath condensate, and tear samples. This goal will be achieved thanks to a collaboration with Sant’Orsola Hospital.

5) The R framework “rexposome”, which includes three Bioconductor packages: rexposome, omicRexposome and CTDquerier will be used to integrate the exposome with different omic layers and to provide some biological insights using exposome database.

Results will be disseminated to scientific community, students and young scientists, and public with scientific papers, contributions to conferences and seminars, contributing also to WP5 – Dissemination of results of 2D-NANO MAD PLANTS.