THE ROLE OF MOTOR VEHICLES IN THE DEVELOPMENT OF CHRONIC DISEASE

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Abstract

Transportation is a means which facilitate human activities either the work or entertainment. In the modern era, humans create a variety of vehicle to support the quality of life and help the daily activities. The rapid development in urban India has resulted in a tremendous increase in the number of motor vehicles. In most of the cities, this has doubled in the last decade. Rapid urbanization and growth of motor vehicles impose a serious effect on human life and the environment. Transportation is a major source of air pollution in many countries around the world due to the high number of vehicles that are available on the roads today. Transport sector contributes a major sector, contributing 90% of total emissions. The pollution caused by motor vehicles is also known as vehicular pollution. It is a serious threat to the environment as well as human health which causes several chronic diseases including nausea, difficulty in breathing, skin irritations, birth defects, immunosuppression and even cancer. All these situations indicate that the excess use of motor vehicles becoming a major problem in Indian context and there is an essential need to build up healthy environment and increase the level of research around the world. The present study is a review of an increase in motor vehicles in India and its effect on human health.

Keywords: Motor vehicles, Air pollution, Human health, Chronic Disease, Carcinogenicity,

Introduction:

Transportation is an important social determinant of human health. Transportation barriers disproportionately affect the most vulnerable groups of society who carry the highest burden of chronic diseases. Therefore, it is critical to identify interventions that improve access to motor vehicles. We synthesized evidence concerning the types and impact of interventions that address transportation to chronic care management. While overall life expectancy has increased since the 1940s, chronic conditions remain the top three causes of death, with heart disease and cancer accounting for 45% of all deaths in 2015 [1, 2]. Chronic diseases by nature require patients to have capacity and stamina to manage their treatment effectively. Efforts to meet goals and decrease burden of illness, though, can last a span of years or decades. To manage their illness, chronic care patients are tasked to consistently make outpatient clinic appointments and obtain medications. Access to transportation, therefore, is a necessity to ensure the completion of this care. The growing cities, increasing traffic, trajectory growth, rapid economic development and industrialization with higher levels of energy consumption have resulted in an increase in pollution load in an urban environment. Vehicular pollution is the major environmental risk to health and is estimated to cause approximately 2 million premature deaths worldwide per year [3]. Besides health effect, vehicular pollution also contributes to tremendous economic losses, especially in the sense of financial resources that are required for giving medical assistance to the affected people [5, 6]. Known factors that influence access to transportation include socioeconomic status, ethnicity, geography (i.e., urban vs. rural), age, mode and type of travel, and distance or time burden [7]. Inaccessibility to health care due to lack of transportation affects the most vulnerable groups of society such as low-income inner-city residents who often belong to ethnic communities [6, 8]. Multiple nationally-representative datasets have revealed that

patients in ethnic minority groups were less likely to obtain medical care due to transportation barriers, controlling for socioeconomic status, and that patients who were white generally had increased access over those identifying as non-white [7], suggesting that transportation options are limited in minority communities.

Reasons of Vehicular Pollution:

Though there are a lot of reasons of vehicular pollution in India however, some of the most important are detailed below-

- **Urban population:** Between, 1951 and 2011, the urban population has quadrupled, from 62.4 million to 377.1 million, and its proportion has increased from 17.3% to 31.16% [5]. In 1991, there were 18 cities with a population of over 1 million; this is estimated to extend to 46 cities. This rapid increase in unplanned urban population has resulted in an increase in consumption patterns and a higher demand for transport, energy and other infrastructure, thereby putting a load on the pollution problem [27].

- **Vehicular Population:** In India, the vehicle population is growing at the rate of over 5% per annum and today the vehicle population is approximately 40 million. The vehicle mix is also unique to India in that there is a very high proportion of two-wheelers are 76% [21]. The growth rate of vehicles is the backbone of economic development and the Indian automotive industry. Today, in the country about 7-8 million vehicles are produced annually. In 2011, the country reported 141.8 million registered motor vehicles. The Road transport sector accounts for a share of 4.8% in India's GDP [13]. In India, the

number of motor vehicles has grown from 72.7 million in 2004 to approximately 141.8 million in 2011, of which two-wheelers (mainly driven by two-stroke engines) accounts for approximately 72% of the total vehicular population. There is a direct relationship between road transport system and air pollution in a city. Vehicular emissions depend on vehicle speed, age of vehicle and emission rate. In general, the average peak hour speed in Indian cities is far less than the optimal one. Growing traffic and limited road space have reduced peak-hour speeds to 5- 10 Km/h in the central areas of many major cities. We must retain that the estimation of road transport pollutant emission should allow significant disaggregation of the result by fuel type and composition, by vehicle type, by emission standard. In general, one differentiates also emission produces in and out of the city, and also time scale can be necessary, depending on the objectives of the environmental assessment [24].

