

Environmental Dioxin Pollution and its
Influence on the African Americans

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Abstract

Dioxins are a group of chemically-related compounds that are persistent environmental pollutants and are formed as an unintentional by-product of many industrial processes involving chlorine such as waste incineration, chemical and pesticide manufacturing and pulp and paper bleaching. Some toxicity of other dioxins and chemicals like PCBs that act like dioxin are measured in relation to TCDD. However, dioxin is a general name for a large group of chemical compounds with similar structure. These compounds are made up of the number of the chlorine atoms and their positions in the dioxin molecule are what determine the toxicity of different dioxins. Dioxin is formed by burning chlorine-based chemical compounds with paper mills which use chlorine bleaching in their process and with the production of Polyvinyl Chloride (PVC) plastics and with the production of certain chlorinated chemicals. In September 1994, by the U.S, Environmental Protection Agency clearly describes dioxin as a serious public health threat. According to the EPA report, not only does there appear to be no "safe" level of exposure to dioxin, but levels of dioxin and dioxin-like chemicals have been found in the general U.S population that are at or near levels associated with adverse health effects. Dioxin was the primary toxic component of Agent Orange, which was found at Love Canal in Niagara Falls, NY and was the basis for evacuations at Times Beach, MO and Seveso, Italy. The most toxic compound is 2, 3, 7, 8 - Tetrachlorodibenzo - Para - Dioxin or TCDD.

Introduction

Dioxins are environmental pollutants. Dioxins are of concern because of their highly toxic potential [1]. Children receive greater exposures to environmental pollutants presents in air, food, and water because, they inhale or ingest more air, food, or water on a body-weight basis than adults do. The people of color are disproportionately exposed to hazardous wastes, dioxin, and air pollution. Existing data demonstrate that children of color are the subgroup of the population most exposed to certain pollutants. For example, lead, air, pollution, and pesticides can be harmful. Children of color are least protected from, environmental health threats. For instance, the air intake of a resting infant is twice that of an adult under the same conditions. They are more active and more curious. Children often play at ground level where pollutants can concentrate. There are many effects on how dioxin can harm human health. Long-term exposure is linked to impairment of the immune system, the developing nervous system, the endocrine system and reproductive functions. Dioxin exposure can damage the immune system, leading to increased susceptibility to infectious diseases, and can disrupt the function of regulatory hormones or its biological action. Some short-term exposure of humans to high levels of dioxins may result in skin lesions, such as chlorance and patchy darkening of the skin, and altered liver function. Due to the omnipresence of dioxins, all people have background exposure and certain level of dioxins in the body, leading to the so called body burden. Current normal background exposure is not expected to affect human health on average. However, due to the high toxic potential of this class of compounds, efforts need to be under taken to reduce current background exposure. The developing fetus is most sensitive to dioxin exposure. Newborn, with rapidly developing organ systems, may also be more vulnerable to certain effects. Some people or groups of people may be exposed to higher levels of dioxins because, of their diet. For example, high consumers of fish in certain parts of the world; or their occupation, which include: workers in the pulp and paper industry, in incineration plants and at hazardous waste sites [2]. Molecular studies have proven that TCDD is a potent carcinogen which could disrupt multiple endocrine pathways via Aryl-Hydrocarbon Receptors (AhR) widely present in animals and humans [3]. TCDD induces a broad spectrum of biological responses, including induction of Cytochrome P-450 1A1 (CYP1A1), disruption of normal hormone signaling pathways, reproductive and developmental defects, immunotoxicity, liver damage, wasting syndrome, and cancer [4].

