



Vehicular air pollution: Human health in urbanized Cities with emphasis on Quetta, Pakistan

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Abstract

Vehicular air pollution is recognized as the major source of air pollution contributing 40-80% of the total air pollution affecting human health directly or indirectly. The drastic climate change owing to the expanding economic activities in the mega cities of the developing world have compromised human health, causing around 7 million premature deaths with larger number of hospitalization cases. Vehicular exhaust has become the main source of air pollution emitting carbon monoxide, nitrogen oxides, hydrocarbons, and particulate matter. It is very important to have depth knowledge about urbanization and human biology for analyzing the adverse effects of environmental pollution on human health. Current review highlights major vehicular air pollutants and the resulting human ailments including, respiratory, cardiovascular and neuropsychiatric disorders demonstrating the state of research regarding the significance of vehicular air pollution in the urban cities and its impact on human health. Quetta is the main capital city of Balochistan Province but with poor urban planning. This study urges to draw the attention of high ups to construct environment friendly policy in all new housing schemes and also implement strict rules in major cities to improve the standard of life.

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Introduction

Only in the late 1950s, it was realized that certain chemical pollutants were capable of persisting in the environment for longer period of time, migrating between air, water, soils, sediments and accumulating to levels that could harm wildlife including human. Air pollution is a major problem of the recent decades having serious toxicological impact on both human health and environment (Robinson *et al.*, 2005). The sources of pollution vary from small unit of cigarettes and natural sources such as volcanic activities to large volume of emission from motor engines of automobiles and industrial activities (Habre *et al.*, 2014). Long-term exposure to air pollution contributes to the onset of a number of diseases including respiratory infections and inflammations, cardiovascular dysfunctions and cancer, genetic disorders and man infertility (Rumana *et al.*, 2014).

Persistence of DDT an insecticide having potential environmental impacts described in 1962 by Carson brought the issue into public eye, shortly thereafter discovery of polychlorinated biphenyl's in fish throughout Sweden (Jensen *et al.*, 1996) showed that industrial chemicals designed for use in closed systems were entering the environment and accumulating to significant concentrations.

Current set criteria for pollutants are ozone, nitrogen dioxide, sulfur dioxide, lead, carbon monoxide (CO), and particulate matter (PM) including particles of size less than 10 μ m in diameter (PM₁₀), and those with size less than 2.5 μ m in diameter (PM_{2.5}) (DOI: 10.1111/risa.13174). Vehicle on the roads have considerably increased in the U.S. and elsewhere in the world over the past 20 years (Schrunk *et al.*, 2007) and have become the dominant source of air pollutants such as carbon monoxide (CO), carbon dioxide (CO₂), volatile organic compounds (VOCs) or hydrocarbons (HCs), nitrogen oxides (NO_x) and particulate matter (PM) (WHO, 2005).

The increasing intensity and duration of traffic congestion increases pollutant emission, contributing to deterioration of the air quality, particularly on and near large roadways in populated areas. The vehicular emissions in the urban areas are contributing to risks of morbidity and mortality for drivers, commuters and individuals living nearby roadways, shown by epidemiological studies, evaluations of proposed vehicle emission standards", and ecological impact assessments for specific road projects (Trueman *et al.*, 2007). It is very important to have in depth knowledge about urbanization and human biology for analyzing the adverse effects of environmental pollution on human health, in particular in country like Pakistan including other third world countries where limited data is available regarding vehicular emissions, traffic flow and federal air quality standards are not maintained. Current review would give an insight about the unhealthy effects of environmental pollution and major diseases that are associated with elevated level of vehicular emissions.

Respiratory disorders

Most pollutants enter the body through airways and respiratory system is thus in the battle line for the onset and progression of diseases from air pollutants. Depending on the dose of inhaled pollutants, and deposition in target cells cause a different level of damages in the respiratory system. Despite epidemiological evidences concerning vehicular air pollution having adverse respiratory disorders many playgrounds is adjacent to roadways causing sustained exposure to particulate matter (PM₁, 0.02–1.0 μ m diameter) causing long-term health risks for exercising children and young adults. Prolonged and sustained exposure to vehicular air pollution both gaseous and particulate including CO, NO₂, SO₂, PM₁₀, and PM_{2.5} cause asthma, a respiratory disease developed as a result of exposure to air toxicants and may also lead to lung cancer (Brunekreef *et al.*, 2009). Other air pollutants such as dust and O₃ have been associated with chronic obstructive pulmonary disease (COPD) though the evidences are still limited (Bahadar *et al.*, 2014).

