

Organic and In-organic Impacts of Road Dusts: Effects on Humans and Adjoining Communities

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ABSTRACT

Road side dust is a major health issue in both developed and developing parts of the world but worse in the later. This research perspective view paper takes a cursory looks at elemental components of roadside dusts along with its microbiological composition and the general impact on humans. Literature search was carried out for articles on roadside dusts, elements, heavy metals, microorganisms, and impacts on humans using online electronic databases such as Google scholar, PubMed, SciElo, Elsevier, and Science Direct for the past 15 years (2006-2021). Data obtained was analysed qualitatively after relevant information on the topic was extracted. The study found that non-carcinogenic elements include Ca, Fe, Mg, Cu, and Zn while Pb, Hg, Ni, Cr, Cd and As are generally grouped as carcinogenic and are released and suspended from various anthropogenic activities on the roads and streets. Apart from cancers, metallic pollutions could predispose to other diseases such as cardiovascular, respiratory, obstetric complications and renal. Contaminated foods from such dusts could also lead to various infections and infestations of the lungs and the intestines. Policies aimed at reducing heavy metal pollutions and roadside dusts in Nigeria and sub-saharan Africa, and indeed most of the developing world should be strengthened and actively enforced to curb the negative impact of roadside and street dust on humans.

Keyword: Dust, Impact, Humans, In-organic, Heavy Metals, Microorganisms, Organic, Roadside

INTRODUCTION

Travelling by road is generally the commonest and by far the cheapest and most convenient means in most parts of the world except in communities dominated by water bodies where water transport becomes more reliable means. This

places the roads within towns and cities and those ones outside the urban centres under heavy vehicular pressure. Just to mention a few: the total length of the Federal roads in Nigeria stood at 36,182.8 kilometres by 2018 consisting of 24,414.7 with asphaltic

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concrete, 60,008.6 surface dressed, and 5,759.5 with gravel or earth; Pakistan on the other hand has about 263,775 kilometres of Federal road network^{1,2}.

Road dust is raised by wind in form of secondary suspension thereby carrying heavy metals released due to vehicular and human activity with it and also the natural dust and contaminants of the respective environment. Heavy metals that contaminate road dust emanate principally from Vehicle tail exhaust pipe, brake pads, brake disks, tires, and road surface abrasion and corrosion. Activities involving all these components lead to generation of heavy metals into the air such as Zinc (Zn), Manganese (Mn), Iron (Fe), Lead (Pb), Barium (Ba), Mercury (Hg) Antimony (Sb) and Cupper (Cu). These heavy metals and other elements can easily enter the human body through inhalation into the lungs, through open wounds and cuts on surface skin, through intact skin, and by eating foods covered with such dusts³⁻⁶.

Irrespective of the mode of entry into the body, some of these heavy metals can generally aggravate several diseases in the body such as: cardiovascular, respiratory compromising the lungs, metabolic, and malignancies among others. This has made suspended heavy metals inside dust on our highways of importance to us. This perspective view paper looks at the nature and patterns of suspended dust on our highways with the aim of raising the awareness of this serious medico-social condition and how to mitigate it^{7,8}.

MATERIALS AND METHODS

The study was based on a systematic review of articles on heavy metals in road dust pollution and the health effects in the past 15 years (January 2006-December 2021). The search was carried out on online electronic databases such as Google scholar, PubMed, SciElo, Elsevier, and Science Direct. The key words used in the search include: Heavy metals and Dust, Street Dust, Road side Dust, Indoor Dust,

Health Hazards and Road Dusts, Health impacts of Road Dusts, and, Health Risks and Road Dusts. Articles written on both primary and secondary data were considered as well as review articles provided relevant information was captured. Either the abstract or the whole article that met the selection criteria was read and relevant information extracted. Data obtained was analysed qualitatively by taking notes of various elements detected in dusts in different locations as well as any associated social or perceived health hazards.

