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Human Health and Health Protection

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Abstract

The state of the environment affects health in many ways. Air and water pollution, pesticides, chemicals in food, cosmetics and other everyday products, noise, various forms of radiation - all this affects both the environment and human health. Human health is directly related with the health of the environment. Pollution can cause a range of health problems, such as asthma, allergies, various cancers, diabetes, cardiovascular disease, fertility problems, neurological conditions such as Parkinson's and Alzheimer's disease, learning difficulties, obesity and many other health problems. Many of the health consequences of pollution become visible only after a long time or occur as a result of chronic exposure. Although the impact of pollution on health has long been known and, although health is the value most people attach the greatest importance to, measures aimed at ensuring a cleaner and healthier environment are still often seen as hard-to-achieve (or worse unnecessary) luxuries. When they demand the introduction of higher environmental standards, environmental organizations most often receive a response from representatives of the state and industry that it costs too much.

Keywords: nature; environment; pollution; toxicology; health

Introduction

Ecology is defined as the study of the interactions between organisms and their environments, including both the living (biotic) and nonliving (abiotic) components [1].

Ecology involves subject matter that is often readily observable and evident all around us. From the moment of birth, each of us interacts with the environment. We begin our life's journey by developing relationships both with other humans and with nonhuman organisms and by engaging in interactions with our physical surroundings.

Most ecologists study wildlife, wetlands, forests, fisheries, or parts of these and other natural systems. The concepts and principles that make up the ecological sciences deal with how nature works. Nearly everybody at one time or another actively observes and even ponders nature, making almost everybody an ecologist of sorts. This is true even for someone who has lived entirely in an urban environment. Ecology is also a broad scientific discipline. In fact the development of ecological thought has involved subsuming numerous ideas from such other sciences as geology, physics, sociology, and economics.

In spite of our intimate connections with the environment and awareness of nature, our processes of determining the scientific concepts of ecology are not always intuitive—and this is just as true when we are working in physics and economics. Every organism interacts with a multitude of other organisms, contributes to the flow of energy and materials (the currency of ecological systems), and responds to the physical environment in myriad subtle ways. We humans, the most conscious species, are unconscious of most of the ways in which we influence and are influenced by our environment; they are in effect invisible to us. For example, most people know little of the organisms and processes that underlie the ecological systems responsible for the oxygen we breathe, the water we use, the food we eat, and the infectious illnesses we contract.

Ecology aims to understand how natural systems such as plant and animal

communities are organized and function. This includes investigating the subsystems and other parts of natural systems, the relationships among them, and the processes at and above the level of the individual organism that allow biological systems to persist and evolve as dynamic entities. Modern ecology emerged from the study of natural history, which focused primarily on compiling descriptions and catalogues of plants and animals and which generally considered biological systems (including species) to be static entities. After Charles Darwin's *On the Origin of Species* was published in 1859, the fact that living organisms undergo change through the process of natural selection began to be incorporated into ecological study of the dynamics of natural systems.

Concerns for the health impact of global warming and other associated dimensions of environmental degradation are increasing [2]. The health of billions of people will be affected by climate change – through direct long-term effects on water security and food chain integrity, population migration and displacement, redistribution of vector-borne diseases, and significant short-term health impacts from catastrophic extreme climatic events. There are also significant environmental health concerns globally that are not directly associated with climate change such as chemical contamination of food and water supplies and the health effects of persistently accumulating toxic agents and deteriorating air quality. These are all global in nature, but may have differential health impacts worsened by systematic, often remediable, disadvantage of whole populations. Climate change together with competition for resources, marginalization of the majority of people in the world and global militarization have been described as the major threats to world peace.

Environmental Conditions

The environmental dimensions of the right to health are easily understood: good environmental conditions including clean air and water, safe and nutritious food, and adequate sanitation, are essential to a wide range of health outcomes, while a poor or polluted environment can have significant health ramifications [3]. The human right to the highest attainable standard of health is guaranteed in several international and regional human rights instruments. Article 12 of the International Covenant on Economic Social and Cultural Rights (ICESCR) (1966) reads:

1. The States Parties to the present Covenant recognize the right of everyone to the enjoyment of the highest attainable standard of physical and mental health.

