

Editorial

Air pollution: a smoking gun for cancer

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Abstract

Once considered a taboo topic or stigma, cancer is the number one public health enemy in the world. Once a product of an almost untouchable industry, tobacco is indisputably recognized as a major cause of cancer and a target for anticancer efforts. With the emergence of new economic powers in the world, especially in highly populated countries such as China, air pollution has rapidly emerged as a smoking gun for cancer and has become a hot topic for public health debate because of the complex political, economic, scientific, and technologic issues surrounding the air pollution problem. This editorial and the referred articles published in this special issue of the *Chinese Journal of Cancer* discuss these fundamental questions. Does air pollution cause a wide spectrum of cancers? Should air pollution be considered a necessary evil accompanying economic transformation in developing countries? Is an explosion of cancer incidence coming to China and how soon will it arrive? What must be done to prevent this possible human catastrophe? Finally, the approaches for air pollution control are also discussed.

Key words Air pollution, cancer, public health

Change is occurring at an alarming speed in the land of the Middle Kingdom. Not long ago, cancer was a stigma, and the diagnosis was commonly hidden from patients. The establishment of hospitals with cancer in their names was considered insensitive. Today, cancer is discussed openly, and cancer hospitals are some of the busiest hospitals in major cities. It is difficult to find anyone who has not been touched by cancer among families and friends.

Cancer is by no means a modern disease. In a perspective by Yan in 2013 in the *Chinese Journal of Cancer*^[1], the recorded history of cancer was traced back to ancient books in both Europe and China. The Chinese character of cancer (癌) describes it as a disease that may manifest as an erupting volcano. In modern days, this cancer volcano seems to be actively erupting and cancer is more prevalent than ever before. The World Health Organization (WHO) recently announced a predicted 57% increase in cancer cases in the world in the next 20 years^[2].

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Epidemiologic studies have shown that aging of the population is a major factor for this increased incidence of cancer. Epidemiologic studies have also identified a number of important causes for cancer, with tobacco use as the number one cause for several cancer types including lung cancer and bladder cancer^[3]. This realization led to impressive anti-tobacco campaigns in the United States (US), which recently marked the 50-year anniversary of the first Surgeon General's Report on Smoking and Health on January 11, 2014. That landmark report by Surgeon General Dr. Luther Terry in 1964 was the first federal government report linking smoking to lung cancer and heart disease^[4]. Vigorous studies over the last decades have provided indisputable evidence that tobacco products cause genetic changes that underlie the development of cancer. Tobacco advertisements have been banned from television, and heavy taxation has been placed on tobacco products. Tobacco use has been banned in public buildings in the US and many other countries. Nevertheless, eliminating tobacco is still not possible because the tobacco industry plays a big part in the livelihood in many regions in the world. It is clear that tobacco is not simply a health issue or a scientific issue, but also an issue with economic and political impact. The drive to control tobacco has spurred technologic development ranging from removing tar from tobacco to adding filters to cigarettes and to the emergence of smoke-free, electronic cigarettes. Tobacco control has taken a slower course in China than in other countries^[5]. The tobacco industry has traditionally been a government-owned enterprise employing millions of people. With diversification of industries, tobacco control has gained support from the Chinese government in recent years and tobacco use has begun to be banned in some public places.

Unfortunately, an even larger, more alarming threat is in the air. With the remarkable industrialization and urbanization of China in the past 30 years, air pollution has become a ubiquitous problem in China, especially in northern and eastern regions of the country. During these most recent winter months of late 2013 and early 2014, northern China has been frequently filled with fog-like haze that blurs visibility^[6]. Many of the pollutants have reached a level more than 10 times higher than the lower unhealthy limit (Air Quality Index of 50) recommended by WHO. This is even more alarming because WHO recently announced that air pollution, like tobacco, is a mutagen that causes cancer^[7]. Air pollution is not a cigarette, but a smoking gun!

The tobacco control effort has just begun in China. Yet, China is immediately faced with tobacco's evil twin: air pollution. Air pollution control has to be on the agenda, and fortunately, the recent announcement by the State Council of China to control air pollution places it there^[8].

Air pollution control is obviously challenging and perhaps more difficult than tobacco control, as it will involve the Political will of the people and government, the balancing of Economic considerations, vigorous Scientific research, and Technological development (PEST). This undertaking will be the largest PEST control initiative of the century.