Cardiovascular Dysfunctions

A growing number of epidemiologic studies have explored relation between air pollution exposure and cardiac-related illnesses (Andersen *et al.*, 2012). Short-term exposure to PM_{2.5} can trigger myocardial infarctions, cardiac ischemia, arrhythmias, heart failure and even sudden death, while prolonged and chronic exposure to moderately elevated levels of PM enhances the risk for developing a variety of cardiovascular diseases, possibly including hypertension and systemic atherosclerosis. (Sun *et al.*, 2008). Exposure to high levels of NO₂, is associated with right and left ventricular hypertrophy.

Neuropsychiatric disorders

The association between nervous system and air suspended toxic materials has always been argued, however multiple epidemiological studies have shown air pollution is contributing to neurodevelopmental and neurodegenerative disorders and central nervous system is target for adverse health effects of air pollution. Exposure to air pollution and traffic-related air pollution primarily diesel exhaust (DE) may lead to neurotoxicity and neurodevelopmental (e.g. autism spectrum disorders) and neurodegenerative (e.g. Alzheimer's disease) disorders with devastating consequences, particularly in infants.

Studies have been reported having relationship between air pollution and neurobehavioral hyperactivity, criminal activity, and age-inappropriate behaviors (Newman *et al.*, 2013) and elevated risk of neuro-inflammation (Calderon *et al.*, 2008). Alzheimer's and Parkinson's diseases (Calderon-Garciduenas *et al.*, 2008). Some studies illustrated that aggression and anxiety in megacities are in close association with the elevated stage of air pollutants (Evans *et al.*, 2003).

Kidney disorders

In addition to traditional risk factors, such as hypertension and diabetes an increasing body of evidence demonstrates that air pollution could be possible risk factor of chronic kidney disease CKD

and even kidney cancer in groups exposed to gasoline vapors, engine exhaust, polycyclic aromatic hydrocarbons and other air pollutants. A short-time particulate matter (PM) exposure was associated with increased urinary sodium excretion (Tsai *et al.*, 2012) and acceleration in the progression of albuminuria during chronic exposure to ambient particles (PM₁₀) (Xu *et al.*, 2016).

Skin diseases

Skin is the largest and outermost body organ serving as physical, chemical and immunological barrier against environmental factors and pollutants. Human skin is exposed not only to natural environmental factors but also to pollutants of anthropic origin (Valacchi *et al.*, 2012).

Various air pollutants such as ultraviolet radiation, polycyclic aromatic hydrocarbons, volatile organic compounds, oxides, particulate matter, ozone and cigarette smoke affect the skin by inducing oxidative stress. Polyaromatic hydrocarbons are associated with extrinsic skin aging, pigmentation, cancers and acneiform eruptions. Volatile organic compounds have been associated with atopic dermatitis (Poonam *et al.*, 2017). Particulate matter penetrates skin either through hair follicles or transdermally induces oxidative stress, contributing to extrinsic skin aging, characterized by pigment on the face and nasolabial folds, and by coarse wrinkles, solar elastosis and telangiectasia (Lademann *et al.*, 2014).

Mortality and morbidity

Rapid urbanization and increased energy consumption worldwide have compromised wellbeing of the human. Ozone, CO, SO_x, and PM have each been linked with increased mortality rates (Abbey *et al.*, 1999), exposure to elevated level of vehicular air pollutants causes diseases such as cardiovascular and respiratory and may even cause death. (Xu *et al.*, 2000). It has been estimated that chronic, low-level contact to air pollution shortens life expectancy by one to two years, a substantial effect related to other environmental risk factors (Zmirou *et al.*, 1998). By preexisting morbidity its effects on pulmonary

function can be affected, such as asthma. When asthmatic and non-asthmatic subjects are considered discretely, nonasthmatic subjects exhibited little to no effect of air pollution, whereas asthmatic subjects showed declines in measures of pulmonary function (yang *et al.*, 1994). Although air contamination can have health effects all through the body, the target organ for many major urban air pollutants is the respiratory system. In a recent review, (Schwela *et al.*, 2000). Noted these effects: “acute and chronic changes in pulmonary role, amplified incidence and prevalence of respiratory symptoms, sensitization of airways to allergens, and exacerbation of respiratory infections, such as rhinitis, sinusitis, pneumonia, alveolitis, and legionnaires’ disease.” However, the current evidence is mixed as to whether air pollution exposure reduces pulmonary function (Schwartz *et al.*, 1989). Asthma exacerbation can also be caused due to air pollution In 1996, natural experiment was conducted in order to support such causes (Friedman *et al.*, 2001).