Dioxin Exposure

Dioxin, like DDT, does not break down easily in the environment. Instead, it bio-accumulates. This means that, the body accumulates any dioxin to which you are exposed too. Over time, continual low level exposures will "build up" until subtle adverse health effects begin to occur. Exposure to Agent Orange conferred a 2-fold increased risk of developing prostate cancer [5]. EPA report, most people thought they lived near an incinerator, a contaminated site, a pulp and paper mill or other direct source. People that ingest dioxin through the meat, dairy products, fish and

eggs they consume. A recent study by Dr. Arnold Schecter of the State University of New York at Binghamton found dioxin in many food products purchased in an upstate New York super market. Schecter estimated that the average daily intake of dioxin is “at least 50 times greater than what EPA estimates is a virtually safe dose of dioxin”. Who is likely to have the highest dioxin levels in their bodies? People that eat more than two in land fish meals a month, people who live near a dioxin source or eat food produced near a dioxin source. Anyone who eats a lot of meat, dairy products, or fish can be harmed. Dioxin is so pervasive that limiting further exposure of the American people cannot be accomplished through lifestyles or dietary changes. The only sensible way to limit further exposure is to shut down the sources of dioxin contamination. Animals are exposed primarily from dioxin emissions that settle onto soil, water and plant surfaces. Soil deposits enter the food chain by ingestion by grazing animals. People then ingest dioxin through the meat, dairy products, fish and eggs they consume. How can dioxin damage us? EPA report is full of new information on dioxin including information on how dioxin-like chemicals (PCBs, furans) damage the body. Scientists have identified a series of steps that are necessary for most, if not all of the observed effects of dioxin and related compounds. Once dioxin is in the body, the molecules of dioxin (the more dioxin you are exposed to the more dioxin molecules present in the body) “Attach” to specific receptor “sites” in cell tissue much like a ship pulling into a loading dock at a pier. When dioxins and dioxin-like chemicals occupy this site instead of hormones and enzymes, select normal cell functions cannot be carried out. One of the most striking findings of the report is the significance of what past dioxin exposures may mean for public health. According to EPA, some adverse effects of dioxins occur at levels slightly above average body burden levels currently found the population and that “as body burdens increase within and above this range, the probability and severity as well as the spectrum of human non-cancer effects most likely will increase”. This means that, as a society, we have been accumulating dioxin and dioxin-like chemicals in our body. It will only take a small additional exposure to “push” us over the edge and trigger adverse health effects. For most people, any exposure to dioxin, no matter how small, may lead to some adverse health effects. In other words, no amount of additional exposure to dioxin is safe. There are many way on what consumers should do to reduce their risk if exposure. Trimming fat from meat and consuming low fat dairy products may decrease the exposure to dioxin compounds. Also, a balanced diet (including adequate amounts of fruits, vegetables and cereals) will help to avoid excessive exposure from a single source. However, the possibility for consumers to reduce their own exposure is somewhat limited. Relevant for girls and young women to reduce exposure of the developing fetus and when breast-feeding infants later on in life can reduce their risk of exposure.

People of color are also more exposed to pollution hazards. The best-known example of this problem is the siting of hazardous waste facilities. Three of the five largest hazardous waste landfills in the United States are in black or Latino neighborhoods and that the mean percentage of people of color in areas with toxic waste sites is twice that of areas without toxic sites. Scientists at the Argonne National Laboratory have found that African American and Hispanic population subgroups experience greater exposure to substandard outdoor air quality. For instance, 52% of all whites live in counties with high ozone concentrations. However, for African

American the figure is 62% and for Hispanics 71%. Population-group distributions were found to be similar for carbon monoxide, sulfur dioxide, nitrogen dioxide, lead, and particulate matter, with higher percentages of African American and Hispanics than whites residing in counties with excessive levels of these pollutants [6]. For example, Native Americans and subsistence fishing communities may be at much greater health risk from dioxin in fish. Most people didn't know that children of color are at greatest risk of dioxin exposure. Children of color may be at the highest risk of any segment of society. The 1988 Centers of Disease Control report on lead poisoning estimated that 68% of poor, inner-city African American children were lead poisoned as compared to 36% of poor, inner-city white children. In the United States, 9.1% of all preschool children had blood lead levels greater than 25mg/dl, while 24.5% of black children exceeded this level. Pesticides provide another illustration that children of color are more exposed. Higher residential exposure to some pesticides for children of farm workers versus children of nonfarm workers. The study did not look at ethnicity of the home's residents, but the vast majority of farm workers are Hispanic. Another issue worth noting is the racial differences in childhood cancer rates. In adults, no such difference exists between blacks and whites. The incidence rates for all cancers in both sexes increased about 19% for both blacks and whites between 1973 and 1990. African Americans in Lafayette Parish had significantly higher serum dioxin toxic equivalent (TEQ) and mono-ortho Polychlorinated Biphenyls (PCBs) levels than Caucasians in Lafayette Parish [7,8].