Numbers of vehicles sold in India are increasing at a rapid rate. In 2005-06, there were 8.9 million vehicles sold and in five years this number has scaled to 15 million (in 2010-11). It is alarming to note that 32% of these vehicles are running in metropolitan cities alone, which constitute about 11% of the total population. Delhi, which contains 1.4% of the Indian population, accounts for nearly 7% of all motor vehicles in India. Two wheelers and cars account for more than 80% of the vehicle population in most large cities. During the year 2000, personalized vehicle population share was more than 90% of the total vehicle population in 6 out of 13 sample sites. The share of buses is negligible in most Indian cities as compared to personalized vehicles. For example, two-wheelers and cars together constitute more than 95% of vehicles in Kanpur and 90% in both Hyderabad

and Nagpur, whereas in these city buses constitute 0.1, 0.3, and 0.8% respectively [28]. A motorization rate in India is 26 vehicles per 1000 population and this is lower than many developing countries through the world, but over the last three decade's number of motor vehicles has been doubling against a 2-5% annual growth rate in Canada, the US, the UK and Japan [12].

- **Vehicle Fuel pollutants:** Automotive vehicles emit several pollutants depending upon the type of quality of fuel consumed by them. The release of pollutants from vehicles also includes fugitive emissions of the fuel, the source and level of these emissions depending upon the vehicle type, its maintenance, etc. The majority pollutants released as a vehicle/fuel emissions are carbon monoxides, carbon dioxides nitrogen oxides, photochemical oxidants, air toxics namely benzene, aldehydes, 1,3-butadiene, lead, particulate matter, hydrocarbon, oxides of sulphur and polycyclic aromatic hydrocarbon [6]. Automobiles are the primary source of air pollution in India's major cities. In India, transportation sector emits an estimated 261 tonnes of CO_2, of which 94.5% is contributed by road transport. The transport sector in India consumes about 17% of total energy and responsible for a 60% production of the greenhouse gases from various activities. The pollution from vehicles is due to discharge like CO, unburnt HC, Pb, NO_2 and SO_2 and SPM mainly from tailpipes. Vehicles in major metropolitan cities are estimated to account for 70% of CO, 50% of HC, 30- 40% of NO_2, 30% of SPM and 10% of SO_2 of the total pollution load of these cities, of which two-thirds is contributed by two-wheelers alone. These high levels of pollutants are mainly responsible for respiratory

and other air pollution-related ailments including lung cancer, asthma, etc., which is much higher than the national average [3,4].

Status of Country:

Total Indian transport emission of CO_2, CO, NO_2, CH_4, SO_2, PM, HC, N_2O and NMVOC are significant in almost all over the country. During 2003–2004, total transport emission of CO_2 was 258.10 Tg. The CO_2 contribution of road sector, aviation, railways and shipping was 243.82 Tg (94.5%), 7.60 Tg (2.9%), 5.22 Tg (2%) and 1.45 Tg (0.6%) respectively. Road sector and aviation mainly contribute 3.03 Tg (53.3%) and 2.57 Tg (45.1%) of CO. Among all types of transport, road and aviation are the major contributors to air pollution [5].

Emissions from different vehicle type of India:

Among different types of vehicles, Trucks and Lorries contribute 28.8% CO_2 (70.29 Tg), 39% $_{NO2}$ (0.86 Tg), 27.3% SO_2 (0.19 Tg) and 25% PM (0.03 Tg), which constitute 25% of the total vehicular emission of India. Similarly, two-wheelers are a major source of CO (0.72 Tg; 23.7%), CH_4 (0.06 Tg; 46.4%), and HC (0.46 Tg; 64.2%) and buses are emitting NO_2 (0.68 Tg; 30.7%) and PM (0.03 Tg; 20.5%). Vehicular emissions vary with type, efficiency and the type of fuel used. Emission analysis based on the vehicle type reveals that bus and Omnibuses contribute higher CO_2 (CO_2: 96.5%, NO_2: 2.28%) compared to two-wheelers (CO_2: 86.8%, CO: 7.18%, HC: 4.6%). Passenger light motor vehicles (CO_2: 86.8%, CO: 7.6%, NO_2: 1.9%), cars and jeeps (CO_2: 98.8%), taxi (CO_2: 94.6%, SO2: 4.68%), Trucks and Lorries (CO_2: 97.6%, NO_2: 1.2%), goods light motor vehicles (CO_2: 98.4%), and trailers and tractors (CO_2: 98.4%) is different [7].