Disorders associated with environmental pollution

The World Health Organization air quality guidelines are based on four major air pollutants, namely particulate matter, ground-level ozone, nitrogen dioxide and sulfur dioxide (WHO, 2006).

Ultraviolet radiation is a physical pollutant. The solar spectrum consists of ultraviolet A (320–400nm), ultraviolet B (290–320nm) and ultraviolet C (200–290nm). More than 95% of ultraviolet A and 1–5% of ultraviolet B reach the Earth’s surface, whereas most ultraviolet C is absorbed by the ozone layer and oxygen in the atmosphere (Dessinioti *et al.*, 2010). Texture of skin, Texture of skin and Wrinkles are produced as a result of exposure of UV radiation to skin (Flament *et al.*, 2013).

Nitrogen oxides are emitted mainly from mobile and stationary combustion sources. They react with O₃ or radicals in the atmosphere, forming NO₂. Among NO_x, NO₂ is known to cause oxidative damage resulting in the generation of free radicals that may oxidize amino acids in tissue proteins and initiate lipid peroxidation of polyunsaturated fatty acids

(Ebrerlein-Konig *et al.*, 1998). Atmospheric sulfur dioxide is formed from fuel combustion from industrial processes, volcanic activity and forest fires. Carbon monoxide, a product of incomplete combustion from mobile sources, acts on cell metabolism which binds to heme and alters its function (Kampa *et al.*, 2008). Flexural eczema was associated with traffic-related air pollutants, including nitrogen oxides and carbon monoxide in Taiwan in middle-school children. A study comparing atopic eczema in East and West Germany showed that the prevalence was higher in East Germany (sulfurous type pollution) and also exhibited a stronger association with nitrogen oxides and close proximity to heavy traffic (Drakaki *et al.*, 2014).

Air pollutants, consisting of complex and varying mixtures of different size and composition particles suspended in the air was called particulate matter (PM). Factories, power plants, refuse incinerators, automobile, construction activities, fires and natural windblown dust are some of the main sources of PM (Dagouassat *et al.*, 2012). Their major components are metals, organic compounds, material of biologic origin, ions, reactive gases, and the particle carbon core (Kampa *et al.*, 2008).

It is an important indoor source of air pollutants. A longitudinal study has shown that symptoms of atopic dermatitis increase in children shifted to a new building due to an increase in exposure to volatile organic compounds (Okada *et al.*, 2012).

Volatile organic compounds along with sunlight and nitrogen oxides form photochemical oxidant products such as ozone at ground level which is the summer photochemical smog. Volatile organic compounds (ingestion of hexachlorobenzene) may induce precancerous skin lesions in rats (Kim *et al.*, 2015). Exposure to volatile organic compounds increases cytokines (interleukin-8 and interleukin-1B) in cultured keratinocytes which cause atopic dermatitis or eczema (Michielsen *et al.*, 1999). Heavy metals Cadmium, lead and mercury are common air pollutants that pose health hazards.

The main sources are volcanoes, waste incineration, cement, iron and steel production and leaded gasoline (Mancebo *et al.*, 2015).

Conclusion

Pollution from industrial and transportation sources has been the main cause various diseases. These environmental pollutants have drastic adverse effects on the human health. This review was designed specifically to investigate harmful effects of various pollutants that pose serious threats to human health in particular and environment in general. A lot of studies have reported that environmental pollutants not only affect the human physiology, growth and development but also result in numerous dysfunctions of cardiovascular, neuropsychiatric and respiratory system of human beings. Nonetheless, effects of pollution should be subject to rigorous research to study the degree of issue, it's likely the outcomes and ways to hinder the effects of pollution on human health and safety. More studies should also be conducted for understanding the effects of environmental contaminants, so that we may save this planet and make it a better place to live in.

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