Traces of Environmental Chemicals in the Human Body:

Are They a Risk to Health?

Revised Edition

Prepared for

THE AMERICAN COUNCIL ON SCIENCE AND HEALTH

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May 2003

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Executive Summary

Because living organisms, including humans, are part of the environment they reflect what is in their surroundings. Traces of a large variety of both natural and man-made compounds can be found in the tissues and fluids of humans as a result of exposure to these compounds in air, soil, water, food, and consumer products.

As analytical capabilities have improved, it has become possible to detect ever-increasing numbers of natural and synthetic environmental chemicals at lower and lower concentrations. The mere ability to measure or detect the presence of a substance in the body is not an indication that the substance poses any health risk, especially at the trace levels at which we can now detect them. It has also become clear that because of the persistent nature of some of these chemicals, they are likely to remain in humans for some time to come. Thus, concerns about the possible health impacts of these chemicals will likely continue to be raised.

To address these concerns, it is important to understand what the trends are in the levels of these trace contaminants and what the health impacts may be from the levels that are currently being detected in human fluids and tissues.

Evidence from analysis of foods and water, as well as from direct measurements of fluids and tissues, reveals that the levels of the synthetic contaminants have decreased greatly over recent time. Studies of lead and persistent organochlorine compounds, such as DDT and dieldrin, clearly document this trend and show a decrease of more than 90% during the last quarter of the 20th century. While the levels have continued to decrease in the last decade, the rate of decrease has slowed. In addition, the data reveal that there are some sub-populations that are still exposed to unusually high amounts of some of these contaminants.

As a result of these large decreases in concentrations, current levels of environmental chemicals in the general population are well below those considered to be associated with adverse effects and thus do not pose a risk to public health. Efforts to improve environmental health should thus focus on those populations with especially high exposures; e.g., children living in homes with high levels of lead.

What are trace levels of environmental chemicals?

The natural world contains a wide variety of different chemicals to which humans may be exposed through their food, water, soil, and air. At low levels, many of these natural substances are necessary for human health: e.g., selenium.(1) Others may have no apparent health benefit and, indeed, may be harmful at levels found in the environment in some locations. Human exposure to these naturally occurring chemicals can be detected through analysis of body fluids and tissues. For example, analysis of the hair of people who drink water containing arsenic can provide a measure of arsenic exposure and help identify areas where arsenic levels in drinking water may be a threat to public health.

In addition to these naturally occurring substances, a large number of chemicals were introduced into the environment as a result of processes and products developed during the 20th century to improve health, increase agricultural production, and improve the standard of living. Because of the volumes produced or their chemical properties (e.g., persistence), or a combination of both, some of these compounds remained in the environment for long periods of time. As a result, human exposure to such compounds was of long duration and evidence of this exposure can be found in human fluids and tissues.

It is possible as well to detect a number of compounds in the human body that result from the use of consumer products, such as pharmaceuticals and dietary supplements, and from lifestyle choices, such as smoking. Some of these chemicals (e.g., by-products of smoking) are also present in the environment due to other sources, so trace levels of such compounds in the body reflect several types of exposures.

The very low levels of these naturally occurring and man-made chemicals in humans are called trace levels in this report. They represent levels that have resulted from general environmental exposure that has occurred around the world; that is, they represent traces of these chemicals in the environment. Higher levels of human exposure that sometimes occurred in people who were involved in the production and use of such chemicals (occupational exposure) or in people who lived close to sources of high levels of environmental chemicals will not be addressed here.

What kinds of chemicals are found at trace levels in humans?

Chemicals that are foreign to the body are known as "xenobiotics." Such substances can be either naturally occurring (chemicals that are part of the earth or produced by microorganisms, molds, plants, or animals) or man-made (such as drugs, industrial chemicals, pesticides, and power generation by-products). The major routes of exposure to these environmental chemicals are inhalation, ingestion, and absorption through the skin.

As indicated previously, because of the volume and variety of environmental xenobiotics to which humans are exposed over their lifetimes, it is not surprising that traces of such substances can be found in human fluids and tissues. Indeed, with the great improvements in analytical capabilities during the past twenty-five years traces of more and more xenobiotics have been detected as it has become possible to measure ever smaller amounts of these substances. As a result, public awareness and concern about the possible human health impacts of such trace levels have grown.

