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Effects of dust storm on health in the Nigerian environment

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Abstract
This paper assessed the ecotoxicity of dust storm on human health risk in the Nigerian environment. Samples of dusts on the rural road and outdoor dusts from the residences close to the road were collected. The common ecotoxicologic micro technique was used to analyze and detect native microbial agents. The results showed that rural environment is generally coated with dusts and visibility is relatively lower in dry than rainy season. These dusts contained typical microbial agents that correlate with those causing respiratory diseases. Adverse health effects arising from exposure may include pulmonary dysfunction, airways responsiveness, immunological factors and endotoxins. Planning implication may involve biological monitoring based on regular air sampling collection which may serve as an appropriate and non-invasive means of sampling exposure among the populace. The study equally highlights the potential hazard of dusts containing potential lethal microbial endotoxins that pose a risk for direct toxicity.

Keywords: Atmospheric pollutants, Dust, Hyper responsiveness, Environmental microbial endotoxin.

Introduction

Exploitation of natural resources has occurred with disregard to the environment and the people whose lives were affected by the development of those resources. In an effort to alter and shape the environment, volatile and toxic chemicals from various sources had polluted the atmosphere with disastrous consequences of denuding the earth of ground cover and concerted vast areas of developing regions into 'Dust Bowls' (Clay and Dahl 1996, Kaumus and Wolf, 1996, Science Daily 2003). Regardless of how well one country deals with its own sources of pollution, environmental problems may remain until individuals as well as all stake holders especially industries, Federal, States and Local governments initiate effective constructive procedures of the rural areas as well as prevention of imminent decay.

Industri`alized nations are known to produce both toxic industrial and agricultural volatile chemicals that escape into the air (Simonic and Hites 1995). Therefore, atmospheric pollutants such as sulfur dioxide (Wellburn 1988) and nitrous oxide (Weiss 1981) may be carried halfway around the world before descending in rain water to pollute soil and kill vegetations. Volatile chemicals such as PCBs and all its derivatives may be carried from warmer to colder regions of the world via dust bowls (Washington State Department of Health 1993). For instance, depletion of ozone layer by hydrocarbons is an international problem of immense concern (Simonic and Hites 1995). Though, the earth can absorb the environmental impact of humans to a degree, we are fast approaching a limit where changes begin to influence climate and the destruction of the environment unabated. The primary urban pollution and the persistence of environmental problems of rural regions in the Nigerian environment necessitate the need to study some of the impact of dust storm on health. Since Nigeria environment is permeated with dusts for most part of the year, there is need to greatly enlighten public awareness of the potential dangers written in the dust. The primary objective of this study was to evaluate the potential dangers of dust exposure in the rural areas. The study had two specific aims: to determine to what extent the rural air dusts and surface dusts from near-by residential homes contain microbial agents that are hazardous and discuss the human health impact of dusts.

In the early 18th century, some studies showed that most if not all respiratory disorders were associated with workers exposure to dusts from vegetable fibers and grains (Lang 1996).

Although, in 20th century, concerns were focused on factories and related issues of workplace conditions (Monarca et al 1996). In recent times, occupational health is magnified as industrial disasters, mine cave-ins, factory expositions and sweatshop fibers (Wolf 1998). These have painted a picture of delusion myth of urban life in contrast to rural and highway road maintenance. The rural and feeder roads have largely been ignored even though agriculture was the source of some of the earliest recognized occupational disease (Lang 1996).

The types and sources of dust storm problems in Nigeria vary greatly from region to region. For example, while combustion of fossil fuels and small scale industries are the main contributors in most urban areas, organic and inorganic air dusts primarily from large trucks transporting goods are the principal sources in rural areas. A situation whereby the imbalance in the quality of air capable of causing adverse effects is ' written ' in the dust and which has characterized the typical hard-looking life style in third world particularly in the rural areas are still present. In urban areas, a large proportion of acute traumatic injury and death comes from accidents, explosion and those that inflict chronic injuries upon workers including noise-induced hearing loss and vibration–associated diseases of the back (Clay and Dahl 1996). In particular are the chemical dusts which post risks for direct toxicity and possibly cancer, example is the firewood or cook stove smoke (Smith 1993, Smith 2007).

