

Proposed Solutions to Reduce the Impact of Air Pollution on Oral and Dental Public Health

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Abstract

Air pollution plays an important role in affecting the general health of people. It can also affect their comfort and well-being and hence the quality of life. Whereas, no one can doubt that air pollution is one of the most harmful things in our daily life. Despite this, air pollution is now a common term that rings in our ears. Therefore, this is a sufficient justification that requires more studies in this important field to increase health awareness and maintain public health. Air pollution is one of those that refer to environmental pollution through gaseous, liquid, solid, or other waste products that have bad effects on the health of all creatures. The paper aims to present the impact of some sources of air pollution on animals and plants as they are among the main sources of people's food. This is in addition to presenting some diseases that affect the general health of humans as a result of air pollution, through a descriptive and observational review of the problem under study as a case in the field of oral and dental medicine. In conclusion, proposed solutions were presented to reduce the sources of air pollution for the benefit of human public health, especially in the current period as a result of the multiple mutations of the coronavirus.

Keywords: Air pollution, human, oral and dental medicine, public health, quality of life

INTRODUCTION

Every human being who breathes polluted air will be exposed to health risks, especially children, pregnant women, and the elderly.^[1,2] Infants and young children are exposed to airborne objects as a result of oral exploration, because children breathe more than adults based on body weight. Thus, air pollutants can interfere with the growth of the nervous, reproductive, and metabolic systems during childhood development. Significant lung growth also occurs during adolescence, because young adults spend more time outdoors.^[1] Therefore, it is certain that these pollutants affect poor health outcomes during pregnancy and the puerperium for both mother and child,^[2-3] and the bodies of the elderly are less able to compensate for exposure to air pollution, due to their chronic diseases such as lung diseases, asthma, diabetes, and others.^[4-6]

Numerous practical studies conducted in different universities around the world confirmed that the application of preventive measures allows participation in the development of solutions to improve the environment in a way that benefits the public health of humans, whether in the prevention of dental caries to maximize the oral and dental public health.^[7-10] While, oral

and dental diseases are among the most common diseases among humans. They can cause serious problems such as pain and headaches that lead to weakness and disabling. Bad mouth conditions may also be exacerbated by other medical conditions such as diabetes, pneumonia, and stroke.^[7] Many chronic oral and dental diseases such as tooth decay, gum disease, and the tongue are related to the environmental, social conditions and behaviors of individuals in life.^[8,9] Hence, the performance of the individual is negatively affected during daily activities when chewing, smiling, talking, brushing the mouth, sleeping, concentrating at work, etc.^[10] These and other diseases are then exacerbated by poor environmental conditions such as air pollution.

Recently, air pollution rates have exceeded all considerations, which make it imperative for everyone try to find solutions to reduce it in order to preserve public health for people. First of

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all, the effects of air pollution on human health are alarming. They are known to create several respiratory and heart conditions along with cancer, among other threats to the body as mentioned above. Based on the studies of Global Burden of Disease (GBD), they found that 1.6 million are known to have died due to direct or indirect effects of air pollution in 2017.^[11] The Health Effects Institute, the Institute for Health Metrics and Evaluation, and the GBD project reported that air pollution is estimated to have contributed to 6.67 million deaths in 2019 globally.^[12] Figure 1 shows that air pollution factor is the fourth largest of the ten-most important causes of the total number of deaths around the world. Figure 2 indicates that China and India have the highest deaths worldwide as a result of air pollution (as indicated on the map, dark blue), the latest statistical estimates in 2019 reaching 1.85 million and 1.67 million, respectively. To be honest, on the other side, this may be due to human growth and industrial growth, resulting in flourish economic in those countries.^[13] However, let's agree that there is a real big problem as a result of the recent increase in air pollution rates in many countries of the world. Therefore, the importance of this paper lies in shedding light on this subject and the need to reconsider to find solutions in order to preserve the public health of the people.

