



INTERNATIONAL CONFERENCE ON  
**Environmental and Occupational  
Determinants of Cancer:**  
Interventions for Primary Prevention  
ASTURIAS (AVILÉS AND GIJÓN), SPAIN



**World Health  
Organization**

## **PRIMARY PREVENTION OF CANCER THROUGH MITIGATION OF ENVIRONMENTAL AND OCCUPATIONAL DETERMINANTS**

### **I.- BACKGROUND AND RATIONALE**

Primary prevention encompasses the elimination or reduction of exposure to recognized risk factors in susceptible populations to prevent a disease. Evidence of effective primary prevention measures in reducing cancer rates are, for example, the observed decrease in cases of male lung cancer from a fall in tobacco smoking or reduced bladder cancer among dye workers after the elimination of aromatic amines' exposures. Primary prevention is an important means to improve public health, and it is by far the most cost-effective and sustainable intervention for reducing the burden of cancer globally.

At least one-third of cancer cases that occur annually throughout the world could be prevented [1]. Cancer prevention involves firstly identifying those factors associated with the development of the disease (risk factors) as demonstrated by epidemiological studies. The risk of developing cancer depends on many factors, including the mode of exposure to a known carcinogen, and the length and intensity of the exposure. Avoiding or reducing exposure to risk determinants will result in a decrease in cancer risk.

Although personal choices, such as tobacco use, dietary and physical activity patterns, play a major role in the development of cancer, environmental and occupational factors are involved in the causation of a large number of human cancers [2]. Human beings are exposed to many carcinogenic agents through breathing, eating, drinking or skin contact and this is a major determinant of the incidence of the disease. Exposure tends to have a larger impact on the disadvantaged segments of the population.

A WHO study found that at least 1.3 million cancer deaths annually could be prevented through healthy working and living environments [3]. Changes in individual behaviour are facilitated by wider contextual changes in the environments where individuals live and work. For instance, an observed decrease in the incidence of stomach cancer has been attributed to the availability of better quality foods due to modern food preservation techniques, rather than to individuals deciding to change their eating patterns [4].

Important health co-benefits are likely to result from reducing exposure to environmental and occupational

carcinogens, since they are common risk factors for the more important noncommunicable diseases. Respiratory diseases, for instance, are tied to cancer risk factors such as smoking and air pollution. Therefore, primary prevention can achieve a number of ends.

### **GOAL**

The capacity of Member States to address the environmental and occupational determinants of cancer requires strengthening. The International Conference on "Environmental and occupational determinants of cancer: Interventions for Primary Prevention" aims to use scientific evidence about environmental and occupational risks related to cancer to raise awareness and promote environmental and occupational interventions in support of more intensive primary preventive measures.

### **OBJECTIVES**

The overall objective is to develop a policy framework for the primary prevention of environmental- and occupational-related cancers and to further mobilize public health and scientific communities and civil society towards that end.

The specific objectives are to:

- A. Review key policy options and environmental interventions that have proven successful for the primary prevention of selected cancers.
- B. Identify gaps in and means to promote existing interventions in scientific, social mobilization, policy, legislation and communication arenas.
- C. Promote innovative approaches to strengthen primary prevention of environmental and occupational cancers.

### **EXPECTED OUTCOMES**

1. A set of policy options and effective interventions for the primary prevention of selected causes of cancer.

2. Key messages to the media and the public to raise awareness about environmental and occupational causes of cancer.
3. Establishment of a coordinated network of institutions for primary prevention of environment-related cancer, involving scientific experts, professional societies, NGOs, academic and governmental institutions, media and others.
4. Release and disseminate a collective "Asturias Pledge: Call to Action" for the primary prevention of cancer.

exposed to environmental and occupational carcinogens and they can complement individual-level programmes.

Occupational exposures are avoidable hazards to which individuals are involuntarily exposed. Though occupational cancer represents only a portion of the total number of cancer cases, it may in fact represent the majority of cancer cases among certain groups of workers exposed to some specific occupational hazards. The prevention of occupational cancer in the formal sector relies heavily on legislation, because the population at risk can be more easily identified.