In light of the animal evidence on dioxins and endometriosis, called for additional studies on the link between dioxin and endometriosis, noting a high prevalence of endometriosis in infertile Belgian women and high dioxin concentrations in breast milk in this country. Similar levels of TCDD, dioxin-like PCDDs, and PCDFs in women with endometriosis and their control group (fertile women) was reported. In an ongoing study, the association between endometriosis and exposure to dioxin is being investigated in TCDD-exposed women living in Seveso, Italy. In other human studies, this study was too small to detect differences in the levels of blood dioxins among women with and without endometriosis, if they were indeed presents. A higher PCB and dioxin levels are found in African American than in white population. African American is more likely to be exposed to any array of PCB and dioxin sources [9]. The multigenerational consequences may hinder African American health. Government efforts to minimize PCB and dioxin exposure may not be as successful protecting African Americans as whites. Consumption may be a significant source of PCB and dioxin exposure among small percentage of African American. The purpose of this study is to explore possible environmental risk factors for breast cancer among African American women living in the San Francisco Bay area. Organochlorine compounds such as dioxins, furans, PCBs and certain pesticides are ubiquitous in our environment and are known to have hormonal or carcinogenic effects in animals and have been suspected to play a role in human breast cancer. African American has borne the brunt of living near industry, landfills and hazardous facilities. African American are more than 79 percent more likely to live in communities where there are dangerous facilities that pose health threats, “says Bullard, director of the Environmental Justice Resource Center at Clark Atlanta University. Residents were retested for dioxins in 2001, with similar results, but in 2006 the agency concluded that residents did

not face a health risk, an assessment echoed by local industry. “The people of Mossville are like an experiment. They know that they have high levels of dioxin in their blood, and they’re allowed to continue to live there and be exposed,” says Subra, recipient of the MacArthur genius grant in 1999 for her environmental work with communities. Although it is likely that TCDD and dioxin-like PCBs would work in a similar manner to disrupt endometrial physiology related to the pathophysiology on endometriosis, little data exists to support this assumption [10,11]. Analyzing the fingerprint from several sources, it can be said that although the amounts of emitted levels of 2,3,7,8-TCDD are generally low or even undetectable, combustion processes still have associated significant emissions of dioxins, where industries like waste incinerators or metal manufacturers like steel industries or zinc production have the highest emission rate of PCDD/Fs [12-18].

Dioxin Body Burden Levels

The average daily intake of dioxin results in an average dioxin tissue concentration in Americans that ranges from 28 to 41 nanogram (ng) TEQ/kg lipids (fat) and from 36 to 58 ng TEQ/KG lipids if dioxin-like PCBs are included. In addition to measuring exposure to dioxin by its daily intake, exposure can also be estimated by measuring how much of it builds up in the body. This is referred to as the “body burden” and is defined as the total accumulation of dioxin at any one time per kilogram of body weight. If dioxin-like PCBs are included, the average dioxin burden ranges from 8 to 13 ng TEQ/kg body weight. In these estimates, TCDD contributes approximately 15% of the total TEQ. Most people didn’t know that dioxin can be in breast milk. Dioxin accumulates in breast milk because; it readily dissolves in the milk’s rich fat content. During nursing, dioxin is transferred from mother to body, which may absorb as much as 95% of the dioxin in the milk. Nursing infants ingest considerably more dioxins each day than adults. Breast-fed babies accumulate far more dioxins than do formula-fed babies. In one study, dioxin intake was 50 times greater in breast-fed infants than it was in formula-fed infants. Although nursing infants are at increases risk because, of their higher intake of dioxins, extensive studies in the Netherlands indicate that the benefits of nursing outweigh the risks. Breast milk contains all the nutrients in ideal proportion of optimum growth and development; the psychological benefits of nursing are invaluable, and breast-fed babies have fewer respiratory illness, fewer skin problems, cry less, have fewer allergies, and are less constipated than other babies.

