



Discussion



Impact of the environment on the health: From theory to practice

A.L. Carducci^a, A. Agodi^b, C. Ancona^c, P. Angelini^d, F. Bagordo^e, F. Barbone^f, L. Birbaum^g, V. Carreri^h, A. Casuccioⁱ, A. Conti^j, M. Conversano^k, A. De Donno^e, O. De Giglio^l, F. Desiante^m, A. Di Pietroⁿ, E. Dogliotti^o, F. Donato^p, G.M. Fara^q, M. Fiore^b, F. Forastiere^c, G. Giammanco^q, A. Izzotti^r, M.T. Montagna^l, G. Oliveri Conti^b, M.G. Petronio^s, S. Sciacca^b, C. Signorelli^t, E. Testai^u, M. Verani^a, M. Vinceti^v, F. Vitaleⁱ, M. Ferrante^{b,*}, The Attendees* (in alphabetical order) to the 56th Erice Course “Evaluation of the impact on environment and health: from theory to practice” and Contributors to the discussion and preparations of The Erice 56 Charter., G. Adani^v, L. Berghella^v, C. Calia^l, R. Calzolari^j, A. Canale^a, D. Castiglione^b, A. Conti^j, C. Copat^b, A. Cristaldi^b, G. Cuffari^j, G. Coronel Vargas^r, E. De Vita^a, F. De Nard^w, I. Federigi^a, T. Filippini^v, A. Grasso^b, N. Leonardi^x, M. Letzguš^w, G. Lo Bianco^y, W. Mazzuccoⁱ, I. Nicolosi^b, P. Orlandi^z, G. Paladino^b, S. Pizzoⁱ, C. Pousis^l, M. Raffo^z, S. Rivolta^w, F. Scarpittaⁱ, G. Trani^{aa}, F. Triggiano^l, A. Tumbarello^z, V. Vecchio^b, P. Zuccarello^b, M. Vassallo^b

^a Department of Biology, University of Pisa, Italy

^b Department of Medical Science, Surgical and Advanced Technologies “G.F. Ingrassia”, University of Catania, Italy

^c Department of Epidemiology of the Regional Health Service, Lazio Region, Rome, Italy

^d Public Health Service, Emilia-Romagna Region, Italy

^e Department of Biological and Environmental Sciences and Technologies, University of Salento, Italy

^f Department of Medicine, Surgery and Health Sciences, University of Trieste, Italy

^g Office of the Director, National Institute of Environmental Health Sciences, National Institutes of Health, Department of Health and Human Services, Research Triangle Park, NC, USA

^h Past-President of Italian Society of Hygiene (SItI), Italy

ⁱ Department of Health Promotion, Maternal and Infant Care, Internal Medicine and Medical Specialties, “G. D’Alessandro”, University of Palermo, Italy

^j Regional Agency for Environmental Protection of Sicily, Italy

^k Department of Public Health, ASL, Taranto, Italy

^l Department of Biomedical Sciences and Human Oncology, Section of Hygiene, University of Bari Aldo Moro, Italy

^m Department of Prevention, Local Health Authority of Taranto, Taranto, Italy

ⁿ Department of Biomedical and Dental Sciences and Morphofunctional Imaging, University of Messina, Italy

^o Department of Environmental and Health. Istituto Superiore di Sanità, Rome, Italy

^p Department of Medical and Surgical Specialties, Radiological Sciences, And Public Health, University of Brescia, Italy

^q International School of Epidemiology and Preventive Medicine “Giuseppe D’Alessandro”, Erice, Trapani, Italy

^r Department of Health Sciences, University of Genoa, Genoa, Italy

^s Health and Environment-Department of Prevention, Local Health Authority-Empoli, Florence, Italy

^t University Vita-Salute San Raffaele, Milan, Italy

^u Istituto Superiore di Sanità, Environment & Health Dept., Rome, Italy

^v Section of Public Health, Department of Biomedical, Metabolic and Neural Sciences, University of Modena and Reggio Emilia, Modena, Italy

^w University of Milan, Milan, Italy

^x University Center for the Protection and Management of Natural Environments and Agrosystems (CUTGAN), University of Catania, Italy

^y Freelance, Palermo, Italy

^z Local Health Authority of Rome, Italy

^{aa} Central Health Department of the Friuli Venezia Giulia Region, Trieste, Italy

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ABSTRACT

* Corresponding author.

E-mail address: marfer@unict.it (M. Ferrante).