### 1. Legislation, regulations and policies

A range of legislation, regulations and policies for eliminating or reducing exposure to chemical and physical exposures to carcinogens exists at both national and international levels, and examples include:

For chemical exposures:

- Regulations for substitution and phasing out of replaceable processes or chemicals: reducing the use of carcinogenic substances in the workplace by replacing them with less dangerous substances, or other measures such as through encapsulation and closed processes in which carcinogens are not released, wet processes, ventilation, filtration or cleaning, or controlling the amount of carcinogens in the working environment (based on threshold limit values);
- Optimizing industrial processes to potentially reduce the exposure to several carcinogens at the same time;
- Offering incentives to corporations to encourage the elimination of harmful chemicals in their products and processes;
- Promote effective measures for storage, disposal or recycling of chemicals;
- Banning the use of all types of asbestos and banning exportation to other countries, and stimulating asbestos replacement with safer substitutes by economical and technological mechanisms;
- Regulations for trade and transport of hazardous substances (e.g. increasing taxes);
- Disclosure labelling laws: for identification and classification of chemicals by types of hazard, including labels and safety data sheets;
- Banning smoking inside buildings and public places;
- Minimizing exposure to aflatoxin in countries where it contaminates food by modifying harvesting and storage methods, applying low technology techniques such as drying crops in the sun, discarding mouldy kernels, and storing crops in natural fibre sacks on wooden pallets;
- Cessation of use of arsenic pesticides and banning cosmetic use of pesticides on residential lawns and gardens;
- Promoting the use of clean burning and efficient stoves, and improve stoves where access to alternative fuels is limited, improve ventilation and kitchen design and placement of the stove to avoid smoke;
- Expanding public and alternative transportation systems and improving urban planning to reduce the need for motorized transport and adding more pedestrian-oriented streets.

For physical exposures (ionizing and UV radiation):

## II.- EXISTING POLICIES AND INTERVENTIONS

Despite cancer being a global public health problem, many governments have not yet included cancer prevention in their agendas. Growing awareness about the linkages between cancer and environmental and occupational risk factors has led to banning or severely restricting the marketing and use of major carcinogens. Examples include restricting the use of tobacco, including smoking restrictions in specified domains, and reducing occupational exposures to carcinogenic chemicals or pollutants. Unfortunately, a consequence of such measures being taken at a national or regional level can be that the manufacturing base that deals with carcinogenic materials and products shifts to other countries without such measures in place.

The interventions to reduce exposure to carcinogens and probable carcinogens often lead to reductions in other health risks in the working and living environment. For example, control measures to reduce air pollution from traffic decrease exposure to diesel exhaust gases and thus may contribute to the prevention of lung cancer. In addition, they will also decrease exposure to ultra-fine particulates contributing to a reduction in non-malignant respiratory and cardiovascular morbidity, and may also reduce traffic accidents and injuries. Banning the use of asbestos will prevent linked lung cancer and mesothelioma and will also prevent asbestosis, a non-malignant fibrotic condition of the lungs. Establishing linkages between public health programmes for the prevention and control of cancer and programmes and plans of action in the areas of occupational health, environmental health, chemical safety, food safety, etc. will create synergies and help governments, industry, the health-care sector, NGOs and advocacy groups, and individuals themselves to work together towards the primary prevention of cancer.

