



# Endocrine Disruptors and Child Health: Food Contaminant Monitoring in the European Union

Donjeta Bali, MD<sup>1,2,3</sup>, Mehmet Vural, MD<sup>1,2,4</sup>, Tudor Lucian Pop, MD, PhD<sup>1,2,5,6</sup>, Angel Carrasco-Sanz, MD<sup>1,2,7</sup>,  
Ida Giardino, MD<sup>2,8</sup>, Maria Pastore, MD<sup>1,8</sup>, and Massimo Pettoello-Mantovani, MD, PhD<sup>1,2,8,9</sup>

**E**nvironmental problems concerning the protection of health are often tackled by giving priority to the more striking aspects such as air pollution, caused by emissions of industrial or residential settlements or an excessive use of vehicles, especially in urban areas. These aspects are easily detectable by citizens; they affect their daily lives and, therefore, are the subject of various forms of protest that compel the authorities to take measures verifiable by all.<sup>1</sup> In contrast, little effort is devoted to substances that might undermine people's daily health in a more subtle way and are, therefore, less commonly detectable. However, these agents might be more harmful and capable of serious and very often irreversible damage to various living organisms.<sup>1,2</sup>

During recent years the European Union Commission (EUC) has placed special interest in endocrine-disrupting chemicals (EDCs) that undermine children's health through the food chain by interfering with the normal activity of the endocrine system.<sup>3</sup> There are many substances capable of disrupting the endocrine system, and the EUC has promoted special research programs for which the goal is to make a major contribution to increasing the scientific knowledge, essential for making socially relevant policy and legislative decisions to counter an increasingly widespread and dangerous situation for children's health.<sup>4,5</sup> The European Pediatric Association, Union of National Pediatric Societies and Associations, in collaboration with the experts of the European member societies, took part in the EUC studies to develop a more effective monitoring system of childhood foods along the European food chain, which aims to decrease the risks that food sources may interfere with the normal function of the endocrine system of children.<sup>5</sup> This commentary, authored by members European Pediatric Association, Union of National Pediatric Societies and Associations working group of social pediatrics, aims to raise further pediatricians' awareness of the relationship between food contaminants and endocrine disruptors and inform all about the EUC's efforts to develop appropriate child health monitoring and control systems.

## Endocrine Disruptors Definition and Characteristics

Endocrine disruptors are substances of various kinds, either naturally occurring or released into the environment as a

result of human activities, that can interact with the endocrine system in different ways. Particularly through the food chain, these compounds have the potential to bioaccumulate and damage the body throughout the life course, from birth through childhood and adolescence and into adulthood.<sup>6</sup> Because of these important characteristics, during recent years EDCs have become a major public health concern and research focus. Assessments by several international agencies indicate that EDCs are a large, heterogeneous, and still incompletely known group of substances that includes compounds used in industrial and consumer products, including dioxins, arsenic, bisphenols, phthalates, perfluorinated compounds, and pesticides.<sup>3,6,7</sup> The assessment of possible risks associated with exposure to EDCs covers several areas and food in particular.

EDCs often mimic the action of hormones and interact with their receptors. They can be classified into 3 main categories, depending on their action. Some mimic hormones, resulting in overstimulation. For example, some can mimic the effects of estrogen, androgens, and thyroid hormones. Others bind to receptors within a cell, preventing binding to endogenous hormone, such as antiestrogens and antiandrogens. Finally, others interfere with the production or control of the use of certain hormones, for example, by altering liver metabolism.<sup>8</sup>

The US Environmental Protection Agency<sup>9</sup> defines EDCs as exogenous agents that interfere with the synthesis, secretion, transport, metabolism, binding action, or elimination of natural blood-borne hormones present in the body and responsible for homeostasis, reproduction, and developmental processes. The EU has adopted a similar, although less detailed, definition referring to EDCs as exogenous substances that alter endocrine system function, causing adverse health effects in an organism, its progeny, or a subpopulation.<sup>10</sup>

Owing to their adverse effects, EDCs have been the subject of research for several years. For example, because of their heterogeneity, toxic substances can alter a variety of

EDCs	Endocrine-disrupting chemicals
EUC	European Union Commission

From the <sup>1</sup>European Pediatric Association/Union of National European Paediatric Societies and Associations (EPA/UNEPSA), Berlin, Germany; <sup>2</sup>Association pour l'Activité et la Recherche Scientifiques, Neuchâtel, Switzerland; <sup>3</sup>Albanian Society of Pediatrics, Tirana, Albania; <sup>4</sup>Turkish Pediatric Association, Istanbul, Turkey; <sup>5</sup>Romanian Society of Social Pediatrics, Cluj-Napoca, Romania; <sup>6</sup>Iuliu Hatieganu University of Medicine and Pharmacy Cluj-Napoca, Cluj, Romania; <sup>7</sup>European Confederation of Primary Care Pediatricians, Lyon, France; <sup>8</sup>Scientific Institute "Casa Sollievo della Sofferenza", University of Foggia, Foggia, Italy; and <sup>9</sup>Italian Academy of Pediatrics, Milan, Italy

