Opinion

Impact of Traffic-Related Air Pollution on Public Health: A Real Challenge

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Air pollution is defined as: "the contamination of air by unwanted gases, smoke, particles, and other substances."[1] In recent decades, in many large and crowded cities of developing countries, traffic-related air pollution (TRAP) is a major public health concern. Exhaust emissions of motor vehicles are the foremost source of outdoor air pollution in developing countries. The combustion of substandard fossil fuels such as leaded gasoline also enhances air pollution. Temperature inversion is another contributing factor, particularly during cold seasons.[2] The elderly, children and those with cardiopulmonary disorders are mainly at risk from TRAP. Additionally, TRAP adversely affects the socioeconomic status of highly polluted cities.

Impacts of air pollution

According to "Nature" magazine, air pollution "has increased over all populated continents except Europe since 1973".[3] It has various short and long term public health effects and L. Perez et al. have stated that TRAP "affects 100% of the population from cradle to grave".[4] In 2008, the World Health Organization (WHO) estimated that air pollution annually leads to the premature death of around two million people worldwide.[5] In a recent animal study, it has been shown that air pollution may cause DNA mutations in the sperm of mice.[6]

Common traffic-related air pollutants in urban areas of developing countries are: particulate matter (PM), carbon monoxide (CO), nitrogen dioxide (NO_2), volatile organic compounds (VOCs) and polycyclic aromatic hydrocarbons (PAHs).[7] PM which is composed of dust and droplets[8] has more adverse public health effects. These tiny particles are classified as PM10 (less than 10 μm) and PM2.5 (less than 2.5 μm) based on their aerodynamic diameter. According to WHO guidelines, PM2.5 is more hazardous because after inhalation these particles may easily reach the lung's bronchioles and disturb its gas exchange.[4]

Some fuel additives also enhance air pollution. Sulfur added to diesel fuels is a factor for the production of two important air pollutants, sulfur dioxide (SO_2) and PM. Sulfur dioxide exposure causes eye irritation and inflammation of the respiratory tract, and presents as coughing, mucus secretion, asthma exacerbation and chronic bronchitis. People exposed to SO_2 are more predisposed to respiratory tract infections. In addition, the combination of SO_2 with water produces sulfuric acid, the main component of acid rain resulting in deforestation[4] which, in turn affects ambient air quality. Tetraethyl lead that is added to gasoline as an antiknock in car engines is an air pollutant and leaded gasoline is still used in several countries.[9] Exposure to environmental lead in highly polluted regions may disturb the autonomic function of the heart.[10] To reduce fuel knocking in a car's engine and increase its octane level, hydrocarbon mixed with benzene is added to gasoline. Continuous exposure to low concentrations of benzene from motor vehicle exhaust and other sources is associated with leukemia, particularly acute non-lymphocytic leukemia.[11] The impact of air pollutants on lung and nasal functions are known.[12]

Long-standing exposure to NO_2 increases the risk of death in cardiopulmonary patients and causes lung cancer in nonsmokers.[13] Recently, the researchers at the McGill University in Canada identified a correlation between exposure to ambient NO_2 and postmenopausal breast cancer.[14] Exposure of pregnant women to air pollutants may lead to preterm delivery.[15] Adverse effects of traffic-related particles on the central nervous system may appear as cognitive disorders in older men.[16]

Air pollution in Tehran

The first car entered Iran in 1900[17] and in due course, as the result of population growth, and increase in the number of motor vehicles as well as industrial expansion, air pollution in major Iranian cities, such as Tehran, Mashhad, Isfahan, and Shiraz gradually appeared. The estimated annual amount of air pollutants in Iran has been reported as 5 million tons.[18] In Tehran, the capital of Iran, air pollution occasionally reaches dangerous levels particularly during the cold season because of the phenomenon known as temperature inversion. Over the past three decades, air pollution in Tehran has been regarded as a multifaceted problem.[19]

Since the 1970s, several studies on Tehran's poor air quali-

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ty have been published by Iranian researchers who discussed the public health-related impacts of air pollution. A study undertaken in December, 1972 detected some polynuclear aromatic hydrocarbons in Tehran's atmosphere.[20] Assessment of air quality in Tehran from 1988 to 1993 illustrated a significant increasing trend in air pollutant levels that included SO_2, CO, total suspended PM (TSM) and hydrocarbons, all of which substantially exceeded permissible levels with the exception of TSM.[21] In a 1994 study, the association of ambient air quality to children's lung function in Tehran and rural areas was evaluated and the authors concluded that Tehran's air pollution had a short term effect on children's lung function and/or affected lung growth and development during the preadolescent period.[22]