Preventions and Control

Proper incineration of contaminated material is the best available method of preventing and controlling exposure to dioxins. It can also destroy PCB-bases waste oil. Prevention or reduction of human exposure is best done via source-directed measures. There is a need for strict control of industrial processes to reduce formation of dioxins as much as possible. This is the responsibility of national governments. More than 90% of human exposure to dioxins is through the food supply, mainly meat and dairy products, fish and shellfish. Therefore, protecting the food supply is critical. One approach includes source-directed measures to reduce dioxin emissions. Secondary contamination of the food supply needs to be avoided throughout the food-chain. The affected population should be examined in terms of exposure. For example, measuring the contaminants in blood or human milk can prevent it. Some effects can be; clinical surveillance to detect signs of ill health. Everybody wants to know where dioxin

comes from. According to EPA, only 50% of dioxin sources are known. Of these, 95% comes from combustion processes. Garbage and medical waste incinerators are the largest identified sources. Although EPA identified chemical manufacturing, processing and industrial municipal processes as major sources of dioxin emissions; they had no data to measure how much dioxin is released from these sources. Forest fires and vehicle exhaust are on the list, but known dioxin sources such as Dow chemical in Midland, Michigan, Vertac in Jacksonville, Arkansas, and Monsanto in St. Louis, Missouri are omitted. Another major source of dioxin emissions are pulp and paper mills. Dioxin is formed in the pulp and paper industry when chlorine or chlorine dioxide is used to bleach pulp and paper. Naturally occurring phenol compounds found in wood pulp react with chlorine to form dioxin. This results in dioxin in proper products, paper mill sludge, and the wastes from these plants. There is a strong dose-response relation between serum concentrations of persistent organic pollutants and diabetes [19].

No amount of additional exposure is safe. Unlike some other societal problems, we know what it would take to stop emitting dioxin. EPA should place a moratorium on new dioxin permits. EPA should sunset existing dioxin permits. EPA should place a moratorium on all new incinerators and phase out the burning of chlorinated wastes at existing dioxin permits. We have to get industry to place public health before private gain. And if industry won’t do that voluntarily we have to get government to create laws and regulations to protect the environment and health of the American people. This has to be hundreds of local coalitions figuring out how to work together to shut down local sources of dioxin, convince corporations to modify their production methods, and create local, state and federal regulations and laws. Dioxin is a powerful national organizing issue. It is a serious health threat to all Americans and so it is the smoke shack in everyone’s backyard. Dioxin can provide the basis for building local coalitions of Vietnam Veterans, La Leche League breast feeding advocates, farmers, indigenous people, incinerator opponents and victims of breast cancer and endometriosis. Organizing around dioxin is a way to initiate a new dialogue with the American people on “getting government off our backs and then getting government on our side.” Dioxin is also linked to serve reproductive and developmental effects. Dioxin exposure can damage the immune system, leading to increased susceptibility to infectious diseases, and can disrupt the function of regulatory hormones. Infertility, birth defects, impaired child development, diabetes, and thyroid changes are linked to dioxin exposure. At the levels present in the bodies of most Americans, dioxin harms the immune system, decrease testis size, and alters glucose tolerance. At levels present in 1% of Americans, (2,500,000 people) dioxin causes endometriosis, decrease sperm count, and reduces testosterone levels. Dioxin affects the level of male and female hormones. The EPA Reassessment of Dioxin gives us the chance to broaden and strengthen our groups and depend our involvement in our local communities. Even if your group is deeply involved in local issues, dioxin affects everyone, and the EPA reassessment provides new, compelling information to share with Sunday school classes and PTAs. Dioxin provides grassroots activists with a way to reach new people and break through the labels that have been given us by the media and the corporations. With encouraging turn out from grassroots activists in most cities, the EPA heard more from the grassroots about dioxin than they had bargained for.