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The Erice 56 Charter titled “Impact of the environment on the health: from theory to practice” was unanimously approved at the end of the 56th course of the “*International School of Epidemiology and Preventive Medicine G. D’Alessandro*” held from 3rd to November 7, 2019 in Erice – Sicily (Italy) and promoted by the Study Group of “Environment and Health” of the Italian Society of Hygiene, Preventive Medicine and Public Health. The course, that included lectures, open discussions and guided working groups, was aimed to provide a general training on epidemiological and toxicological aspects of the environmental health impact, to be used by public health professionals for risk assessment, without forgetting the risk communications. At the end of the course 12 key points were agreed among teachers and students: they underlined the need of specific training and research, in the perspective of “One Health” and “Global Health”, also facing emerging scientific and methodological issues and focusing on communication towards stakeholders. This Discussion highlight the need to improve knowledge of Health and Environment topic in all sectors of health and environmental prevention and management.

1. The charter

The 56th course of the “*International School of Epidemiology and Preventive Medicine G. D’Alessandro*” titled “Evaluation of the impact on environment and health: from theory to practice”, held in Erice - Sicily from November 3rd to November 7th 2019, has focused on the understanding of the complex dynamics of the relationship between the environment and health, and how to study it through epidemiology and toxicology. The course has also addressed to the methodologies of Health Impact Assessment (HIA) and Integrated Assessment of Environmental and Health Impact (IAEHIA), without forgetting the crucial role of risk communication (Carducci et al., 2019).

Both Teachers and Attendees, at the end of the course, have unanimously agreed on upon the Erice 56 Charter, titled “Impact of the environment on the health: from theory to practice” (Ettore Majorana Foundation, 2019).

2. Discussion

According to the World Health Organization (WHO), some structural remedial measures could reduce overall mortality by almost 20% (Prüss-Üstün et al., 2016). It is therefore vitally important also in our country to deal with environmental and health issues. In the last 30 years central and local institutions have organized many training activities on Health and Environment relationship. However, the operators of the National Health Service (NHS) and the National Environmental Protection System (NEPS) still suffer, particularly in some Regions, from the absence of an organic and shared training activities that may provide the necessary cognitive tools. Knowledge, languages and common practices in environmental health risk assessment are, to date, still lacking, with negative consequences on the services and activities of general public health professionals. The situation is further worsened by the lack of training also at university level, in both degree courses and post-graduate courses: the issue “Environment and Health” is absent or only marginally addressed at every level of university educational courses. In European countries this aspect is missing or not sufficiently debated, in fact, the school European educational programmes, and teaching activities related to environmental education, environmental sustainability and green economy are well carried out, but no health aspects are still integrated to these course programmes (EU Commission, 2019; WHO, 2015).

The European “environment and health” process fosters a common concern for the future of health and the environment within a very large number of global and regional developments and frameworks relevant to both sectors, however, this forecast tendency isn’t coupled to adequate educational training at all levels (WHO, 2015). A better organizations of degree courses is available in USA universities, as many as 19 American universities have courses on “Environment and health” as Master and degree courses. Instead, a lowest number of courses in Canadian and Chinese programs are found.

The 2017 Inter-ministerial Conference on Environment and Health in Ostrava stimulated the Governments and Ministries of the Environment

and Health of the European Region to collaborate more and work together, especially on the topic of training (WHO-UNECE, 2017). In Italy, the National Prevention Plan (2014–2018) has also included the theme “Environment and Health” inside its activities, so the collaboration between the NHS and the NEPS appears to be essential for integrated efficient and effective activities useful for a global disease prevention.

At the end of 2017, the Ministry of Health set up an “Environment and Health task force”, composed of representatives of the two Ministries concerned, experts on issues coming from all Italian regions and from the various national and regional institutions involved, in order to identify both the most critical executive issues and lacks of knowledge about this topic in the relevant sectors such as the public sector (NHS and NEPS), the Family Practice Doctor, also named as General Practitioners (GPs) or Family Physician, and the Paediatricians, in university training during the degree course and in post-graduate specialization, and to make proposals operating in the various sectors in environmental health. These public health professionals can foster advocacy with patients, improving the correct lifestyles.

It was also formulated a proposal of training “environment and health” curriculum that can be modulated for different subjects, such as operators of the public system (NHS, EPS), GPs and PFC, Schools of Specialization (especially Hygiene and Public Health, but also Occupational Medicine, Toxicology, Cardiology, Pneumology), Schools of medicine, biology and other scientific courses such as geology, physics, etc ..., but also business and law courses for their implications in the management of environment and health relation.

It cannot be ignored that on the theme Environment and Health there are numerous critical aspects in Italy about the attribution of competences between structures of the Regional Environmental Protection Agencies and the National Health Services. General training on these aspects is still insufficient and heterogeneous, and evident inter-regional differences that require action programs and coordinated, coherent and non-sectoral training.

Moreover, it is absolutely fundamental that epidemiology and toxicology work together in risk assessment of environmental agents. Only epidemiological and toxicological data intersection would permit straightforward conclusions with regard to a causal relationship between environmental agents and health effects.