2. The steps to be taken by the States Parties to the present Covenant to achieve the full realization of this right shall include those necessary for:

(a) The provision for the reduction of the stillbirth-rate and of infant mortality and for the healthy development of the child;

(b) The improvement of all aspects of environmental and industrial hygiene;

(c) The prevention, treatment and control of epidemic, endemic, occupational and other diseases;

(d) The creation of conditions which would assure to all medical service and medical attention in the event of sickness.

Environmental determinants of health need to be measured and analyzed using system approaches that account for interactions between different agents that can elicit a biological response [4]. The exposome offers a useful framework to examine the totality of exposures and their contribution to health and disease. Advances in exposure science, analytical chemistry, molecular biology, and toxicology have primed us to investigate the health effects of exposure to mixtures and concomitant exposures.

The role of the environment in disease etiology has received increased attention over the past several years. The genome and genetic variations account for far less of the disease burden in the population than was previously thought and the variation in population burden of disease is now largely attributed to nongenetic factors.

The environment encompasses a broad range of factors in the physical world. It includes but is not limited to dietary factors, exposure to infectious and synergistic organisms, toxicant exposures through various media and routes, the built environment, and neighborhood-level characteristics such as access to healthy food and parks. Furthermore, it includes structural policies that control access to healthcare and influence other health-related behaviours and choices. Given how diverse the environmental health umbrella is, it is not surprising that there are several definitions of what the environment constitutes. For the purpose of this chapter, we define the environment as all nongenetic factors that can be measured in the human body which may contribute to variability in disease risk and burden in an individual and the population.

Toxicology

Toxicology is the study of the adverse effects of chemicals on biological systems [5]. These adverse effects can range from mild skin irritation to liver damage, birth defects, and even death. Both natural and man- made chemicals are studied. The breadth of topics in toxicology requires the field to take an interdisciplinary approach, borrowing techniques and methods from numerous scientific fields. The term biological system can be broadly defined, and so a toxicologist might study the effects of pesticides on insect physiology, of herbicides on plant development, of antibiotics on bacterial growth, or of pollution on an entire ecosystem (the latter has evolved into a separate discipline termed ecotoxicology). However, most work in the field of toxicology is focused on the adverse effects of chemicals on human health.

Toxicology is an essential part of environmental health and of public health more generally. Public health professionals manage resources necessary to maintain health, prevent disease, and treat illnesses. A chemical or other environmental contaminant that harms humans at levels found in the environment raises obvious public health concern.

The field of toxicology helps determine the conditions under which a given compound may cause adverse effects, so it is important for public health professionals to understand key concepts that toxicologists use to make these determinations.

Once exposure has occurred, through what routes does the compound enter the body? How much of the compound enters? Where in the body does it go? What does it do once it reaches a particular organ? What physiological effects follow, and if appropriate, what forms of treatment exist? How does the body handle the compound? Is it stored in particular organs, and is it metabolized and cleared? Armed with the scientific principles of toxicology, the public health professional can find answers to these questions and make prudent decisions on how to manage a particular exposure.

Toxicology is integrated into public health practice in several ways. For example, in providing safe drinking water to a community, it is important to understand both the adverse effects of organisms found in the water and the adverse effects of chemicals used to kill the organisms. Toxicology can help in identifying these compounds, assessing the risk they pose, and balancing that risk against the risk of microbiological contaminants. Once again, the collaboration between professionals in related disciplines, risk assessment in this case, becomes critical in protecting the public.

Pollution

In general, the types and concentrations of air and water pollution are site-specific and are likely to vary significantly over time [6]. An interested party may be able to sense the presence of pollutants by their accompanying odors or irritating effects, but typically is not able to discern their magnitude or composition. Furthermore, because pollutants migrate in air and water and soil, and because the same pollutant typically is emitted by many firms, it is usually difficult to identify the original source of pollution at a specific site and time. (Polluters might be aware of their own hazardous emissions, but it certainly is not in their interest to share that information with others.) Of course, interested parties could monitor pollution sites and the emissions of suspected polluters. Monitoring, however, is a costly activity and because externalities deaden incentives to reduce pollution, monitoring is unlikely to be pursued in an unfettered market system.