Composition of roads' inhaled dusts

While the composition of the soils on which the roads are constructed in terms of mineral composition may vary from region or country to another, the machines, the fossil fuel they combust, the tires, brake system and other components may be closely similar from one country to another. The volume and nature of various anthropogenic activities may also influence the dust composition and heavy metal loads. In Massachusetts in Boston USA, an analysis of dusts adjoining roads showed high levels of Fe, Ti, Cu, Ba, Calcium (Ca), Potassium (K), Molybdenum (Mo) and Zirconium (Zr)⁹. In Krakow Poland, Cu was found to be 15 times higher in road dust compared to other environments while elements such as Zn, Mn, Fe, Pb, Ba, and Sb were equally found to be high in varying forms of multiple proportions. This was largely from anthropogenic sources¹⁰. In another study on at least 130 road dusts in Xinyang China, it was found that the concentration of the four heavy metals Pb, Zn, Cu, and Co were exceptionally higher than that of the background in over 99% of the samples analysed¹¹. An analysis of the concentration of two heavy metals Lead and Platinum (Pt) in road dusts in South Africa showed concentrations in the range of 103 to 1,928 µg/g and 2 to 391 ng/g, respectively. This was adjudged extremely high compared to the background; the high Pt concentrations were however believed to be due to

the mining activity of this element¹². Also in a study carried out in the Metropolitan Area of Sao Paul Brazil, it was found that the high levels of Ba, Cd and Sb originated from the brake and hydraulic system of vehicles while the high levels of Zn, Sr, Co, and Tungsten (W) came from the wear and tear of tires and pavements¹³. Findings from Russia, Austria, Turkey, Indonesia, Egypt and Argentina about the elemental composition of road dusts were essentially similar and many others¹⁴⁻¹⁹.

In Egypt however, a study on the detection of Polycyclic Aromatic Hydrocarbons (PAHs) on road side dusts showed that: PAHs such as (naphthalene, benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene and benzo(a)pyrene) were detected in high levels capable of initiating carcinogenesis in children¹⁸.

Road side dusts in Nigeria

Less than 1/10th of the entire Nigerian road network is properly paved or covered with laterite, and hence

moving on such roads leads to generation of enormous dusts from the original soil in addition to other vehicular emissions. In Kano, road side dust samples were analysed using flame atomic absorption spectrometry and were found to contain high levels of Cd, Cr, Ni, Pb, Cu, and Zn²⁰; in Lagos, a similar study found Ca, Cd, Cr, Cu, Fe, Mg and Mn to be high in road side dust in mainland areas²¹; and in Jimeta/Yola, Fe, Zn, Pb, As, Cu, Ni, Cr, and Cd were found to be the major elemental pollutants of roadside dusts²². Similar findings were recorded in Ibadan and Damaturu^{23,24}. Dusts could carry several microorganisms such as: *Shigella spp*, *Salmonella spp*, *Escherichia spp*, *Staphylococcus spp*, *Streptococcus spp*, among the bacteria, and *Penicillium spp*, *Aspergillus spp*, *Fusarium spp*, *Acremonium spp*, and *Cladosporium spp* among fungi; several viruses and unicellular parasites causing various diseases as well²⁵⁻²⁷.

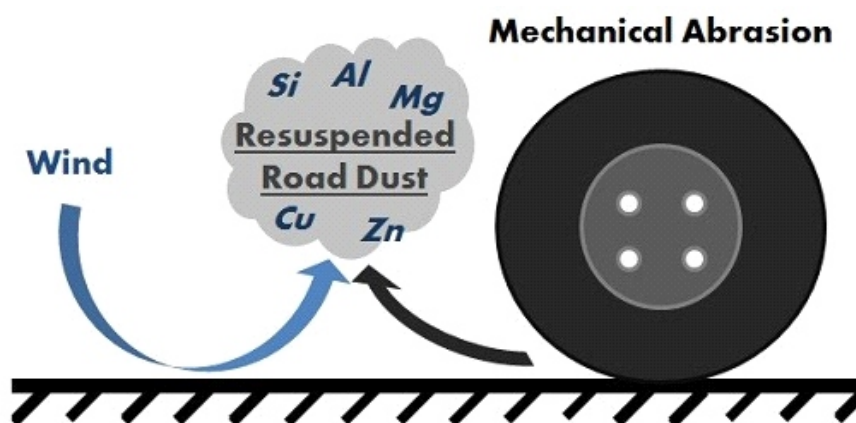


Figure 1: Mechanism of generation, suspension and resuspension of heavy metals in road dusts (Culled from Hetem IG and Andrade MDF, Atmosphere, 2016)