To correctly perform epidemiological studies in the themes of health and environment, we start from the environment and population available data and from the identification of the appropriate study design to be applied and then consider the confounders, the mediators and the effect modifier factors. We then consider all the confounding and modification factors, evaluating the results with more adequate methodological criteria, no longer related to statistical significance testing and *p* values (significant or not) and going beyond simple calculation of relative measures of effect (such as relative risks) to discuss the observed effect size.

In this context, the molecular epidemiology and the use of early indicators of environmental damage may allow a deeper understanding of the dynamics that regulate the impact of risk factors on the aetiology of

diseases (Weston and Harris, 2003; Rossner et al., 2015; Domingo et al., 2020).

Today, we also have to take in account the complexity of the exposition (exposome) and the complexity of the metabolic, genetic and immune responses to it (Wild CP, 2005; Ferrante and Conti, 2017; Wang et al., 2019).

Among the various risk factors, there is no doubt that air pollution (Fang et al., 2020) and its interrelations with climate change are among the most important and widely studied problems (Signorelli et al., 2019; Khaniabadi et al., 2017; Wang et al., 2019). In this perspective, it is of primary importance to apply the well known dose-response function of exposure to air pollution to evaluate the impact of different scenarios related to interventions and policies (Capolongo S et al., 2018; Oliveri Conti et al., 2017; Herrero et al., 2020).

The transition from environmental and toxicological data to the estimation of the health impact of environmental origin requires the understanding of the entire path of pollutants, from sources of human contamination to exposure assessment (Shaffer et al., 2019; Bocca et al., 2020).

Although the research in this field has produced a huge amount of data, the precise definition of risk determinants and the quantification of their impacts are still far from being complete. Often the methodologies themselves are questioned: this is the case of the use of statistical significance/null hypothesis testing in epidemiology (Amrhein et al., 2019), or the approach for the definition of dose response relations (Forastiere et al., 2014). The production of evidence through meta-analyses is also affected by the uncertainty related to the different methods applied, however, to reduce the chance of arriving at misleading conclusions, guidelines on the conduct and reporting of systematic reviews were recently published and easily available (Hutton et al., 2015; Morgan et al., 2019).

The segregation among disciplines, the separation of environmental and health protection institutes and the separate consideration of lifestyles (Fiore et al., 2019) and environmental risk factors (Ledda et al., 2017; Ferrante et al., 2018; Conte et al., 2016) has till now hampered a complete understanding of the complexity of the interactions between environmental and health.

In general, the prevention of the diseases of environmental origin requires a complex effort of action both on behaviors and lifestyles, and on the institutional rules and measures that make it possible to guarantee the safety of the population exposed to environmental risks (Graham and White, 2016).

Epidemiologic studies suggest that a Mediterranean diet, an antioxidant-rich cardioprotective dietary pattern, delays cognitive decline (Valls-Pedrett et al., 2018) and counteracts the toxic effects of some contaminants. Also, the Mediterranean diet, should be seen as extremely and incomparable healthy, affordable and environmentally sustainable food model (Serra-Majem et al., 2018).

Kolb and Martins, for e.g., carried out a meta-analysis on factors contributing to diabetes risk, including aspects of diet quality and quantity, little physical activity, increased monitor viewing time or sitting in general, exposure to noise or fine dust, short or disturbed sleep, smoking, stress and depression, and a low socioeconomic status. Multiple mechanistic pathways were detected come into play including environmental exposures and lifestyles (Kolb and Martin, 2017).

Food quality, however, can be influenced by environmental aspects so, a correct communication of health risks is a real tool of prevention strengthening the preventive aspects of the diet through more conscious and correct eating habits (Filippini et al., 2020; Zuccarello et al., 2019; Oliveri Conti et al., 2020; Razzaghi et al., 2018; Copat et al., 2018).

Therefore, it is now the time that researchers and institutions multiply their efforts towards an integrated approach for the protection both of environment and health, following the "One Health" perspective (Mackenzie and Jeggo, 2019) and the principles of sustainable development (WHO, 2020).

With this perspective, the Istituto Superiore di Sanità (ISS, Rome -

Italy) has published recent guidelines on HIA (GLHIA), to be applied in the context of DLgs 104/2017, implementing the directive 2014/52/EU (Dogliotti et al., 2019). They must be disseminated to the public health professionals, through a training facing the methodologies of risk assessment and their integration. Even if these regulations limit the HIA to particular industrial plants (Crude oil refineries, gasification and liquefaction plants, thermal power plants and other combustion plants with a thermal power exceeding 300 MW), we propose that a HIA approach must be adopted in many different contexts and situations, and carried out by public health professionals. In fact, a HIA must be included in the context of different procedures required by national and EU regulations: Environmental Impact Assessment (EIA), Integrated Environmental Authorization (IEA), Strategic Environmental Assessment (SEA) and Integrated Environmental and Health Assessment (IEHA).