In other words, dioxin is found everywhere in the world in water, air, soil, and sediment- even in places where dioxin or dioxin-containing products have never been used. Unlike most chemicals and combustion processes which involve chlorine. Dioxins have no intended use or value. Dioxins are also released to water, soil and into consumer products, but these sources are poorly defined and only a few estimates have been made. Overall, EPA's confidence in data used to define dioxin releases to air, water, land, and products is weak and underestimate dioxin releases. Source categories that are left out of EPA's dioxin inventory include iron ore sintering, Polyvinyl Chloride (PVC) production, accidental/structural fires, landfill fires, backyard burning, releases from petroleum refineries, asphalt mixing plants, and contaminated sites and other "reservoirs" of dioxin. Some of these source categories, if included, would contribute substantially to the national inventory and significantly increase the amount of dioxin estimated to be released into the environment. Choosing a balanced diet that is low in saturated fats and total fats helps consumers minimize any potential exposure to dioxin from food because dioxins are found mostly in animal fats due to its fat soluble properties of the dioxin compound [20].

The human aryl hydrocarbon receptor is a protein for which there is little evidence of polymorphic variability of functional consequence. It has been hypothesized that potential variability in dioxin sensitivity may be due to polymorphisms in AhR-associated proteins, such as human AhR-Interacting Protein (AIP) [21]. The AhR is a ligand-dependent transcriptional regulator of several genes including the Cytochrome P450(CYP1) family as well as genes encoding factors involved in cell growth and differentiation [22]. It has been reported that a very limited presence of polymorphisms in the core ligand binding region of the human AhR. Other regions, such as the trans activation domain, seem to be slightly more polymorphic in the human population [23].

Conclusion

EPA was forced to hold three additional dioxin public meetings in Columbus, OH, Atlanta, GA and Seattle, WA in response to the demands of the grassroots. Activists also held a rally in front of City Hall, using body cut-outs, tombstones, and body bags to dramatize the severe health impacts of dioxin exposure. Speaking for the 800,000 member Texas PTA, Kim Phillips told the EPA panel, "It is not acceptable to poison or expose any child to a hazard that can be avoided. The illness and death of a child is extremely significant to parents, family, and community. EPA is considering holding "dioxin policy workshops". Whether these occur, or whether EPA or Congress acts to drastically reduce dioxin exposure, is in the hands of grassroots environmental justice groups across the country. The American People's Dioxin Report is intended to inform the public and their representatives in government so appropriate action can be taken to safeguard the health of the American people. Most of the new studies on dioxin address its effects on children, notably the effects on the development of the immune, reproductive, and nervous systems, in particular cognitive and learning abilities. In particular, dioxin has been associated with IQ deficits and increased susceptibility to infections in Dutch children exposed to "background" levels of dioxin (These "backgrounds" level are essentially the average daily intake of dioxin from children) Children exposed in the womb during critical periods of development appear to be the most sensitive and vulnerable to the toxic effects of dioxin. Dutch studies have also shown an

association between dioxin and a higher prevalence of withdrawn/depressed behavior in children. In new evidence from human studies provides strong confirmation of the toxicity of dioxin and its impact on the general American public. Americans have a choice: take action to protect public health by eliminating dioxin creation or continue to allow dioxin to be created and not burden industry with the short term transition cost of elimination.

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