### MEASURES TAKEN AT GOVERNMENTAL OR POLICY-MAKER LEVEL

People may be exposed to hazardous materials in the home, workplace, school, health care settings or recreational settings and, in many cases, without acute symptoms or recognition of hazard. Primary prevention offers the greatest public health potential and the most cost-effective opportunity for long-term cancer control. Large-scale population-based interventions are potentially valuable options for the prevention of cancer as they can reach many people in a given country. Environmental policy approaches can benefit large numbers of people

- Harmonization of standards for radiation protection (e.g. International Basic Safety Standards (BSS) for Protection against Ionizing Radiation and for the Safety of Radiation Sources co-sponsored by IAEA, WHO, PAHO, ILO, FAO and NEA/OECD);
- Promoting appropriate justification of radiological medical procedures to avoid unnecessary radiation exposures;
- Education of practitioners to promote the use of referral guidelines as decision-making tools to justify the diagnostic procedures of choice;
- Education and training of imaging professionals (radiologists, nuclear medicine physicians, medical physicists, technicians) to apply diagnostic reference levels to radiological procedures, to reduce radiation doses without affecting image quality;
- Regulations for occupational radiation protection (e.g. shielding, time and distance to the source, limits for the effective dose in workers of 20 mSv/y) and dose monitoring systems;
- Increasing ventilation in enclosed spaces where radon accumulates, reducing negative pressures within buildings (active and passive soil depressurization), to prevent inflow of radon from the ground;
- Setting national radon programmes: establishing national reference levels, identifying geographical areas (radon maps), raising public awareness (effective risk communication and encouraging householders to measure radon), collaborating with other health promotion programmes (e.g. indoor air quality and tobacco control), ensuring professional competence in prevention and mitigation of radon, establishing building codes (installation of prevention measures in homes under construction and measurement during purchase and sale);
- Increasing the provision of shade in public areas and other settings;
- Banning unsupervised tanning beds and restrict access for those under 18 years of age.

## 2. Generic principles

In situations where there is the possibility of harm from a particular agent but definitive scientific understanding does not as yet exist, some generic principles have been developed to assist policy makers when taking public health and environmental decisions:

- Application of the Precautionary Principle [5];
- Application of the ALARA principle to exposures "As Low As Reasonably Achievable";
- Disseminating information and raising awareness about carcinogenic risks (by governmental agencies responsible for chemicals and industries, industrial organizations, labour unions and consumer organizations).

## 3. Control measures in the working environment

Fifteen industrial processes or occupations, such as the rubber industry, painters, etc. have been classified by the International Agency for Research on Cancer (IARC) as falling within Group 1 (carcinogenic to humans) [6]. Occupational cancer tends to be concentrated among relatively small groups of individuals among whom the risk of developing the disease may be quite high. These cancers are almost entirely preventable through eliminating or

reducing exposure, substituting with safer materials, and adjusting industrial processes and ventilation, as mentioned above. Measures to control occupational carcinogenic hazards should therefore have a high priority in any programme of cancer prevention, even if they represent a small proportion of all cancers, and may include:

- Identification and surveillance of exposure and health surveillance: estimating the number of workers who come into contact with substances and are employed in occupations and industries with increased carcinogenic risk, and reducing to a minimum the number of workers exposed, and the duration and degree of exposure, and establishing an appropriate system of records;
- Regulating the use of protective equipment for workers and decontamination facilities in industries;
- Establishing recommendations for proper use and handling of chemicals (in agriculture and also in trade schools), and training packages for workers (measures for technical prevention and personal hygiene);
- Raising the overall awareness of workers, employers, health and safety professionals about occupational carcinogens, their recognition and elimination, and ensuring the reporting of cancer cases with a suspected occupational etiology;
- Inclusion of occupational cancer in national lists of occupational diseases and ensuring that physicians report all such cases;
- Integration of prevention of occupational cancer with overall cancer control programmes;
- Implementing regular radiation safety training programmes for workers;
- Providing monitoring services at the workplace and assessing occupation radiation exposures;
- Establishing national dose registries for radiation and information systems on occupational exposures. Promoting radiation safety culture and raising awareness about radiation among health-care workers (e.g. interventional radiologists and nuclear medicine professionals);
- Raising awareness among health professionals (clinicians and public health officers) about the links between environmental and occupational exposures and cancer disease;
- Empowering workers by providing them with access to information about their exposures and risks (e.g. increasing access to the International Chemical Safety Cards).