Maintaining the health of children is an essential step within the objectives of the strategies of the World Health

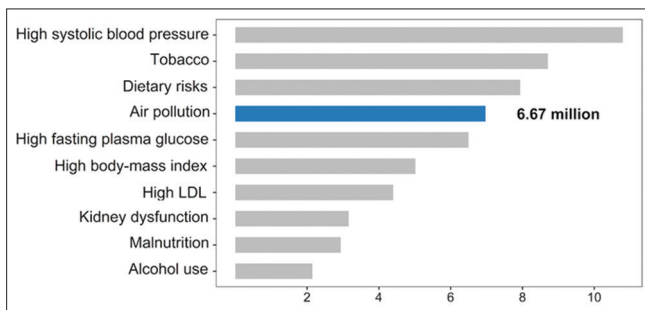


Figure 1: The influence of top 10 risk factors on total number of deaths (million) in 2019^[12]

Organization (WHO), because they are the nucleus of societies and the youth of the future. Children in areas which are exposed to air pollution are commonly suffered from pneumonia and asthma. Furthermore, air pollution causes irritation of the respiratory tract, eye, nose, and throat. The mercury which comes from fossil fuels may result in nerve, brain, and kidney damage.

Moreover, the impact of air pollution on animals comes when they feed on plants coated with particles, especially fluorine, lead, and arsenic. And then, animals may be affected by arsenic poisoning and lead poisoning, which leads to bronchitis and lack of appetite, as well as pets. These toxic chemicals may also deposit on the surface of the water, so they can also affect marine animals.

On the other hand, the impact of polluted air on plants may be from pesticide spraying, and other agricultural practices have exposed plants to a large number of air pollutants. This all has adverse effects on their growth and metabolism. Pesticides also destroy chlorophyll and disrupt photosynthesis. For example, sulfate dioxide shifts to the surface of the leaf and causes loss of chlorophyll and yellowing of the leaves, especially in leafy vegetables. Nitrogen oxide causes premature defoliation and growth inhibition resulting in reduced yield of crop plants.

It has also been proven that doctors and health-care workers are, of course, most susceptible to infection and transmission. While, many research studies have confirmed that pollution increases the risk of infection with corona.^[14-16] It showed complex interactions that can increase the sustainability of the coronavirus (COVID-19) in the air as a result of the following:

1. Transmission of infection
2. Expected physical and chemical interactions between respiratory viruses and ambient air pollutants.

There is also a popular saying that dentists are always the most susceptible to infection as a result of the COVID-19 outbreak, which makes us look to reduce sources of air pollution according to special infection control protocols.

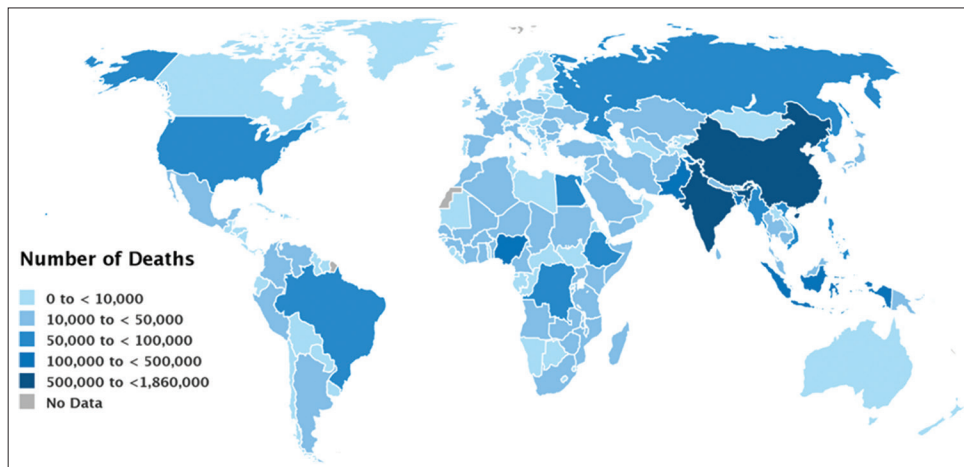


Figure 2: Number of deaths attributable due to total air pollution in 2019^[12]

The objective of this paper is to understand the risk factors and emphasize the importance of air pollution risks and awareness of it, then guide and encourage the transition to a pollution-free environment (as much as possible) according to objective criteria and essential characteristics to ensure the improvement of public health, especially in the field of oral and dental health, and provide conclusions for urgent solutions. This is to be able for provide pioneering conclusions for future solutions in the field of study.