While the numbers of xenobiotics that have been detected is large, the greatest concern has been focused on a small subset of these compounds that are persistent in the environment. Persistent chemicals are of most concern since their longevity in the environment can lead to continuous, chronic human exposures and, in some cases, to increasing levels in human fluids and tissues.

Examples of such persistent chemicals include large organic molecules such as DDT, dieldrin, and polychlorinated biphenyls (PCBs), as well as metals and their compounds, such as lead and methyl mercury. While actions have been taken over a number of years to reduce the introduction of such compounds into the environment, it is expected that their persistence will lead to exposures for some time and so trace levels will continue to be found in humans. Thus, it is important to understand the significance, if any, of such trace levels for human health.

How do we determine trace levels of xenobiotics in humans?

A. Fates of absorbed xenobiotics

To understand the methods available for detecting trace levels of environmental xenobiotics, it is important to appreciate what happens in the human body when exposure to such chemicals occurs. The human body handles all chemicals including trace chemicals in numerous ways. However, in general, the first step is absorption of the chemical into the blood where it can be transported freely throughout the body and distributed to various tissues in the body.

After absorption and distribution, the chemical may have three fates: it may be stored in the body, it may be excreted from the body, or it may interact with the body to cause changes that may be beneficial or adverse. Depending on its characteristics, the chemical may be stored in a variety of locations in the body. For example, lipophilic (fat-loving) molecules such as DDT dissolve in and are stored largely in fat. Lead, on the other hand, is stored mainly in bone. Mercury may be found in hair and fingernails. Levels of chemicals that are stored in the body tend to increase over time as long as exposure continues and the rate of accumulation exceeds the rate of excretion.

Depending on its characteristics, a chemical may remain in the body for varying amounts of time before it is excreted. Some chemicals are very rapidly excreted—within a day or two—so they do not stay in the body long. Unless exposures are repeated frequently, or unless assessments are made immediately after exposure, measured levels of such chemicals in the body are generally quite low and often non-detectable.

Chemicals that interact with the body may cause a wide variety of changes. These can range from small alterations in the amounts and/or nature of essential chemicals such as enzymes to fundamental changes in the functioning of organs. According to the basic principle of toxicology, whether or not any effect will occur depends on the dose and the time course of exposure, and it is very unlikely that effects seen at high doses in laboratory experiments will occur at the trace levels to which humans are typically exposed.

Often, after xenobiotics are absorbed by the body they are changed into other compounds by a process called metabolism. The products of metabolism (metabolites) may undergo the same fates as the compound originally absorbed—storage, excretion, or interaction. For example, acetylsalicylic acid (aspirin) is broken down into salicylic acid and acetic acid in the body. While each of these metabolites may share the same fates as the original compound, the rates and extent of storage, excretion, or interaction will be different. Metabolites may be more or less toxic than the original compounds.

Because metabolism is often incomplete, traces of both the absorbed xenobiotic and its metabolites may be found in human fluids and tissues. How much of an absorbed chemical is metabolized and how much remains unchanged generally depends on dose. This is one additional reason that caution must be used in applying the results of high-dose toxicity studies in animals to trace level exposures of humans.

B. Implications of fates for determination of trace levels

Because of the varying fates of chemicals in the human body, a number of different techniques must be used to detect their presence. For example, if a chemical is stored in fat, analysis of samples of fat can be used to detect and quantify the levels of this chemical in an individual. In nursing mothers, such compounds can often be measured in breast milk since they tend to be associated with milk fat.

Taking samples of body fat is an invasive procedure with some medical risk so it is rarely employed at present. With advances in analytical capabilities, it has become possible to take advantage of the fact that not all of the xenobiotic moves to the fat; a small portion of it stays in the blood where it may be detected using a routine blood sample. Similarly, levels of chemicals stored in bone or hair may be measured directly in these tissues. Chemicals that are not readily stored in the body may be detected as they are excreted—for example, in urine or in exhaled air.

Because many xenobiotics are metabolized, the absorbed chemical may not be present at levels high enough to be measured. In this case, analysis of its metabolites in fluids such as blood and urine must be performed. Xenobiotics and/or their metabolites in body fluids and tissues are known as biomarkers of exposure. Simply stated, this means that their presence indicates that exposure has occurred. The concentrations of these biomarkers in the body reflect the environmental levels to which the individuals were exposed.

