



Environmental pollution, public health, and energy sources

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Dear Editor,

The concern about the issue of energy sources and environmental impact has been the subject of large studies. This issue has not proved to be an easy equation, as it must consider several aspects with great impact on mankind, such as health, economic, social, and cultural factors, among others.

The replacement of fossil energy sources with low-carbon emitting technologies has been the focus of studies and discussions, with the establishment of goals and efforts at a global level.¹⁻³ Several energy sources were shown to be efficient, such as wind, solar, biomass, and hydroelectric energy, among others.⁴ The process of replacing energy sources has already begun with progressively discontinuing of fossil fuels, although the speed with which these established goals will be achieved remains unknown.

The major impacts of climate change and environmental pollution on health are of great concern.⁵⁻¹¹ Pollution has been identified as one of the main risk factors for global morbidity and mortality,⁷ responsible for the increased incidence and mortality of cardiovascular, respiratory, neoplastic, metabolic, and genetic diseases.^{5-7,9}

Environmental pollution consists of particulate matter of different sizes and chemical compositions, grouped into three different categories according to particle size: PM10, PM2.5, and ultrafine particles. It is formed by different chemical compounds, including sulfur dioxide (SO₂), ozone (O₃), nitrogen oxides (NO₂, NO), and carbon dioxide (CO₂).^{7,10} Once inhaled, the particulate material, especially PM2.5 and ultrafine particles, reaches the lungs and is

capable of reaching smaller bronchi, bronchioles, and alveoli, causing an inflammatory reaction and producing carcinogenic substances in the mucosa of the respiratory tract.¹² The particles may also enter the bloodstream and cause cardiovascular problems, oxidative stress, and several other diseases through various pro-inflammatory mechanisms.¹²

Some diseases have been particularly affected by the increase in environmental pollution, both regarding worsening of symptoms and increase in mortality, such as chronic obstructive pulmonary disease (COPD), ischemic heart disease, stroke, respiratory infections, lung cancer, diabetes, cataracts, and asthma.^{6,7,9,11,13}

Health-related costs are estimated to be very impactful. Studies have shown a significant increase in hospital visits, including visits to the emergency room due to respiratory problems and asthma exacerbation, in periods of higher concentrations of particulate matter in the atmosphere.^{5,10,11,13}

There is evidence of a synergistic effect between temperature and pollution, with temperature worsening the deleterious effects of pollution on health. In this sense, worsening of respiratory symptoms was associated with increased pollution and high temperatures, whereas higher incidences of cardiovascular problems were associated with increased pollution and low temperatures.¹⁴

Fossil fuel burning from vehicles and industrial processes is the main cause of pollution in urban centers.¹⁵ Particulate matter emission resulting from fuel burning by urban vehicles is estimated to account for 37% of urban pollution rates (CETESB, 2018).

Another study showed that the use of ethanol can reduce CO₂ emission by up to 80% compared with gasoline.²

Specifically related to the relationship between pollution and health, some more prevalent diseases are worthy of note due to the proportion of their socioeconomic consequences. Asthma, for example, is the most prevalent chronic respiratory disease in the world, affecting 358 million people.⁵

Researchers found that increased concentrations of particulate matter were associated with an increase in patient visits to emergency services and hospitalizations due to asthma exacerbation.^{5,10,16} Increased pollution was also associated with an increase in medical appointments due to cardiovascular diseases such as angina, myocardial infarction, and stroke.^{6,8} Prolonged exposure to environmental pollution also negatively affects other diseases, such as rhinitis, hypertension, neurodegenerative disorders, premature skin aging, premature birth, low birthweight, and fertility problems.⁷

Recent studies reported that pollution not only directly affects health, but also the economic sector due to increased demand in the health care system, medical appointments, additional tests, hospitalizations, and medications. Increased absenteeism and decreased work productivity and school performance also play a significant role.

Some populations are known to be more vulnerable to the deleterious effects of pollution exposure, such as people with pre-existing conditions (asthma, allergic rhinitis, COPD, pulmonary fibrosis, hypertension, arrhythmias, ischemic heart disease, diabetes, obesity), children < 5 years old, older adults > 80 years old, taxi drivers, pregnant women, people with genetic susceptibility, populations living close to industrial centers with little access to healthy food, and residents of large urban centers who use public transport in locations with heavy traffic.⁷ These populations require greater attention in situations of critical pollution levels.

Considering the aforementioned, the search for alternative energy sources that emit less particulate matter is clearly crucial. Biofuels have proved to be a viable alternative. Brazil has a privileged position in this issue because of climatic conditions and territorial extension. The development of new technologies allowed the use of ethanol, which reduced CO₂ emissions by up to 80%.^{2,4}

Biodiesel should also be carefully considered due to its capacity to reduce pollutant emission when used in urban transportation.⁴ Mixing biodiesel with diesel is already a reality, with a proven reduction in the emission of particulate matter.⁴

The research and development of low-carbon emitting technologies have positively contributed to the fight against environmental pollution. It should be noted that we are facing something new, and careful observation of what may come from these changes is still necessary.

Field management in monocultures of sugarcane, for example, which is used to obtain biofuels, can have

major impacts on the soil and the environment.¹⁷ The legislative branch needs to urgently look at this new reality with care and responsibility.

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