## INDIVIDUAL MEASURES

Cancer prevention and control interventions can be directed at individuals. Many members of the public remain unaware of many common environmental carcinogens such as radon, or manufacturing and combustion by-products that are released into their environment. It is important to inform the public about control options for radon in new dwellings, radon reduction in existing dwellings as well as benefits of different radon prevention and remedial actions. In principle, rates of cancer-related illness and death can be lowered by increasing public awareness about cancer and its risk factors through changing behaviour according to risk perception (using social marketing techniques, for example), developing awareness among young people and parents, and involving the media in educating the public about the growing impact of environmental and

occupational carcinogens. For example, school-based programmes focused on vulnerable populations (e.g. children, fair-skinned individuals) could educate individuals to avoid too much sunlight at midday and aim for them to use personal protection measures. An example of improving behaviours and environments for sun protection was The Pool Cool in the United States, an educational and environmental interventions prevention programme for skin cancer directed at children aged 5 to 10 years enrolled in swimming lessons, their parents, and the lifeguards and aquatic staff at outdoor swimming pools. Reasons given for successful implementation were the provision of a toolkit, ease of implementing the programme, pool staff and children enjoying the programme and the field coordinators' support. Evaluation of the programme suggested that there was a trend towards fewer sunburns as social norms, pool policies, and participation in the Pool Cool programme increased; and that interventions in the workplace were effective for reducing sun exposure and improving sun protective behaviour of outdoor workers [7-9].

Medical procedures involving radiation exposure have both risks and benefits, and patients are entitled to know both in order to provide informed consent. It is important to inform patients and members of the public about the health effects of ionizing radiation and on how to optimize protection reducing unnecessary radiation exposure. Radiation risk communication to parents is essential in paediatric health care.

Informing the public about, for example, the health benefits of pollution reduction by using public and ecological transportation, will allow civil society to request action on issues that lie out of an individual's control (e.g. urban air pollution or tobacco use in public places). Other measures that can be taken at individual level are, for example: changing purchasing practices by consumers to reduce cancer-causing chemicals entering into homes, checking homes for high levels of radon and reducing radon levels by installation of a ventilation system in the basement, ventilating rooms when working with solvents or working outside, or avoiding contact with pesticides.

### **III.- RESEARCH**

Research on environmental cancer etiology and prevention provides evidence to support work on the global incidence and prevalence of cancer, and for the designing of effective strategies for cancer prevention, respectively. Identifying risks related to the general and working environment and technological development are research priorities for improving the health of the population. Defining a cancer prevention research agenda at all levels (basic, clinical and epidemiological) is necessary to identify the areas where action is needed to prevent environmental- and occupational-related cancers. Scientific and technological infrastructure and adequate human resources are needed to properly develop these areas of research. Examples of necessary research areas that have been proposed include:

- Encouraging research on genetic and epigenetic interactions with environmental risk factors to support

the development of evidence-based preventive strategies;

- Analysing the molecular and cellular mechanisms involved in the origin, development and progression of environmentally-related cancer;
- Further developing epidemiological research on environmental- and occupational-related cancers, identifying the populations at risk, and studying the links with timing of exposures, multiple exposures and chronic low-dose exposures;
- Improving risk assessment of environmental and occupational exposures;
- Promoting operational research on the effects of environmental and occupational interventions;
- Boosting coordinated cancer research centre networks;
- Increasing resources for multidisciplinary research;
- Assisting developing countries through a structured programme of research collaboration, education and training, to develop an increased understanding of the causes of and predisposition to regionally important cancers;
- Ensuring the rapid transfer of research outcomes to control measures for the benefit of all populations.

### **IV.- GAPS AND OPPORTUNITIES**

Cancer may be prevented by effective and accessible environmental and occupational interventions. However, there is some lack of action or knowledge in certain areas that arguably should be covered to better achieve this end.