In a study reported in 1997, the environmental conditions in Iran which included air pollution were studied and the authors noted lack of enforcement against air pollution.[23] In 1998, the researchers warned against the growing numbers of motor vehicles and danger of CO poisoning. Carbon monoxide exposure has potential health hazards which include acute respiratory problems in children, an effect on pediatric growth and increased medication use among asthmatic patients.[24]

The presence of volatile organic compounds in Tehran's ambient air was studied in 2001 and a total of 54 hydrocarbons that included benzene, ethyl benzene, toluene, xylene and its derivatives were detected. Their levels were higher in the afternoons; particularly in southern Tehran.[25] Hydrocarbon air pollutants have several major health impacts such as carcinogenic, mutagenic and teratogenic effects.[18]

A Tehran study by Masjedi et al. in 2008 confirmed that the increasing number of hospital admissions of asthmatic patients and exacerbations of chronic obstructive pulmonary disease correlated with weekly NO_2 concentrations in ambient air.[26] An investigation showed high CO levels in Tehran's air to be consistent with increasing numbers of daily hospital admissions due to angina pectoris.[27]

The authors of a paper in 2004 declared that the highest pollutant in Tehran's air was suspended PM and the monthly mean level of PM10 in Tehran was higher in autumn than spring.[28] In 2005, Ziaei et al. reported that in polluted area in central Tehran neonates born to mothers exposed to CO had increased circulating absolute nucleated red blood cells compared with those of the control group. The authors concluded that air pollution exposure during pregnancy should be avoided because it may affect fetal oxygenation.[29] The impact of air pollution on platelet activation and atherosclerosis associated with cardiovascular diseases was reported in 2010.[30] According to Hosseinpanah et al., in more polluted areas of Tehran, the passage of solar ultraviolet B (UVB or medium wave) to the earth is decreased and as a consequence, causes a reduction in vitamin D synthesis which may lead to vitamin D deficiency, particularly in women.[31] In 2010 investigators found that PM, as the major source of air pollution in Tehran's air, was increased during cold seasons. PM inhalation enhances pulmonary and oxidatative stress which in turn impacts the systemic and coronary circulations.[32] Based on several worldwide cohort studies, the life span of the general population with PM exposure may decrease between 2 to 4 years.[33]

In a recent study in 2010, a strong association was detected between children's poor lung function and increased outdoor air pollutants such as nitrogen oxide (NO) in District 12[34] located in southern Tehran, near the main bazaar. Between 1992 and 2000, a study evaluated nitrogen deposition in the greater Tehran metropolitan area. The amounts of nitrate ion ($NO3^-$), deposited as wet deposition in the greater Tehran metropolitan area was notably higher than its concentration in Chitgar Park,[35] approximately nine kilometers from Tehran.

Air pollution in Tehran is a challenge. Recently in December, 2010 schools and government offices were closed for few days due to critically high levels of air pollutants. In total, during the current Iranian calendar year which started on March 21, 2010, air pollutants in Tehran have exceeded standard levels for over 33 days.[36]

Over the past several decades in Tehran and other large Iranian cities, the following measures have been implemented to improve traffic and decrease air pollution.

• Expansion of the public transport system. Tehran's bus transport system started in the 1920s. In 2008, Tehran's Bus Rapid Transit (BRT) began with the purpose of providing a faster and more efficient public transport service. In 2001, the first two of eight metro lines were inaugurated and new lines are under construction.[37]

• The use of compressed natural gas (CNG) in the former diesel-fuelled motor vehicles, especially in taxis and buses.

• Annual technical inspection of motor vehicles.

• Restricted traffic zones in Tehran to prevent the use of private motor vehicles during peak traffic hours in the city center. Air pollution is more severe in southern Tehran and the city center when compared to the northern districts, due to lower altitude.[38] Entering traffic zones needs a special permit.

• In 1993, Tehran Municipality established the Air Pollution Control Company and this company has founded a few air pollution control stations in Tehran.[39] The Pollution Indicator Boards continually monitor the level of common air pollutants such as PM10, NO_2, SO_2, CO, and ground-level ozone in addition to displaying the Pollutant Standards Index (PSI) which classifies the levels of each pollutant as safe, hazardous or dangerous.[37]

• A ten year Master Plan to control air pollution in Tehran was proposed in 2001.[40] However, after ten years, it has not been fully implemented.