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mechanisms of the complex endocrine system and the multiplicity of possible routes of exposure. In addition, the ability of EDCs to affect numerous organs and systems, including the reproductive, nervous, immune, and thyroid systems, especially in the prenatal and postnatal developmental stages, generate a spectrum of negative clinical effects, the understanding of which is still incomplete.<sup>11</sup> Finally, experimental data also indicate the risk of additive or synergistic effects of EDCs and the possibility that they may have harmful effects at very low doses at vulnerable stages of the life cycle, particularly for compounds that interact with nuclear receptors.<sup>12</sup>

## Endocrine Disruptors, Food, and Water

In EU countries, food, water, or materials intended for contact with them are protected by strict regulations and subject to strong controls by authorities. The levels of endocrine disruptors contained are safe in general.<sup>13</sup> However, in many cases, regulations prove insufficient for various reasons that include the identification of new contaminants, or variants of substances already recognized as toxic, attempts to circumvent regulations, or even the introduction of foods produced by other international markets with less stringent rules into the European market.<sup>13</sup> The main sources of endocrine disruptors in foods are meats (especially from carnivorous and omnivorous animals, fish, dairy products, vegetables, and eggs).<sup>7,8</sup>

The prevalence of EDCs in animals and their products is mainly due to their long persistence in the environment, where they can be absorbed by plants and ingested by animals. Moving up the food web, animals may eat greater amounts of food that contains EDCs, so that there will be an accumulation of these substances. Endocrine disruptors are also found in vegetables, either because they are derived from pesticides or because plants naturally produce phytoestrogens that are known to interfere with endocrine activity. So, legumes, fruits and vegetables may contain EDCs.<sup>5-7,14</sup> In particular, soy and other legumes, nuts, whole grains, and sprouts are rich in phytoestrogens.<sup>14</sup>

It is important to remember that food packaging also poses important risks. In fact, some materials that come in contact with food contain EDCs, such as baby food packaging, tubs, greaseproof paper, transparent film, plastic bags, and cans.<sup>15</sup> Pans and particularly nonstick pans also often contain EDCs, such that cookware origin should be checked, and it should be verified whether risk analysis was assessed by the authorities. Water can be contaminated by itself or by the plastic bottles in which it is contained. Thus, it is clear how crucial the need is for continuous updating and improvement of food monitoring systems along the food production chain, from cultivation to packaging.<sup>15</sup> In the US, rigorous policies and regulations ensure a solid protection against the risks of EDCs on public health. In 1996, the Food Quality Protection Act provided an important stimulus for the establishment of the current Endocrine Disruptor Screen Program.<sup>16</sup> In Europe, the EUC Regulation 178/2002 defines the possible risks

as a function of the probability and severity of an adverse health effect resulting from the presence of a hazard in food.<sup>17</sup> This regulation provided the ground for the activities of the EU agencies, including the Joint Research Centre, European Food Safety Authority, and the European Chemicals Agency, which are dedicated to monitor the safety of food and the hazards resulting from the presence of toxic substances, including endocrine disruptors.<sup>3</sup> Finally, the EUC allocated €50 million under the research program Horizon 2020, allowing the funding of 8 projects on new testing methods for endocrine disruptors.<sup>3</sup>

## Conclusions

The hazards to children's health caused by endocrine disruptors are serious and the risks of children's exposure through numerous pathways are high. Indeed, these are ubiquitous substances with which everyone comes into contact every day, albeit with significant variations in relation to environment, consumption, and lifestyles.<sup>18,19</sup> Food is an important vehicle through which EDCs are a hazard to children.

In Europe, although in the absence of a specific regulation regarding EDCs, the EUC after repeated reminders from the General Court, the EU Parliament, and the scientific community, has begun to introduce some amendments to EC regulation 1107/2009 for plant protection products and to EU regulation 528/2012 on biocidal products. In particular, such amendments have introduced scientific requirements regarding the identification of endocrine disruptors in these products.<sup>3</sup> An additional EUC effort regards the financial support to studies aimed at developing an integrated approach to enhance the identification, assessment, detection, and mitigation of safety risks raised by microbial and chemical hazards all along the infant food chains.<sup>15,20</sup>

In conclusion, there is evidence in the literature suggesting a central role of exposure to EDCs in modulating several endocrine conditions, prenatal and perinatal growth, and pubertal timing in humans.<sup>1,2</sup> However, further studies are needed to clarify how many EDCs may primarily act on epigenetic processes and what our role as clinicians is in being able to limit exposure to these substances, with the goal of improving health in children today and in future generations.<sup>21</sup> ■

## Declaration of Competing Interest

The authors declare no conflict of interest.

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Reprint requests: Massimo Pettoello-Mantovani, MD, PhD, Department of Pediatrics, Scientific Institute "Casa Sollievo della Sofferenza", University of Foggia, 00199 Foggia, Italy. E-mail: [mpr@unifg.it](mailto:mpr@unifg.it)

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