However, the relationship between environmental levels and concentrations of biomarkers may be complicated if exposures occur from other sources, such as smoking, as well as from environmental contamination. In such cases, it is often difficult to draw conclusions about environmental contaminant levels from analysis of tissue or fluid levels.

For chemicals that interact with the body, a variety of techniques can be used to detect the effects of this interaction. In a simple case, the interaction may influence the levels of one or more chemicals in the blood (e.g. enzymes), and so enzyme level changes can be used as surrogates to indicate that exposure has occurred. Similarly, the interaction may result in changes in excretion patterns of other chemicals that can be measured in urine. These substances that are neither the absorbed xenobiotic nor its metabolites are known as biomarkers of effect since they are indicative that effects have occurred. For example, the members of the class of compounds known as organophosphate pesticides can cause alterations in the blood level of an enzyme, cholinesterase.

In some cases, the changes detected in the body are so great that they can be said to be indicators of adverse effects in that individual. For example, if the enzyme levels have either increased or decreased to a point where proper functioning of an organ system is compromised, then it is clear that toxicity has occurred. Similarly, if a xenobiotic leads to a significant change in either function or number of cells crucial for normal health or functioning, this is also indicative of toxicity. An example is exposure to high levels of benzene leading to decreases in red blood cell counts. Such indicators of clear-cut toxicity are known as biomarkers of adverse effect. Changes of this magnitude are rarely if ever seen from trace level exposures.

Ideally, biomarkers of effect can provide better measures of the toxic potential of trace chemicals than biomarkers of exposure since the mere presence of a substance, while a reflection of exposure, is not necessarily an indicator of toxicity. For a number of reasons, however, even biomarkers of effect may not be perfect indicators. One problem in interpreting biomarkers of effect (or biomarkers of adverse effect) is that often more than one xenobiotic can produce the same effect. For example, the whole class of organophosphate pesticides (as noted above) can cause alterations in the blood level of the same enzyme, cholinesterase. Likewise, several solvent chemicals can affect liver enzymes. In addition, it is possible that yet unidentified chemicals could cause these same effects. Thus, in the absence of other data such as measurements of levels in the environment, the biomarkers of effect are less specific than biomarkers of exposure in reflecting human exposures to trace levels of environmental xenobiotics. A number of studies have been performed in different countries and by international organizations to gain population-based data on biomarkers of exposure and, in some cases, effect. In the United States, the largest effort has been the National Health and Nutrition Examination Survey (NHANES), a continuous survey which includes household interviews, a physical exam, and blood analysis for a nationally representative sample of the non-institutionalized population.

C. Using monitoring of intake to estimate trace levels

Since it is difficult and expensive to undertake population-based studies of biomarkers of either exposure or effect, other techniques have been employed to provide indirect measures of trace levels of environmental xenobiotics. Perhaps one of the most comprehensive of these is the effort of the U.S. Food and Drug Administration (FDA) to estimate human intakes of selected pesticides, synthetic chemicals and mineral elements through the diet. This effort is referred to as the "Market Basket Survey" or the "Total Diet Studies." First conducted in 1961, the Market Basket Survey involves the retail purchase of foods considered to be representative of the "total diet" of the U.S. population. The survey includes analyses of 234 items that make up the diets of eight population groups of different ages and both sexes.

What are the trends in trace levels of environmental chemicals?