The methodology of this work is based on the study and analysis of many data related to air pollution and oral health of the past and the reality from local and global experiences by linking three main axes: statistical results, public health, and entrepreneurship management in order to encourage access best care for “healthy people” to be able to work hard and be happy in their future quality of life.

CASE STUDY IN ORAL HEALTH

Oral health is an accurate monitoring indicator of the overall health of humans. The WHO defined oral health as “a state of being free from chronic mouth and facial pain, oral and throat cancer (oropharyngeal cancer), oral infection and sores, periodontal (gum) disease, tooth decay, tooth loss and other diseases and disorders that limit an individual’s capacity in biting, chewing, smiling, speaking and psychosocial well-being.”^[17]

Environmental pollution undoubtedly threatens the world. Various oral diseases such as tooth decay and fluorosis are affected by the quality of food that depends on animals and plants. The use of chemicals in food and water can have a significant impact on the teeth and oral mucosa, especially industrial materials and air pollution. Excess chemical concentrations are harmful elements such as nitrogen oxides, polycyclic aromatic hydrocarbons in the air, and arsenic in water, which can have a negative effect on health, especially body tissues, including the tongue, gums, and buccal mucosa.^[18-20] Without access to clean air and water, people living in developing and underdeveloped countries may experience poor oral health in adulthood. This results in, for example, tooth loss, periodontitis, and even oral cancer. Air pollution affects the development of cleft palate in some animal species. There is evidence from epidemiological data of a relationship of prenatal exposure to air pollution and the risk of clefts in the mouth. Mouth cancers and cancer are complex multifactorial diseases arising from the interaction between genetic components and environmental determinants. This study mainly focuses on the environmental pollution of air and water and its negative effects on human oral health.

In the field of oral and dental medicine, a cancerous (malignant) tumor begins in abnormal cells in the mouth. A group of cancer cells can grow into and multiply to destroy nearby tissue. The mouth is covered by a lining called the oral mucosa. The oral mucosa is made up of squamous cells called the squamous epithelium. Most often, oral cancer begins in these flat, thin

squamous cells. This type of cancer is called squamous cell carcinoma of the mouth. There are also common cancerous diseases in the mouth such as leukoplakia and erythroplakia. While there are cases in which oral cancer spreads to the lymph nodes in the neck, it is called oral cavity cancer or mouth cancer. Hence, it can be indicated that the abnormal cells are not yet cancerous, but there is a possibility that they will develop cancer, if they are not treated and the sources of pollution are stopped. The cancer can also spread (metastasize) to other parts of the body.^[21]

Researchers from Asia University and Chung Shan Medical University in Taiwan have found an association between air pollution levels and mouth cancer in Southeast Asia area. In the UK, around 7800 new cases of mouth and oropharyngeal cancer are diagnosed last year and globally there are in excess of 300,000 new cases every year.^[22-24] The number of new cases and deaths from oral cancer is also increasing in many parts of the world as a result of known risk factors smoking, drinking, tobacco, human papillomavirus, and air pollution. The organizers of this year’s Oral Cancer Action Month (www.mouthcancer.org) noted that this type of disease caused a significant increase in deaths compared to breast cancer, cervical cancer or skin cancer. It is therefore expected that around 60,000 people worldwide will be diagnosed with oral cancer each year for the next decade. It was found that when the levels of particles weighing $<40.4 \mu\text{g}/\text{m}^3$ increased, the risk of mouth cancer increased by 43%.^[25] The WHO guidelines rules state that the maximum safety level is an average annual concentration is $10 \mu\text{g}/\text{m}^3$ or less.^[26]