Pollution Load from road traffic in various megacities:

The vehicle pollution load as estimated through a joint study conducted by Central Road Research Institute (CRRI), National Environmental Engineering Research Institute (NEERI) and Indian Institute of Petroleum (IIP) in the year 2002 for four key pollutants (i.e. CO, NO_2, HC and PM) in eight megacities, namely Delhi, Mumbai, Kolkata, Chennai, Bangalore, Hyderabad, Kanpur and Agra. This is attributable to the highest number of automobiles operating in Delhi. From the study, it can be seen that Delhi has the maximum vehicle pollution load compared to any other city in the country.

Vehicular pollution problems in India:

Motor vehicles have been closely identified with increasing air pollution levels in urban centers of the world [9,11]. Besides substantial CO_2 emissions, significant quantities of CO, HC, NO_2, SPM and other air toxins are emitted from these motor vehicles in the atmosphere, causing serious environmental and health impacts. Like many other parts of the world, air pollution from motor vehicles is one of the most serious and rapidly growing problems in urban centers of India [10]. The problem of air pollution has assumed serious proportions in some of the major metropolitan cities of India and vehicular emissions [11]. Although recently, improvement in air quality with reference to the criteria pollutants (viz. NO_2, SO_2, CO and HC) have been reported in some of the cities, the air pollution situation in most of the cities is still far from satisfactory. The problem has further been compounded by the concentration of a large number of vehicles and comparatively high motor vehicles to population ratios in these cities [12].

Health effects of vehicular pollutants:

The vehicle emissions have damaging effects on both human health and ecology. There is a wide range of adverse health effects of the pollutants released from vehicles. The effects may be direct as well as indirect covering right from reduced visibility to cancers and death in some cases of acute exposure of pollutants especially carbon monoxide. These pollutants are believed to directly affect the respiratory and cardiovascular systems. In particular, high levels of Sulphur dioxide and Suspended Particulate Matter are associated with increased mortality, morbidity and impaired pulmonary function [15, 16].

Pollutants specific health effects (CPCB, 2010): Pollutant specific health effects of vehicular

emissions are as below:

a. **Carbon monoxide**: Carbon monoxide (CO) is an odorless, invisible gas created when fuels containing carbon are burned incompletely poses a serious threat to human health. CO is known to cause death at high levels of exposure. The affinity of blood hemoglobin is 200 times greater for carbon monoxide than for oxygen, CO hinders oxygen transport from the blood into the tissues. The effects of this gas on human have been shown even at low levels of exposure. The low level of exposure accelerates and angina (chest pain) in people having coronary artery diseases [18]. Healthy individuals are also affected, but only at higher levels. Exposure to elevated CO levels is associated with the impairment of visual perception, work capacity, manual dexterity, learning ability and the performance of complex tasks.

b. **Nitrogen Oxides**: Nitrogen dioxide (NO_2) has been linked to increased susceptibility to chronic infection, increased airway resistance in asthmatics, and decreased pulmonary function. It has been shown that even short-term NO_2 exposures have resulted in a wide range of respiratory problems in school children; cough, runny nose and sore throat are among the most common. The oxides of nitrogen also contribute to acid deposition on plants and surface water resulting in damages of trees and aquatic life [19]. NO_2 emissions also increase the levels of particulate matter by changing into nitric acid in the atmosphere and forming particulate nitrate.

c. **Photochemical Oxides (Ozone)**: There is no release of ozone as such from the vehicles, but it is formed as a result of chemical reactions of volatile compound and NO_2 in the presence of heat and sunlight. In other words, the pollutant release from vehicles also results in the formation of ozone through chemical reactions [20]. The ground level ozone, which is the main part of the smoke, can cause chronic problems such as chest pain, cuffing etc. The ozone gas is known to cause inflammation respiratory tracks, reduction in the ability to breath (lung function), increase in asthma and other lung diseases. In addition to, effects on human health, ozone is also known to adversely affect the environment in many ways, including reducing yield for crops, fruits, commercial forests, ecosystem etc.

d. **Oxides of Sulphur**: High concentrations of sulfur dioxide (SO_2) can result in temporary breathing impairment in asthmatic children and adults who are active outdoors. Short-term exposures of asthmatic individuals to elevated SO_2 levels while on moderate exertion may result in reduced lung function that may be accompanied by such symptoms as wheezing, chest tightness, or shortness of breath [22]. Other effects that have been associated with longer-term

exposures to high concentrations of SO_2, in conjunction with high levels of PM, include respiratory illness, alterations in the lungs' defenses, and aggravation of existing cardiovascular disease

e. **Gaseous Air Toxins**: The hydrocarbon emissions release from vehicles also contained toxic air pollutants that may have a significant effect on public health particularly the chronic diseases[23].