Air Pollution Control Requires the Political Will

Air pollution has reached such a scale that it will take a collective effort to control it. The condition is ripe for political actions in the form of policy change, more vigorous law enforcement, and government budgetary allocation for air pollution control. Air pollution has become so annoying to the public that it is impossible to take the traditional "see no evil, hear no evil, speak no evil" (非礼勿视, 非礼勿听, 非礼勿言, 非礼勿动) tolerance approach that is so ingrained in the Chinese Confucian outlook. Breathing polluted air outdoors 50% of time does not allow people to look the other way anymore. Doing nothing or not doing anything fast enough on the part of the government will be viewed as a lack of moral responsibility. Therefore, politically, air pollution control is a must and the time is ripe to take "unpleasant" actions.

Air Pollution Control Requires Shrewd Economic Consideration

The increase in air pollution has paralleled the economic transformation of China in the past 30 years. In the last 30 years there have been three waves of air pollution. The first wave was from burning coal and use of air conditioners. The second wave was from unprecedented construction across the country. The third wave is the rapid expansion of the auto industry. A common argument for tolerating air pollution is that it is a "necessary evil" of economic development that also occurred in early years in the industrial countries in Europe, as epitomized by the "London Fog"^[9]. Living with the so-called necessary evil has lasted for 30 years, if not more, in China. The beneficial economic result (Yang) from air-polluting

industries is being replaced by the deleterious impact (Yin). Frequent air pollution has reduced tourism. Blocked road traffic has lowered work efficiency. Diseases caused by pollution have driven up the cost of medical care. Air pollution has become bad economically and has to be tackled as an economic issue.

Air Pollution Control Needs Vigorous Scientific Research

The adverse public health impact of air pollution is well recognized and accepted based on published research. WHO has declared that air pollution is a carcinogen^[6,10]. In this special issue, Loomis *et al.*^[11] from the International Agency for Research on Cancer (IARC) of WHO provide a review on the link between air pollution and cancer. Raaschou-Nielsen *et al.*^[12] recently published a comprehensive investigation on the link between air pollution and cancer in 17 European cohorts, and in this issue, Hoek *et al.*^[13] provides an abbreviated review on the impressive effort of this European consortium. Although air pollution is an indisputable carcinogen for lung cancer based on a number of studies, the exact link and extent of the association in China have not been established because of a lack of data. Although it is not necessary to prove a point that has been proven, much needs to be learned about the impact of air pollution. In an article by Huang *et al.*^[14] in this issue, the investigators comprehensively examine available cancer registry data and detailed air pollutant measurement data and provide an extensive analysis of the link between air pollution and cancer in China. The goal of this special issue of the *Chinese Journal of Cancer* is to bring the relationship between air pollution and cancer into focus and encourage international collaboration on this topic. We hope this special issue will stimulate discussions and help identify important questions, such as those that follow here. In addition to lung cancer, what other cancer types are caused by air pollution? What genetic and epigenetic alterations are caused by different components of air pollution? Are there targeted therapies that provide therapeutic solutions to air pollution-induced cancer? For example, are lung cancers in non-smoker Chinese women characterized by frequent mutations of epidermal growth factor receptor (*EGFR*) caused by air pollution? *In vitro* and animal model studies are needed to identify specific and targetable mutational changes associated with air pollution that may have a therapeutic solution.

Air Pollution Control Needs Technological Advancement

Air pollution control is clearly a technological issue. Old-generation technologies that emit pollutant fumes in steel- and cement-producing industries must be replaced with modern and clean technologies. Air quality must be monitored effectively through satellite and stationary devices. Collected data must be stored and analyzed using modern informatics. A national cancer registry has to be established to monitor cancer incidence and trends in a timely fashion. Personal devices that monitor exposure to pollution and easy-to-use, over-the-counter assays should also be developed as personalized medicine.

Pharmacogenomics should be extended to the arena of air pollution to fully understand the genetic and epigenetic impact of pollutants on the human genome and epigenome. Clinical trials should be initiated to match mutational events with specific silver bullets as therapeutic solutions. These are some emerging medical challenges to humanity in this era of living with cancer and with causes of cancer. Great opportunities exist for international collaborations to share information on environmental pollutions including air, water, and land pollutions and on cutting-edge technologies to reduce global environmental pollution levels. Like the war on cancer, the fight on environmental pollution has no borders.

In summary, air pollution is a smoking gun for cancer. It might

have been a necessary evil for the last 30 years in China, but it is an evil, nonetheless, that must be tackled urgently before it causes a major public health catastrophe. This is certainly easier said than done because of the multitude of political, economic, scientific, and technological issues involved. However, like Charles Caleb Colton said: "Evils in the journey of life are like the hills which alarm travelers on the road. Both appear great at a distance, but when we approach them we find they are far less insurmountable than we had conceived."

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