Several studies have also that the high levels of air pollutants such as particulate matter ($\text{PM}_{2.5}$) have been shown to increase the risk of oral cancer.^[27-29] $\text{PM}_{2.5}$ with a diameter $\leq 2.5 \mu\text{m}$ is very harmful to people’s health, as it also contributes to respiratory and cardiovascular diseases.^[30-32] Figure 3 shows a common case of oral cancer caused by air pollution.^[32]

It became clear that there is a large burden of oral diseases such as oral cancer affecting humanity as a result of air pollution,



Figure 3: One of the common cases of oral carcinoma caused by pollution^[32]

which requires appropriate care to prevent these risks. Taking into account the risks arising from the links between general health and oral health. Therefore, efforts must be made to reduce pollution by all means.

It is worth noting that a recent inaugural paper dealt with the topic of challenges facing the dentist, especially in light of the corona pandemic.^[33] It can be summarized in eight main challenges, which are as follows:

1. Does coronavirus spread only through patients with active symptoms?
2. Is the dental team well equipped to deal with COVID-19?
3. Can I run my dental practice after the COVID-19 pandemic as I run it before?
4. Is my current knowledge suitable for practice?
5. Can I be cost-effective to my patients?
6. Are dentists really at high risk when compared with other health-care workers?
7. Is managing saliva a significant challenge for the dentist?
8. Can I defer treatment to a patient during or post COVID-19?

To be more clearly, dentists use a variety of biomaterials and equipment. Some of the materials used today include heavy metals and biomedical waste, such as dental amalgam, lead, and silver. These materials may pose potential challenges to the environment. Therefore, a scientific study addresses the environmental impact of dental materials and describes measures that should be taken to reduce the harm caused by this potential waste.^[34]

To sum up, it can be said that there is a strong belief, based on accurate statistics in the field of dentistry, that air pollution has a detrimental allot of harmful effects on our health. Hence, all these harmful issues resulting from air pollution have a direct negative impact on the public health of humans. This will undoubtedly be included in one of the most important goals of the Environmental Protection Agency to serve humanity.

DATA ANALYSES AT THE GLOBAL AND LOCAL LEVELS

Although high rates of air pollution poses significant public health risks around the world. However, on the other hand, the fact confirms that there are practical international and national efforts aimed at reducing these rates. It is therefore important to review some of those distinguished efforts at the global and local levels. Hence, in this section, the available data will be collected and analyzed at the international and local levels. This is to provide a clear image of the relevant current issue, both for the specialized and general readers.

In fact, the WHO and many developed countries have long taken an interest in the issue of air pollution. Therefore, there are many scientific reports and academic research that have included important data in this context. Where a set of rules and standards have been developed that must be circulated to work to improve public health. Therefore, we briefly present

what we have concluded on the events taking place in this regard at the international and local levels.

It should be noted here that the rapid economic growth in the past 50 years has led to an increase in the number of industries, especially the automobile industry, whose operation depends on the use of fossil fuels, and then it has been confirmed that vehicle exhaust, as well as the operation of stationary engines, is the main source of air pollution. Meanwhile, during the past 15 years, the results of strategies of modern industries to reduce air pollution rates have also emerged. For example, but not limited to, the spread of solar energy technology and cars that run on nonfossil fuels, such as gas and hydrogen, as well as technology for the electric car industry, especially in the seven major industrial countries such as Germany and Japan.

Then, we briefly present the Egyptian experience during the past 10 years in this regard. At the time, Egyptian researchers and engineers were closely monitoring the situation. They had many questions and inquiries about the feasibility of these industries, especially in light of Egypt's geographical and strategic location due to many natural causes and dense human competencies. The question that we were looking for an answer to is "Where do the new industries that do not pollute the air of Egypt start from? Are they government decisions, the efforts of large or individual companies, research and development activities within those companies, or the role of Egyptian research institutes and universities? The second difficult question is from where and how do these repercussions come and how can they be stimulated. When it became clear to our Egyptian government, it began issuing instructions and putting in place the necessary legislation, which was the real locomotive to answer all previous questions with clarity.^[35,36] Now, you can imagine that Egypt has a number of plants to produce electric power using solar cells. Indeed, it has reached a number of newly built cities to be fully lit and services that use solar energy. Not only this, but a strategic plan is being implemented to manufacture electric cars in Egypt to achieve a new environmental dimension. In parallel, the Egyptian government has taken care of a number of other important related axes such as:

- Supporting environmental monitoring stations and working to verify the accuracy of the performance of their devices and increasing the number of stations in coordination between the Ministries of Environment, Higher Education, and Scientific Research
- Establishing a new sector for environmental oversight under the umbrella of the Accountability State Authority (ASA)
- Supporting the establishment of a specialized hospital by self-efforts called "57357" only concerned with the care and treatment of cancer patients from children.^[37] The hospital applies the strongest quality systems to eliminate pollution and applies the latest standard systems in preserving the environment. Cooperation protocols were also signed between Hospital 57357 and the new

environmental monitoring sector of ASA, and with a number of relevant institutions in Arab countries such as Kuwait, Sultanate of Oman, Tunisia, Iraq, Jordan, and Mauritania to exchange experiences. Discussing the development of new cooperation protocols is also necessary to benefit from successful environmental experiences in the safe disposal of all types of waste.

To briefly mention that the Egyptian experience during the past 15 years has been an ambitious plan and a role model to reduce air pollution rates at the local level, which will have a sustainable impact based on joint action in three basic dimensions: environmental, economic, and for social.^[13] However, we are still looking for more and more progress both at the international and local levels to reduce air pollution rates and improve its quality for the public health, oral and dental health, and well-being of all. This is in light of the interest in implementing pioneering actions to participate in the development of the national and global economies to achieve the desired prosperity.

CONCLUSIONS

As a result of the popular saying: the dentists are more susceptible to transmit infection and due to outbreak of the Coronavirus (COVID-19), which may require adherence to special infection control protocols. Therefore, this paper is presented as an attempt on our part to answer many of the frequently asked questions in the minds of dentists to start practicing dentistry during or after the COVID-19 pandemic. Hence, this work focuses on providing proposed solutions to common issues currently being raised that have an impact on daily clinical practice and hence the quality of life. Therefore, it has recently become important to find solutions to reduce air pollution rates to support public health. Thus, substantial entrepreneurial conclusions can be drawn from the following proposed solutions:

- The time has come to reconsider the strategies of cultural awareness bodies and ministries such as the Ministry of Culture, Information, Health, Industry, Higher Education, and Environment to cooperate with each other in countries with more deaths from air pollution rates to reduce their death rate, in light of the policies of state ministries, with low air pollution rates such as Finland, Sweden, and Australia
- It is important to conduct more specialized studies in various medical specialties in the field of oral and dental medicine in order to clarify and understand the impact of air pollution on societies with high accuracy after estimating uncertainty as one of the most important sources of confidence in the results
- Further study is needed to understand how air pollutant contributes to oral cancer in light of the expectations of the organizers of mouth cancer in 2018 (www.mouthcancer.org)^[25]
- It is important to conduct more statistical studies in this

field in relation to the population or area and per capita income

- From my opinion, the best solution to reduce air pollution is that we should understand the concept of reduce, reuse, and recycle. We should get throw away items that are of no use to us in a sound scientific way, because reuse them for some other purposes will save the environment
- It is necessary to direct the R and D (research and development) studies to the development of renewable strategies for the dentist according to the renewable mutation of the coronavirus (the latest mutation of the current corona is Omicron)
- In this difficult period result of the outbreak of the COVID-19, I think it has become necessary for the dentist to use one of the indirect communication systems with the patient using teledentistry, except in cases of necessity such as surgery, treatment of root canal, or fillings
- The dentist must also participate in preserving the environment from the dangers of harmful biological materials to human health.

Eventually, if we take the previous recommendations into account, we can actually reduce air pollution rates to participate in saving the environment and society from degradation, and then the level of human health can be improved.

Author contribution

Maryam Salah H. R. Ali designed this study, wrote the article, collected the data, and performed the analysis. The author revised the paper for important intellectual content and approved the final version.

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