• Since 1989, the urban green space per capita in Tehran has increased significantly from 2.5 m^2 to 10 m^2 in 1993,[41] yet it is low. For instance, this figure in Sao Paulo, Brazil in 2010 was around 50 m^2 per capita.[42]

Below is a list of some current challenges that need to be addressed in order to prevent public health hazards of traffic-related air pollution in Tehran and other large Iranian cities.

• The present capacity of the public transport system in Tehran is insufficient. Tehran with an area of about 900 km^2 is the most crowded city in Iran. Over the past decades, its population and surrounding areas have grown significantly due to mass-migration from rural areas.[38] Based on the latest census in 2006, Tehran's population was about 11 million.[36]

• Tehran has a capacity for 700,000 cars but the current number exceeds three million.[37] Approximately 70% of Tehran's air pollution is caused by motor vehicles.[43]

• Substandard fuel quality and old cars, including taxis, have been blamed for ambient air pollution.

• Meteorological factors: Tehran is surrounded in its northern, eastern and southeastern borders by mountains. Temperature inversions frequently trap Tehran's polluted air.[38] In addition, one of the main components of photochemical smog formed at the ground-level is ozone which arises from the interaction of nitrogen oxides and VOCs with sunlight. Ground-level ozone pollution is highest during sunlight in Tehran. According to WHO guidelines, excessive ozone exposure adversely affects health and results in aggravation of such respiratory disorders as asthma.[4] Air pollution may decrease rainfall[44] and decreased rainfall in turn may lead to increased concentrations of ambient air pollutants.

Source: http://www.presstv.ir/detail/153074.html

Suggestions

The main question is how to combat TRAP more effectively, however, the answer is not simple. Thus it seems that the following items should be reconsidered and fully implemented.

• Enhancing new existing motor vehicle technologies based on international standards; it is particularly mandatory in the car manufacturing industry.

• Enforcement of technical inspection and maintenance of motor vehicles.

• Discarding old cars and motorcycles with faulty combustion systems.

• Expanding and improving the current public transportation system, including the metro. A study in Mashhad, Khorasan Province in northeastern Iran showed that low usage of public transportation by civilians was due to bus shortages, irregularities in the public transportation system, bus delays and crowded bus stations.[45]

• Public training on the health-related impacts of air pollution is essential. Ordinary face masks are not helpful for protection against air pollutant hazards. According to WHO guidelines, an efficient face mask should filter particles smaller than 2.5 μm and tightly seal around the mouth and nose of the wearer.[46]

• Continuous air quality monitoring is required. According to WHO guidelines, in many polluted cities of the world, the average annual levels of PM10 are more than 70 $\mu g/m^3$, but the safe level is less than 20.[4]

• In order to combat TRAP, active participation and close cooperation between citizens, NGOs, universities and business organizations is essential.[47]

• Increasing urban green spaces is highly recommended. Physical and psychological well-being are among the several benefits of urban green spaces.[48] In addition, a study showed that the severity of air pollution in Tehran's districts was directly correlated with the green space area per capita and vegetation cover density. Urban green spaces improve air quality by absorbing common air pollutants such as SO_2, CO and nitrogen oxides.[49] Nevertheless, the capacity of natural environments to remove air pollutants differs widely based on their type.[50]

• Establishing specific bicycle riding lanes reduces air pollution,[47] however, full implementation of safety measures including helmet use is mandatory to prevent bicycle-related injuries.[51] In a study, Japanese investigators studied those travel behaviors and psychological factors that may affect the use of automobiles and suggested a useful method called the "Travel Feedback Program" for modifying travel behaviors.[52]

• Avoiding unnecessary transportation and instead using telephone, mobile, mail and e-mail for correspondence by governmental organizations is helpful.[47]

• Mutual cooperation between health authorities, public transport and traffic experts are required for combating pollution, otherwise they independently may either under evaluate or overestimate the problem.[53] WHO guidelines must always be considered as valid principles in planning and decision-making to more effectively combat TRAP health impacts.

• Living near busy roads and highways is a known health risk factor. American investigators recommended assessing the relationships between residential proximity to highly polluted roads and various unfavorable respiratory impacts, especially in children.[54] A cohort study on TRAP and death was conducted in 2008 in Canada which showed that such residential proximity resulted in a shorter life-span compared to the natural life span of people who lived farther

away.[55]

• To protect public health in polluted megacities, reduction of sulfur content of diesel fuels to 15 ppm, known as ultra-low-sulfur diesel fuel, is highly suggested.[56]

• Last but not least, fighting air pollution necessitates sound scientific research in large Iranian cities.

In conclusion, the public health issue briefly addressed in this article is of paramount importance for the Iranian medical community and the urgency of measures to reduce TRAP cannot be overemphasized. Tomorrow is too late.

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