DISCUSSION

In Nigeria and most parts of sub-saharan Africa where infrastructural constraints such as lack or poor road network is still a major public issue, un-tarred roads constitute a major source of dust in communities situated along busy bad roads. The social impacts of dirty and dusty vehicles, dirty and dusty clothes of travelers, accelerated wear and tear of the vehicles plying these roads, and similar impacts on people living along such paths is enormous. Contamination of foods and drinks with dust laden with microorganisms along these roads causing different gastrointestinal and skin diseases is one major health factor in addition to the inhalation of these biophysical dusts and potential lung impacts.^{28,29} Elements found in roadside dusts have generally been grouped into carcinogenic and non-carcinogenic to both children and adults. The non-carcinogenic elements include Ca, Fe, Mg, Cu, and Zn while Pb, Hg, Ni, Cr, Cd and As are generally grouped as carcinogenic. It has generally been established that high concentrations of these heavy elements will tilt the Air Quality Index (AQI) of the surrounding towards the abnormal with elevated Hazard Index (HI); a continuous inhalation, ingestion or absorption will lead to elevation of Target Hazard Quotient (THQ) and Incremental Lifetime Cancer Risk (ILCR). The higher the ILCR of an individual the higher the chances of sustaining cancer diseases from prolonged exposure to these heavy metals above baseline levels. The occasional finding of bronchogenic and other lung cancers unexpectedly in non-smokers could be traced to the contributory role of heavy metals in roadside dusts together with other industrial and anthropogenic activities emitting same in the environments^{30,31}. The suspended heavy and light elements in roadside dusts have also been closely linked with intrauterine growth retardation, intrauterine foetal death and premature labour³².

It is indeed a good development as fossil fuel engines of automobiles are being gradually phased out in the western world to cut down accumulation of these heavy metals and others in the environments. This technology should be facilitated and extended to Sub-saharan Africa reputed for dusty roads to help curb this menace, and also encourage the utilization of mobile devices such as bicycles that do not need fossil fuel for their activity. The expansion and modernization of the rail transport system in Nigeria and the African continent in general should be accelerated, and also closely backed with vigorous asphalted road constructions to reduce dust in our proximal road settlements.

CONCLUSION

Roadside dust emanates from the soil upon which the road sits, the anthropogenic activities from combustion and non-combustion components of vehicles plying the roads, and the wear and tear of tires and other surfaces in friction with road surface. The dust contains both microorganisms and elements and can enter the body through ingestion, inhalation, intact skin, and cuts and are capable of causing diseases in man. While the microorganisms may cause various infections and infestations, the elements generally grouped into carcinogenic and non-carcinogenic may cause several diseases such as cardiovascular, respiratory, renal and cancers. The non-carcinogenic elements include Ca, Fe, Mg, Cu, and Zn while Pb, Hg, Ni, Cr, Cd and As are generally grouped as carcinogenic. Road dust generation in Nigeria and many parts of Africa is still high due to poor unpaved road networks polluting communities that line those roads.

Recommendations

Mechanical mobile devices relying heavily on fossil

fuel consumption should be phased out on Nigeria and other African roads in general and be substituted with less fossil fuel consuming devices for both unitary and mass movements. Also the poor road networks in Nigeria, Africa and elsewhere should be urgently constructed and paved to reduce dust in the skies over those regions along with the associated risks to human health. Policies aimed at strengthening and enforcement of cutting down suspension and re-suspension of dusts and heavy metals should also be put in place.

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