f. **Benzene**: Benzene is a known human carcinogen by all routes of exposure. Low term respiratory exposure to high level of ambient benzene has been shown to cause cancer all the tissues that formed white blood cells. Exposure to benzene or its metabolites have also been linked with genetic changes in human and animals [25]. The occurrence of certain chromosomal changes in individuals with known exposure to benzene may serve as a marker for those at risk of contracting leukemia.

g. **Formaldehyde**: Formaldehyde has been classified as a probable toxin to the human being. Epidemiological studies suggest that long-term inhalation of formaldehyde may be associated with tumors of the nasopharyngeal cavity (generally the area at the back of the mouth near the nose), nasal cavity and sinuses [26]. Formaldehyde is also known to produce mutagenic activity.

h. **1, 3-Butadiene**: 1,3-Butadiene has also been classified as a Group B_2 carcinogen based on evidence from two species of rodents and epidemiologic data [6].

i. **Lead**: Lead affects many organs and organ systems in the human body, with sub cellular changes and Neuro developmental effects appearing to be the most sensitive. Lead also causes impaired sensory motor function and renal functions. A small increase in blood pressure has also been associated with lead exposure. Airborne lead can be deposited on soil and water, thus reaching humans through the food chain and drinking water [6]. Atmospheric lead is also a major source of lead in household dust. Ingested, inhaled or absorbed through skin. 86% of atmospheric lead auto exhaust, leaded petrol, water pipes, paint, battery storage, crystal glass, ceramic glaze, enamel jewelry, etc. Lead concentration in dust is directly proportional to the volume of traffic. Children absorb 50% and adults 10-20% of ingested lead. Lead in tissue, cord blood correlates with air levels. The effect of lead is on GIT, peripheral nerve, central nervous system, decreased IQ, convulsions, coma and death [15].

j. **Particulate Matter**: represents a broad class of chemically and physically diverse substances that exist as discrete particles (liquid droplets or solids) over a wide range of sizes. Particles may be emitted directly to the atmosphere or may be formed by transformations of gaseous emissions such as sulfur dioxide or nitrogen oxides. The key health effects associated with PM include premature death, aggravation of respiratory and cardiovascular disease, as indicated by increased hospital admissions and emergency room visits, school absences, work loss days, and restricted activity days; changes in lung function and increased chronic symptoms; changes in lung tissues and structure; and altered respiratory defense mechanisms. Exposure to coarse fraction particles is primarily associated with the aggravation of respiratory conditions such as asthma. Fine particles are most closely associated with health effects such as premature death by cardiopulmonary diseases [17].

k. **Suspended particulate matter (SPM)**: In particular, high levels of sulphur dioxide and suspended particulate matter (SPM) are associated with increased mortality, morbidity and impaired pulmonary function. Environmentalists claim that living in an Indian metropolitan city is like smoking 10-20 cigarettes every day. More than 40,000 people die prematurely every year because of air pollution, says a World Bank report, of which Delhi's share is the highest i.e. 19% [10]. Out of all causes of death, 16% and 27% deaths are due to chronic infections and respiratory diseases and cardiovascular problems in India respectively. If we compare the past data of 1984, 1988 and 1998 it is seen that the chronic disease like asthma and bronchitis among the different age groups are increasing; especially the senior citizens are most affected [14].

Conclusion:

Various studies revealed that motor vehicle emissions are the combination of various pollutants which have the potential to result in adverse health effects, including carcinogenicity, mutagenicity, cardiovascular mortality and the aggravation of the health of the vulnerable group such as people with compromised health conditions like the asthmatics, children and elders. The acute exposures have resulted in hospitalization due to chronic diseases while health effects such as carcinogenicity, mutagenicity, cardiovascular health conditions lead to chronic exposures. Therefore, it is recommended that effective vehicle emission control strategies should be developed and implemented. Vehicle maintenance and inspection program should be developed to ensure the effectiveness of the vehicle emissions-control systems. Proper maintenance, inspection, clean car, use of clean fuel is the ways to reduce emissions. It's often been said that we only have one earth and we should do everything to protect it. One cannot afford to sit on the

sidelines and watch because when it comes to pollution, everyone is affected, even the ones that did not contribute to it. Vehicle transportation is one of the leading causes of air pollution the world over. The good thing is that something can actually be done about it. It begins with individual responsibility in having a cleaner planet. When people change their mindsets and become more proactive, a lot of good things can be achieved. In the same manner, vehicle pollution can also be reduced and managed so that the casualty due to chronic disease can be minimized.

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