Though, dust storms and particles may reduce harmful effects of ultraviolet radiation from the sun (Bruce 1990), many organic dusts may account for most common exposure leading to respiratory diseases that come from dusty roads, in mining of minerals, agriculture, whether in bush burning involving farm machinery, or in confinement unit containing organic dust rich in endotoxins such as in a terminal grain elevator and silos. In addition, flaring of petroleum gases and other gases released in industries at potentially lethal concentrations (e.g. chlorine, hydrogen sulfide, ammonia etc) diesel exhausts, chemical solvents, welding fumes, infectious agents and viral diseases from animals, organic and inorganic dusts which can intensify any of the other (Ogbeide and Aisien 2000). Also, environmental problems have arisen from over population and rapid overuse of natural resources. Much surface water is contaminated with heavy metals including lead, cadmium and burning of mercury gold amalgam to release the bound gold, release mercury fumes which injure workers and settled on vegetation where, it is eventually washed by rain into the soil and rivers. Studies of reservoirs downstream demonstrate chemical contaminants in water and sediment samples (Tehseen et al 1994).

Also, several studies have reported household dust (Lewis et al 1994) and yard soil (Fenske et al 1990, Iversen et al. 2000) as significance sources of exposure to dust residues and other toxicants. In the instance where data reporting of dust poisoning cases are neither lacking nor having any indicator of the hazards associated with dusts in the immediate environment, it is pertinent to present reporting data that allow assessment of the overall prevalence or severity of chronic exposures to dusts. To this end, this study attempt to provide information on human exposure to rural dusts and discuss its potential health risk in the Nigeria environment. However, present reporting data do not allow assessment of the overall prevalence severity of chronic exposures to dust. Reliance on such statistics may be limited by at least three factors:

(1) Reported cases generally involved only acute intoxications as in cases of asthma incidence.
(2) Even acute cases may not be recognized or reported consistently by physicians as dust or allergen related.
(3) Cases tend to provide little information for exposure mitigation. Thus, properly focused environmental sampling represents more reliable and preventive approach for investigating public health concerns related to human exposure to dust storm.

Materials and Methods

Study design

This study employed a cross-sectional environmental seasonal photography and five sampling sites. The period of study and photography extended from acute dry (January – February) and rain (May to October) seasons. Sampling goals were to collect raised dusts on feeder road mainly plied by trucks transporting agricultural produce and goods. In addition, to collect dusts from outdoor areas at each residence located at about ten feet distance to the road. Aba Joshua near Yekemi village located at about 25 kilometers NE from Ile-Ife was chosen for study because of its unique location as a typical rural settlement. Its residents are all engaged predominantly in agricultural production of tree fruits including

cocoa, oranges, kola nuts, pears and cashews (fig 1).

Sampling and analysis

Five locations within the designated settlement were chosen for sampling. A 26cm diameter Petri dish was placed on the ground in front of each of these residences for twelve hrs. A layer of settled dust was scrapped with the edge of 5-inch stainless-steel spatula. A wet cotton swab was used to collect raised dust after each passing vehicle on the same dusty road. Dust samples were summed together, sieved through a 150-mm stainless mesh top to remove large non-dust debris, hair and other fibers, to yield the smaller-diameter particles shown to adhere more readily to the hands following the method of Driver (Driver et al 1989). The sieved dust samples were stricken on agar non-defined culture medium.

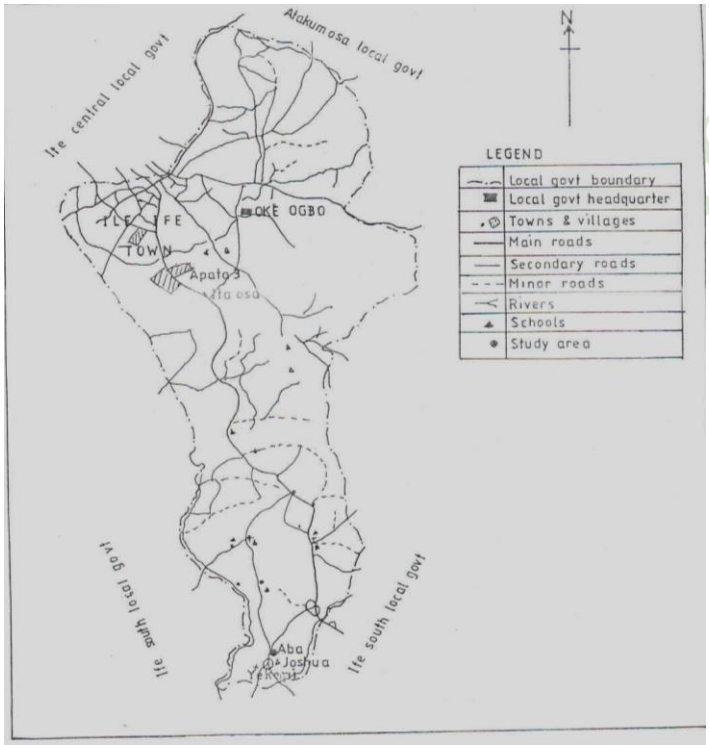

Fig.1 Location of sampled area (Aba Joshua village) in Ife East local government, a distance of about 25km from Ile-Ife township

Table 1: Prevalence of microbial count at 37^0 C in the air dust.