#### **1. In implementation:**

In some cases, there is evidence and knowledge about a particular environmental risk factor for cancer, but action is not taken. Some examples include:

- Using and exporting asbestos is still a common practice in many mostly developing countries;
- Only a few countries, such as Scotland, Belgium, Germany, Spain, France, Brazil, Canada or Australia have regulations about the use of tanning beds [10-13];
- In many countries the importance of occupational hazards has not been fully assessed by the corresponding occupational health institutions, and prevention of occupational cancer has not been given high priority;
- Occupational hygiene conditions in small enterprises in some high-resource countries, and in industries in low- and middle-income countries (e.g. asbestos, crystalline silica and pesticide industries) remain substandard;
- Nationwide assessment of environmental and occupational cancer risk factors is not performed systematically in all countries;
- Lack of stringent mechanisms to reduce exposure to substances that are used under less controlled conditions (e.g. diesel motor exhaust);
- Mechanisms to measure the level of exposure to carcinogens of the general public (typically lower than those experienced in occupational settings) are often neglected;

- Despite an increased body of scientific knowledge about cancer epidemiology, causation, and preventive measures, this knowledge has not been translated adequately into initiatives that will impact public health;
- Communication strategies on environmental and occupational risks need to make policy-makers aware that most environmental risk factors are beyond the personal control of individuals; but at the same time, to increase individuals' risk perception and concern about changes in behaviour so as to avoid exposure to certain substances;
- Differences in resources and cultural contexts in low- and middle-income countries may affect the feasibility or efficacy of interventions validated in high income countries;
- Priority interventions for primary prevention of cancer may be uneven among communities due to different trends in cancer incidence;
- Many substances do not qualify for classification as a carcinogen by IARC because of a lack of available information. Carcinogen testing data should be available for many industrial and commercial chemicals and such testing should be performed before products are introduced in the market;
- Interventions for environmental and occupational primary prevention of cancer are too often left out of National Cancer Plans.

## 2. In knowledge and research:

On the other hand, there is still lack of compelling evidence in some areas, and research priorities could address:

- Studying the interplay between timing of exposures and multiple exposures, and mixtures: quantitative estimates of risk are especially difficult to develop for mixtures, because the effect depends on the specific components of the mixture, their concentrations, and their interactions;
- Studying environmental risks and genetic susceptibility;
- Identifying carcinogenic exposures at work;
- Identifying the populations at risk, e.g. children;
- Further research on vitamin D in relation to UV exposure is needed;
- Further research is needed to reduce uncertainties about radiation-induced cancer risks including dose response for different types of cancers, influence of gender and age, risk of prenatal exposures interaction of radiation with chemical carcinogens and radiation quality effects;
- Non-ionizing radiation includes electromagnetic fields such as those emitted by mobile phones or power lines. Although there is no strong evidence so far for a possible association between exposure to electromagnetic fields and cancer, the possible effects of long-term heavy use of mobile phones require further investigation, because these technologies are relatively new [14];
- Low-level exposures to carcinogenic pollutants because of the multiplicity of substances, the involuntary nature of many exposures, and the potential that even low-level exposures may contribute

to the cancer burden when large numbers of people are exposed;

- Extrapolation of findings from experimental animals studies: the time and expense of these assays limit the number of agents that can be tested; animal studies may have been conducted using only one route of exposure, which may or may not be the most common route of exposure or concern in humans;
- Lack of reliable epidemiological data on dose-response relationships and therefore problems with setting standards;
- Further studies of the health effects of manufactured chemicals not yet fully assessed.

## V.- NEXT STEPS

We foresee that the conclusions of the International Conference on "Environmental and occupational determinants of cancer: Interventions for Primary Prevention", based on the review of the scientific evidence, the interventions and actions already available, the identification of the gaps and barriers, will help define a road map to better address the environmental and occupational determinants of cancer, to develop a range of proposals for primary prevention of cancer and to introduce environmental and occupational exposures into the global cancer agenda.

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