In the vast majority of cases, it is also difficult to determine the effects of specific environmental pollutants on human health. Many human diseases associated with environmental exposure have multiple potential causes, and may be the result of synergistic effects. This often makes it virtually impossible to ascertain whether an individual's disease was caused or exacerbated by environmental exposure rather than by nonenvironmental factors such as diet, genetic predisposition, or physiological or psychological stress. This problem is compounded by the fact that there frequently is a long latency period—sometimes 20 years or more—between exposure to the environmental health hazard and the manifestation of the consequent disease. Similarly, in many cases the environmental damage—such as deforestation, soil erosion, acid rain, depletion of stratospheric ozone, reduction of dissolved oxygen in water, and animal poisonings—caused by specific amounts and types of pollutants have not yet been quantitatively established.

Environmental Health

The definition of environmental health continues to change. In recent years, the field has evolved toward a more holistic view of the effect of environment on health and has recognized the challenges and the opportunities inherent in this broader view in advancing the field [7]. The World Health Organization defines environmental health as the direct pathological effects on health of chemical, physical, and biological agent and of the effects of the broad physical and social environment on human health. This definition is one of many examples that not only apply to air, water, and soil, but in the broadest sense to the pathological effect on health of the broad physical and social environment.

The mission of environmental public health extends well beyond remediating, cleaning up, or otherwise making up for past mistakes [8]. It is to assure conditions that enhance the health of humans and other species.

The environment has a major impact on individuals' risk of chronic diseases and conditions, such as cancers, chronic lung disease, and birth defects, and on the risk of acute illnesses, such as viral gastroenteritis, respiratory infections, and such vector-borne diseases as malaria. Accordingly, environmental public health is concerned with the prevention of these conditions.

But the environment has far broader impacts on health. Some environmental conditions confer resilience to the most harmful impacts of natural disasters, whereas others put people directly in harm's way (through building homes and other structures on fl ood plains and earthquake faults, for example.). Some environments promote health by providing nutritious food, adequate supplies of drinking water, opportunities for outdoor recreation, and aesthetic and mental health benefits of nature contact. The state of knowledge about causation of communicable diseases is more advanced that that for chronic diseases and natural disasters, which are in turn better understood than environmental aspects of health promotion. However, prevention efforts in environmental health need to address all of these concerns.

From the outset it is important to emphasize that certain environmental health problems are much more serious in developing countries than in wealthy countries. In developing nations, for example, drinking water contaminated by microorganisms and toxic substances causes considerable morbidity and mortality, and burning coal, wood, and other biomass fuel sources for cooking and heating contributes to indoor air and outdoor air pollution. Chemical releases are more common, and there are fewer means to protect workers, nearby communities, and passersby. Worldwide there are large numbers of preventable deaths and injuries due to earthquakes, storms, and floods; many of these deaths are preventable with appropriate environmental measures, such as construction standards for homes and buildings.

From earliest recorded times, human beings have recognized the need for guidelines, ordinances, and infrastructure to ensure the protection of the environment and human health [9]. The practice of environmental health has grown and evolved as it has been informed over the years by the public health sciences of epidemiology and biostatistics and the emerging disciplines of toxicology and exposure and risk assessment. In addition, the public at large has demanded an increasing role in the design and delivery of community environmental health services. The

practice of environmental health is carried out in a variety of settings, from local and state governments to federal and tribal governments and also in medical facilities and both the private and nonprofit sectors.

Health Care

People come into contact with potentially hazardous chemical contaminants as part of daily life [10]. Chemical contaminants arise from natural and anthropogenic sources. Chemical contaminants occur in the ambient environment such as outdoor air, surface water and soil, and in the air, dust on surfaces, food, water, and products found and used in indoor environments, e.g. workplaces, schools, and homes.

