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Most types of cancer not due to “bad luck” IARC responds to scientific article claiming that environmental and lifestyle factors account for less than one third of cancers

Lyon, France, 13 January 2015 - The International Agency for Research on Cancer (IARC), the World Health Organization’s specialized cancer agency, strongly disagrees with the conclusion of a scientific report¹ on the causes of human cancer published in the journal [Science on 2 January 2015 by Dr Cristian Tomasetti and Dr Bert Vogelstein](#).

The study, which has received widespread media coverage, compares the number of lifetime stem cell divisions across a wide range of tissues with lifetime cancer risk and suggests that random mutations (or “bad luck”) are “the major contributors to cancer overall, often more important than either hereditary or external environmental factors.”

For many cancers, the authors argue for a greater focus on the early detection of the disease rather than on prevention of its occurrence. If misinterpreted, this position could have serious negative consequences from both cancer research and public health perspectives.

IARC experts point to a serious contradiction with the extensive body of epidemiological evidence as well as a number of methodological limitations and biases in the analysis presented in the report.

“We already knew that for an individual to develop a certain cancer there is an element of chance, yet this has little to say about the level of cancer risk in a population,” explains IARC Director Dr Christopher Wild. “Concluding that ‘bad luck’ is the major cause of cancer would be misleading and may detract from efforts to identify the causes of the disease and effectively prevent it.”

The past five decades of international epidemiological research have shown that most cancers that are frequent in one population are relatively rare in another and that these patterns vary over time². For example, oesophageal cancer is common among men in East Africa but rare in West Africa. Colorectal cancer, once rare in Japan, increased 4-fold in incidence in just two decades. These observations are characteristic of many common cancers and are consistent with a major contribution of environmental and lifestyle exposures, as opposed to genetic variation or chance (“bad luck”).

Furthermore, IARC experts identify several limitations in the report itself. These include the emphasis on very rare cancers (e.g. osteosarcoma, medulloblastoma) that together make only a small contribution to the total cancer burden. The report also excludes, because of the lack of data, common cancers for which incidence differs substantially between populations and over time. The latter category includes some of the most frequent cancers worldwide, for example those of the stomach, cervix, and breast, each known to be associated with infections or lifestyle and environmental factors. Moreover, the study focuses exclusively on the United States population as a measure of lifetime risk. The comparison of different populations would have yielded different results.

Although it has long been clear that the number of cell divisions increases the risk of mutation and, therefore, of cancer, a majority of the most common cancers occurring worldwide are strongly related to environmental and lifestyle exposures. In principle, therefore, these cancers are preventable; based on current knowledge, nearly half of all cancer cases worldwide can be prevented. This is supported in

¹ Tomasetti C, Vogelstein B (2015). Variation in cancer risk among tissues can be explained by the number of stem cell divisions. *Science*. 347(6217):78–81. <http://dx.doi.org/10.1126/science.1260825>

² Stewart BW, Wild CP, editors (2014). *World Cancer Report 2014*. Lyon, France: International Agency for Research on Cancer.

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practice by rigorous scientific evidence showing decreases in cancer incidence after preventive interventions. Notable examples include drops in rates of lung cancer and other tobacco-related cancers after reductions in smoking and declines in hepatocellular carcinoma rates among people vaccinated against hepatitis B virus.

“The remaining knowledge gaps on cancer etiology should not be simply ascribed to ‘bad luck’,” says Dr Wild. “The search for causes must continue while also investing in prevention measures for those cancers where risk factors are known. This is particularly important in the most deprived areas of the world, which face a growing burden of cancer with limited health service resources.”

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The International Agency for Research on Cancer (IARC) is part of the World Health Organization. Its mission is to coordinate and conduct research on the causes of human cancer, the mechanisms of carcinogenesis, and to develop scientific strategies for cancer control. The Agency is involved in both epidemiological and laboratory research and disseminates scientific information through publications, meetings, courses, and fellowships. If you wish your name to be removed from our press release e-mailing list, please write to com@iarc.fr.