Because the primary mission of public health professionals is the health protection and promotion, they are involved in every step of risk management, including the risk communication that has a crucial role in collective and individual choices and is determinant for the effectiveness of interventions. Public health professionals have generally a technical profile and background (as medical doctors, biologist, chemists, physics), which in their university training did not include communication studies. On the other hand, when they face environmental problems, they should be prepared to understand communication dynamics and to produce adequate communication plans and messages. Currently, a gap can be observed between technicians and public in the context of a general mistrust: technicians think people cannot understand the complexity and the public think that science is not neutral but related to private interests. So, a key role is entrusted to participation: all efforts are to be conducted to strengthen the relationships among the different stakeholders. The regulations concerning HIA require public information and involvement that need the knowledge of specific methodologies and approaches, including the understanding of risk perception and its determinants (WHO, 2013).

In the scenarios and applications of the HIA the study of local experiences permits to going into the specific problems that the actual normative lack poses. The hygienic-sanitary risk linked to the discharge of wastewater on soils related to the fact that supply destined for human consumption often draws from groundwater (Darai et al., 2020; Dettori et al., 2016), especially in regions poor in water bodies ((SCA.Re.S. Project, 2019-2020). This phenomenon causes a pauperization of groundwater bodies at a disadvantage of water quality, often subject to marine intrusion, or conditioned by the hydrogeological characteristics of the territory, by anthropic, agricultural and industrial activities or by natural events of pollution such as for e.g. cyanobacteria blooms (Zuccarello et al., 2020) or volcanic eruptions and gas releases (Radon222) (De Giglio et al., 2016, 2017; Keramati et al., 2018; Fakhri et al., 2016).

Among the polluting factors, an important role is represented by wastewater discharges, which are not always compliant with the current legislation. Although the purification processes of these waters have the task of containing the spread of pathogenic microorganisms with known and emerging chemical contaminants such as endocrine disruptor and microplastics and including disinfectants byproducts by drinking water treatment (Feretti et al., 2020), today cases of contamination due to the use of raw or inadequately purified wastewater are still reported.

Urban Health is a fundamental condition that permits to drastically reduce the major risks related to public health highlights the role of the urban planning strategies for the management of Diseases Prevention and Health Promotion activities (The Erice 50 Charter) (D'Alessandro et al., 2017). It is important to promote urban requalification interventions that guide citizens towards healthy behaviours finding the appropriate indicators, as the reduction of soil consumption, to avoid the urban sprawl phenomenon, the dissemination of new construction sites in separated areas, by non-urbanized areas from other densely built environments.

The synergism between environmental and health institutions, for

the protection and promotion of health, thus underlining the SNPA and NHS role and actions in HIA.

3. Key points

- A specific training programme for public health professionals on the environmental health, and risk assessment and management are urgent.
- It is also crucial the promotion of research in Environmental Health (EH) not only on environmental risk factors, but also on the integration of different disciplinary approaches in one unique view.
- The concepts of “One Health”, “Global health” and Sustainable development should be the inspiration principles of the environmental risk analysis.
- It is determinant to promote urban requalification interventions that address citizens towards healthy behaviours, to detect urban health indicators as reduction of soil consumption, and to avoid the urban sprawl phenomenon, the dissemination of new construction sites in separated areas, by non-urbanized areas, from other densely built environments.
- It is therefore necessary to evaluate the impact of environmental factors on health by promoting and integrating epidemiological studies with toxicological and monitoring studies.
- The risk assessment and management should be also supported by the evaluation of efficacy of public health interventions:
 - a) The exposure assessment remains the *Achille's heel* of risk assessment. It is time to incorporate in EH studies new technologies to measure external and internal exposure by the approach of the exposome;
 - b) Integrated measures of population health such as environmental burden of disease (EBD) require adequate data to credibly estimate exposure to the risk factor. Such data do not currently exist for most EH risk factors;
 - c) The evaluation of the effectiveness of public health interventions is also crucial. Such evaluations must take into consideration relevant confounders and effect modifiers present at the individual and community level, particularly the social determinants of health.
- Emerging themes as the multiple exposures and the biomolecular pathways and indicators should be deeper understood and largely applied
- The communication should be an integral part of HIA and carefully planned and evaluated within the risk assessment and management.
- The risk perception should be studied as a determinant of environmental health risks and taken in consideration in every communication action.
- Integrated HIA must be essential in any environmental impact assessment (EIA, ESE, IEA, UEA) applying the latest Integrated Environmental Health Impact Assessment (IEHIA) principles.
- Where data systems are in place, risk assessment combined with health surveillance may often be the most efficient, informative response to the exposure event.
- The application of the HIA in all environmental impact applications is now required in light of the development of the legislation and the jurisprudence. To give more tools and greater clarity to all stakeholders (GLHIA), an adequate regulation is urgent.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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