Contact or exposure to a hazardous chemical contaminant is necessary but not sufficient in itself to result in an adverse health effect. A sufficient amount of the chemical contaminant must be absorbed into the body and must reach the relevant site within the body where it may change or disrupt normal function. Absorption (or uptake) is influenced by properties of the body and properties of the chemical contaminant. Once inside the body the contaminant may be altered by metabolism, stored, or eliminated as waste

Ironically, health care workers, dedicated to promoting health through treatment and care for the sick and injured, all too often face serious risks to their own health in the course of this work [11]. Health care workers now report a rate of work-related injuries greater than that of construction workers, farmers, miners, and manufacturing workers—all highly hazardous occupations. Exposure to airborne and bloodborne infectious agents, workplace assault, ergonomic hazards, toxic drugs and other chemicals, radiation, and work stress often due to or exacerbated by inadequate staffing have resulted in increasing rates of injuries over the past a few decades. Thus health care workers often struggle to provide quality and compassionate care in an inherently dangerous work environment.

Patient care, although the primary source of injuries and illnesses to nursing staff, is not the only activity that impacts health care workers' health and safety. All patient care and treatment areas, sterilization areas, pharmacies, support laboratories, housekeeping, maintenance, and waste disposal areas include exposures and activities that may pose health and safety hazards to workers. In addition, the generation and disposal of biologic, chemical, and radiological wastes pose risks to the communities surrounding health care facilities and beyond, in particular if these facilities incinerate their waste on-site. The widespread use and resulting incineration of plastics containing chlorine compounds, such as poly vinyl chlorine (PVC)-containing products, have the potential to create and release into the atmosphere dioxins, among the most toxic substances known.

Health care organizations consist of many separate industries all housed within the walls of the facility. Hazards range from the biologically associated, with airborne and bloodborne exposures to infectious agents, to industrial strength disinfectants and cleaning compounds in use throughout the facility. Hazards associated with food preparation and waste disposal are also present in health care. In addition, chemical hazards include waste anesthetic and sterilant gases, antineoplastic drugs, and other therapeutic agents. Physical hazards include exposure to ionizing and non-ionizing radiation, safety and ergonomic hazards, violent assaults, and psychosocial and organizational factors, including psychological stress and shiftwork.

Childrens

Children are not just little adults [12]. They are different organisms in many ways, particularly with regard to their exposures and responses to the environment. Their status as developing organisms, their heightened biological sensitivity, their diet, and their unique exploratory nature enhance their vulnerability to many toxic threats in their environments.

To review, toxicology is the study of the negative effect of a physical stressor (chemical, biological, or radioactive) on a biological system—a cell, tissue, organ, organ system, or organism. The key variables in determining the relationship between an exposure to a stressor and a health effect are (1) the "dose" of the exposure, (2) the duration of the exposure, (3) the toxicity or strength of the toxin, and (4) a variety of host factors (such as age, sex, weight, health status, other exposures). Environmental toxins can enter the human body via ingestion, inhalation, and dermal exposure. People may ingest toxic chemicals in their drinking water as well as in foods and other beverages. Air pollution toxins, both indoor and outdoor, are absorbed in the lungs, and some toxic exposures, such as solvents and some pesticides, can be absorbed through the skin.

In the same way that the desired effects of pharmacological agents are dose dependent and also depend on the characteristics of the person receiving the medication, the effects elicited by toxic chemicals in our environment are dose dependent and dependent on the characteristics of the host. This concept is extremely important when discussing children's special vulnerabilities to environmental exposures because there are a number of variables that influence the dose of toxic chemicals to which children are exposed and their response to the chemicals.

Conclusion

Human health and ecosystem health are inextricably linked. We all need clean air, water and food every day to be able to function. Staying in nature, exercising, socializing and relaxing contribute to the development of each person, but also to the development of the whole community. On the other hand, if we live, work, study or play in a polluted environment, we endangering our body and mind. The goal of nature protection is not to protect the planet, but to ensure our own health and well-being and the health and well-being of our children. Pollution prevention is a measure of public health protection. Identifying the complex links between environmental quality and human health risks is a key challenge today, which depends on the timing of exposure to an environmentally harmful substance, the socio-economic status and personal habits of the individual, and hereditary and other factors. In addition, the impact of global mega-trends such as climate change, depletion of natural resources, as well as the reduction of ecosystem services and biodiversity have direct and indirect effects on preserving the health and well-being of the population.

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