

Journal Pre-proof



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

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1 **Impact of the environment on the health: from theory to practice.**

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8 “*Evaluation of the impact on environment and health: from theory to practice*”.

9

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20 *toxicological study, exposure assessment, urban health, risk communication.*

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57 Abstract

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

71

72 The charter

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

81 Both Teachers and Attendees, at the end of the course, have unanimously agreed on upon the Erice
82 56 Charter, titled “Impact of the environment on the health: from theory to practice” (Ettore
83 Majorana Foundation, 2019).

84

85 **Discussion**

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

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

107 health” as Master and degree courses. Instead, a lowest number of courses in Canadian and Chinese
108 programs are found.

109 The 2017 Inter-ministerial Conference on Environment and Health in Ostrava stimulated the
110 Governments and Ministries of the Environment and Health of the European Region to collaborate
111 more and work together, especially on the topic of training (WHO-UNECE, 2017). In Italy, the
112 National Prevention Plan (2014-2018) has also included the theme "Environment and Health"
113 inside its activities, so the collaboration between the NHS and the NEPS appears to be essential for
114 integrated efficient and effective activities useful for a global disease prevention.

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

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

130 It cannot be ignored that on the theme Environment and Health there are numerous critical aspects
131 in Italy about the attribution of competences between structures of the Regional Environmental
132 Protection Agencies and the National Health Services. General training on these aspects is still

133 insufficient and heterogeneous, and evident inter-regional differences that require action programs
134 and coordinated, coherent and non-sectoral training.

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

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

146 In this context, the molecular epidemiology and the use of early indicators of environmental
147 damage may allow a deeper understanding of the dynamics that regulate the impact of risk factors
148 on the aetiology of diseases (Weston & Harris, 2003; Rossner et al., 2015; Domingo et al., 2020).

149 Today, we also have to take in account the complexity of the exposition (exposome) and the
150 complexity of the metabolic, genetic and immune responses to it (Wild CP, 2005; Ferrante & Conti,
151 2017; Wang et al., 2019).

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

158 The transition from environmental and toxicological data to the estimation of the health impact of

159 environmental origin requires the understanding of the entire path of pollutants, from sources of
160 human contamination to exposure assessment (Shaffer et al., 2019; Bocca et al., 2020).

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

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

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

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

181 Kolb and Martins, for e.g., carried out a meta-analysis on factors contributing to diabetes risk,
182 including aspects of diet quality and quantity, little physical activity, increased monitor viewing
183 time or sitting in general, exposure to noise or fine dust, short or disturbed sleep, smoking, stress

184 and depression, and a low socioeconomic status. Multiple mechanistic pathways were detected
185 come into play including environmental exposures and lifestyles (Kolb and Martin, 2017).

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

190 Therefore, it is now the time that researchers and institutions multiply their efforts towards an
191 integrated approach for the protection both of environment and health, following the “One Health”
192 perspective (Mackenzie & Jeggo, 2019) and the principles of sustainable development (WHO,
193 2020).

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

205 Because the primary mission of public health professionals is the health protection and promotion,
206 they are involved in every step of risk management, including the risk communication that has a
207 crucial role in collective and individual choices and is determinant for the effectiveness of
208 interventions. Public health professionals have generally a technical profile and background (as
209 medical doctors, biologist, chemists, physics), which in their university training did not include

210 communication studies. On the other hand, when they face environmental problems, they should be
211 prepared to understand communication dynamics and to produce adequate communication plans
212 and messages. Currently, a gap can be observed between technicians and public in the context of a
213 general mistrust: technicians think people cannot understand the complexity and the public think
214 that science is not neutral but related to private interests. So, a key role is entrusted to participation:
215 all efforts are to be conducted to strengthen the relationships among the different stakeholders. The
216 regulations concerning HIA require public information and involvement that need the knowledge of
217 specific methodologies and approaches, including the understanding of risk perception and its
218 determinants (WHO, 2013).

219 In the scenarios and applications of the HIA the study of local experiences permits to going into the
220 specific problems that the actual normative lack poses. The hygienic-sanitary risk linked to the
221 discharge of wastewater on soils related to the fact that supply destined for human consumption
222 often draws from groundwater (Daraei et al., 2020; Dettori et al., 2016), especially in regions poor
223 in water bodies (SCA.RE.S Project 2019-20, Apulia region, Italy). This phenomenon causes a
224 pauperization of groundwater bodies at a disadvantage of water quality, often subject to marine
225 intrusion, or conditioned by the hydrogeological characteristics of the territory, by anthropic,
226 agricultural and industrial activities or by natural events of pollution such as for e.g. cyanobacteria
227 blooms (Zuccarello et al., 2020) or volcanic eruptions and gas releases (Radon²²²) (De Giglio et al.,
228 2017; De Giglio et al., 2016; Keramati et al., 2018, Fakhri et al., 2016).

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

235 Urban Health is a fundamental condition that permits to drastically reduce the major risks related to

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

242 The synergism between environmental and health institutions, for the protection and promotion of
243 health, thus underlining the SNPA and NHS role and actions in HIA.

244

245 **Key points**

- 246 • A specific training programme for public health professionals on the environmental
247 health, and risk assessment and management are urgent.
- 248 • It is also crucial the promotion of research in Environmental Health (EH) not only on
249 environmental risk factors, but also on the integration of different disciplinary
250 approaches in one unique view.
- 251 • The concepts of “One Health”, “Global health” and Sustainable development should be
252 the inspiration principles of the environmental risk analysis.
- 253 • It is determinant to promote urban requalification interventions that address citizens
254 towards healthy behaviours, to detect urban health indicators as reduction of soil
255 consumption, and to avoid the urban sprawl phenomenon, the dissemination of new
256 construction sites in separated areas, by non-urbanized areas, from other densely built
257 environments.
- 258 • It is therefore necessary to evaluate the impact of environmental factors on health by
259 promoting and integrating epidemiological studies with toxicological and monitoring
260 studies.

- 261 • The risk assessment and management should be also supported by the evaluation of
262 efficacy of public health interventions:
- 263 a) The exposure assessment remains the *Achille's heel* of risk assessment. It is
264 time to incorporate in EH studies new technologies to measure external and
265 internal exposure by the approach of the exposome;
- 266 b) Integrated measures of population health such as environmental burden of
267 disease (EBD) require adequate data to credibly estimate exposure to the risk
268 factor. Such data do not currently exist for most EH risk factors;
- 269 c) The evaluation of the effectiveness of public health interventions is also
270 crucial. Such evaluations must take into consideration relevant confounders
271 and effect modifiers present at the individual and community level,
272 particularly the social determinants of health.
- 273 • Emerging themes as the multiple exposures and the biomolecular pathways and
274 indicators should be deeper understood and largely applied
- 275 • The communication should be an integral part of HIA and carefully planned and
276 evaluated within the risk assessment and management.
- 277 • The risk perception should be studied as a determinant of environmental health risks and
278 taken in consideration in every communication action.
- 279 • Integrated HIA must be essential in any environmental impact assessment (EIA, ESE,
280 IEA, UEA) applying the latest Integrated Environmental Health Impact Assessment
281 (IEHIA) principles.
- 282 • Where data systems are in place, risk assessment combined with health surveillance may
283 often be the most efficient, informative response to the exposure event.
- 284 • The application of the HIA in all environmental impact applications is now required in
285 light of the development of the legislation and the jurisprudence. To give more tools and

286 greater clarity to all stakeholders (GLHIA), an adequate regulation is urgent.

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All the Authors declare that they have no conflict of interests.

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Declaration of interests

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.

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

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