Microbial species	Viable cell count (CFU/g)
Alternaria	1.403×10^{11}
Aspergillus	1.502×10^{11}
Bacillus	6.17×10^{12}
Proteus	7.82×10^{9}
Staphylococcus	6.53×10^{12}
Streptococcus	4.86×10^{10}
Fusarium	5.08×10^{11}
Penicillium	7.74×10^{11}
Escherichia	9.24×10^{9}
Clostridium	8.26×10^{12}
Actinomycetes	7.45×10^{10}
Botrytis	4.52×10^{9}

Results and Discussion

Analysis of dusts contained microbial agents that normally reside in soil (Table 1) and are also found in homes as part of household dusts. Bacteria such as Clostridium species, Actinomycetes and Molds such as Alternaira and Botrytis among the materials found in the rural dust. Often it turns out that these microbes and/or dust particles are culprit as the cause of major problems with airway diseases. A comparative photography of dusty (dry season) and clear (rainy season) roads in the same vicinity is shown in Fig 2a&b and Fig3a&b. One thing that stands out is that this rural environment generally is coated with dust boom and visibility is relatively lower in dry than rainy season. Given that reality, it is striking that rural residents have such major problems with airway diseases. The frequencies of detectable soil microbes were negligible during the wet seasons. Nonparametric analysis of variance of soil dust revealed a tendency for microbe's concentrations in the dry season dusts to decreasing with increasing distance from the road. However a significant difference was observed across the wet season.

Rural inhabitants and some urban dwellers encounter a variety of airborne organic dusts between 30-40% of particles in the respirable range (Wolf 1998 and Hurley et al. 2002). This includes molds, pollens and dusts generated by moving vehicles on the dusty roads, cement bagging, stone quarries and silos dusts. Organic dusts measured in enclosed settings such as in the living rooms are biologically active. Along with suspected inorganic matter (primarily silicates), contain plant materials (spores and pollens), animal derived particles (Skin, hairs, feathers, dropping urine) bacterial and fungi, mites, insect and other anthropoids, insect fragments, feed additives (including antibiotics), pesticides and microbial toxins (including glucans from molds). Fungal mycotoxins and endotoxins lipopolysaccharide fraction of certain bacterial cell walls and cobb-webs are also included (Roberts et al 1992).

Potential dangers of unwritten dust

Human health impact of environmental dust on streets and rural raised dust has not been addressed. Except a patient is diagnosed in specific global environment e.g. mushroom growers or cotton environment, it could be hard to understand why airways diseases are expressed as flu-like symptoms, such as general weakness, headache, chills body ashes and cough. Chest tightness and shortness of breath may also occur. At any rate, adverse health effects arising from exposures to dust storm may include pulmonary dysfunction, airway responsiveness, immunological factors and endotoxin (Ogbeide and Aisien 2000). Endotoxins are released into the surrounding environment during active cell growth or breakdown (Lyses) or when bacterial cells are engulfed by immune cells called phagocytes. The symptoms of the self-limited respiratory illness include chest tightness and cough much like symptoms of byssinosis (Science Daily 2003). Exposure to dust endotoxins cause an influx of inflammatory cells into the lungs. They bring with them and release various agents called cytokines which cause swelling, exudate or seepage from blood vessels. These are very potent inflammatory agents (Shaw et al 1994).

Dust endotoxin

Initially, the response to endotoxins may seem to be allergic (Lang 1996 Science Daily 2003). The most recent understanding of the situation is that there are acute and chronic forms of dust diseases in general (Ogbeide and Aisien 2000 European Commission 2008). An estimated 30-40% of people exposed to organic dusts will develop organic dust toxic syndrome (ODTS) (WHO 1990). As to the chronic response, symptoms would be similar but one must have had a history of prior exposure, i.e. presence of serum antibodies to that dust while the response in the lung is lymphocytic.

Summary and planning implications

This paper has shown that the particle dust contains microbial agents that account for the most common exposure to respiratory disease. It also shows that the intendment environment is playing a tremendous role in the increasing prevalence of organic dust toxic syndrome among the populace. Finally, provocation of endotoxins in dust storm is a big factor. Planning implication may involve biological monitoring based on regular air sampling collection which may serve as an appropriate and non-invasive means of sampling exposure among the populace.

a

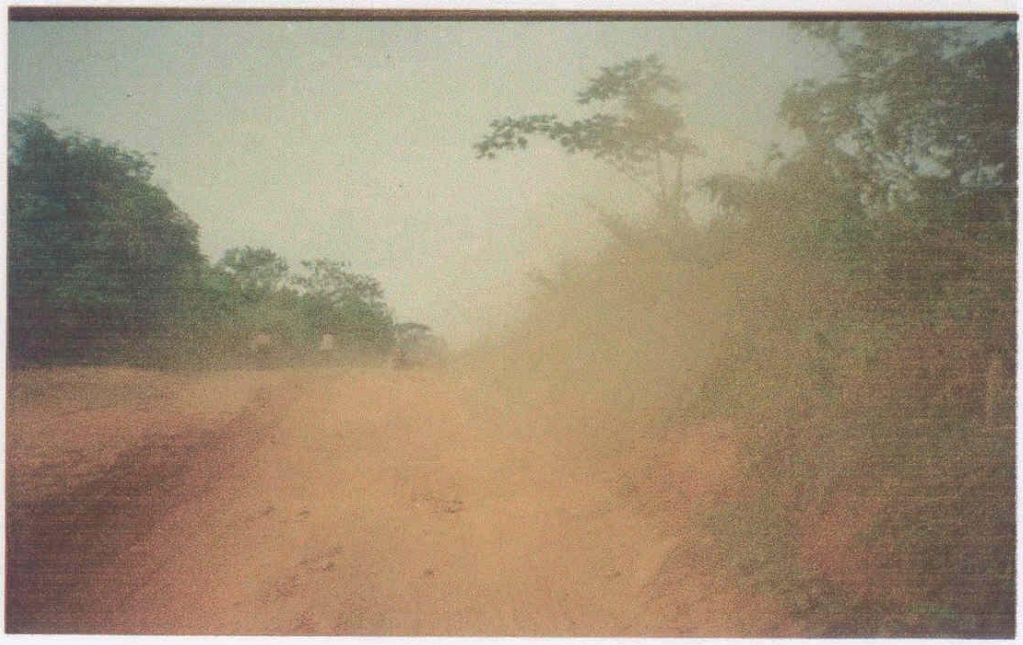

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FIG. 2: Showing a typical feeder road and risk of exposure to microbial endotoxin. note the figure of persons on the road

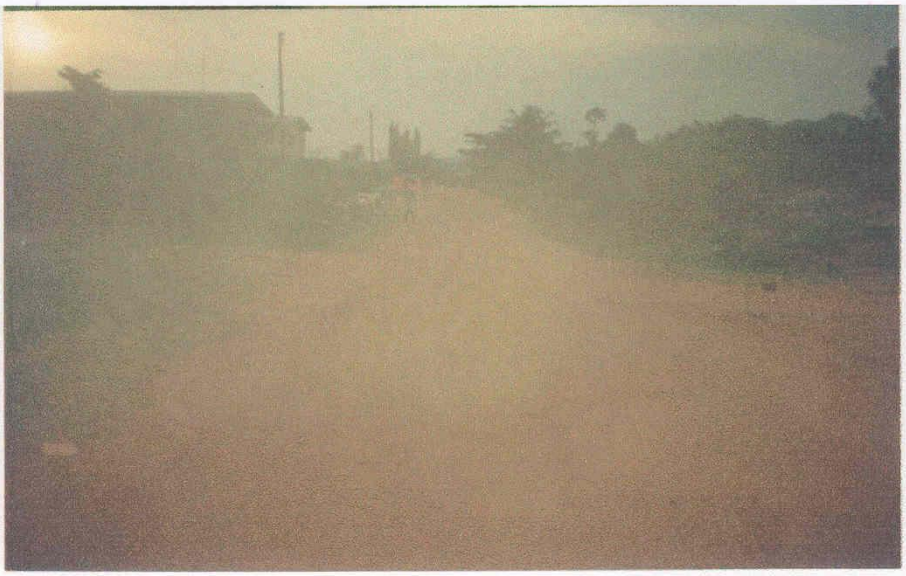

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FIG. 3: Showing contrast of dusty and clear road. Note the figure of man on the road in the pictures.

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