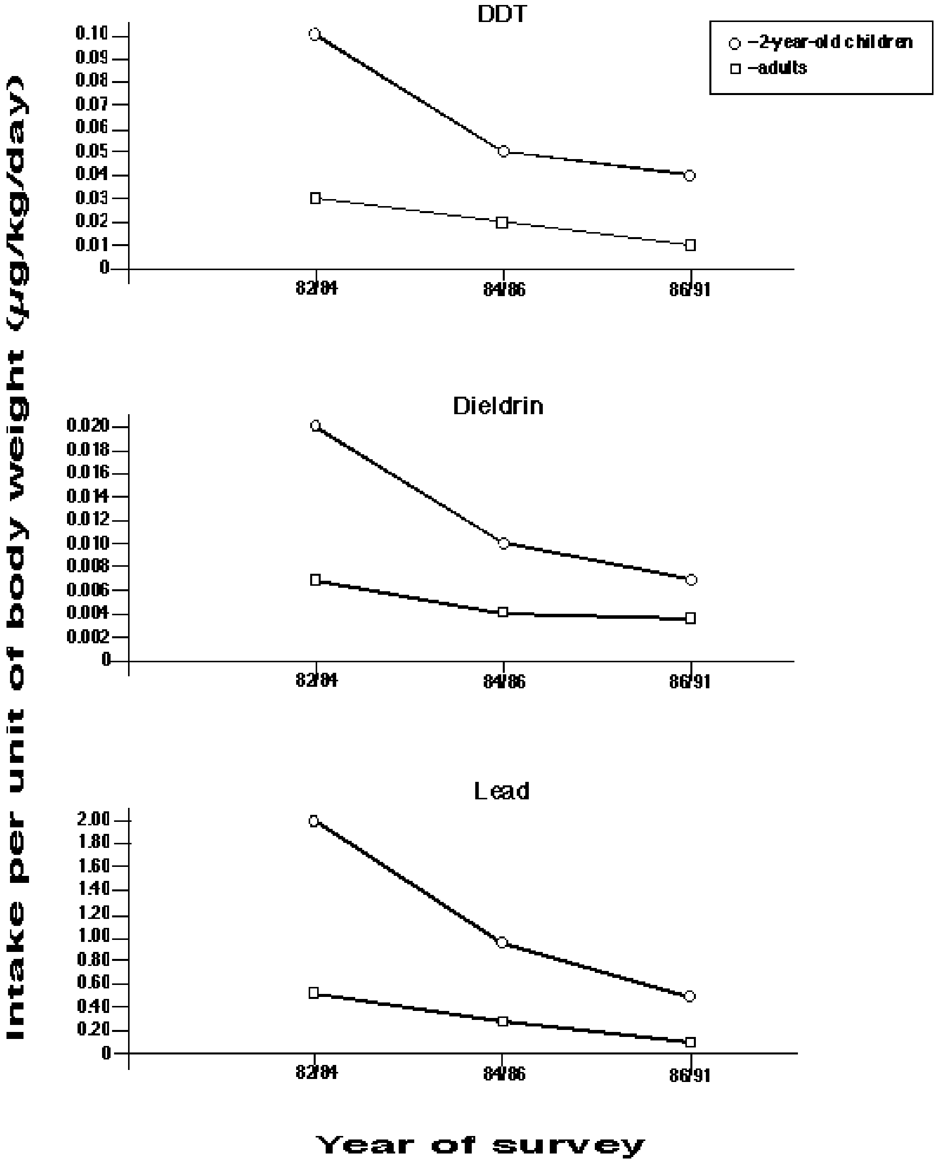
A. Trends from food data

Data from the Market Basket Surveys for the years 1986-1991 have been used to provide a very good summary of the trends in the dietary intakes of nearly 120 compounds in a variety of population groups. These data clearly indicate that during this period the daily intake of selected pesticides and metals either remained stable or decreased. There was no indication of increasing human exposure to these substances through food.(2) (See Figure 1 on next page.)

In addition, the 1986-91 analysis shows that daily intakes of the heavy metals lead, arsenic, cadmium, and mercury were well below the provisional tolerable daily intakes during this period. Further, intakes of all pesticides analyzed were far below the acceptable daily intake (ADI) levels set by the World Health Organization and the United Nations Food and Agriculture Organization.(3) The levels of the pesticide with the highest intake, dieldrin, averaged about 1/30th of the ADI in the most highly exposed population—teenage and young adult males.

The levels of pesticide residues found in individual foods in the 1986-1991 Market Basket Survey were much lower than the residue tolerances for raw agricultural products established by the U.S.

Figure 1. **Trends in Intake by Children and Adults of Three Environmental Chemicals***



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[*] Adapted from data presented in Gunderson EL. FDA total diet study, July 1986–April 1991, dietary intakes of pesticides, selected elements, and other chemicals. *J AOAC Int*. 1995;78:1353–1362.

Environmental Protection Agency (EPA).(4) This analysis also showed that levels of certain persistent pesticides in food have declined steadily since their use in agriculture was curtailed or eliminated.

The most recent data, for the year 2000, show that these persistent pesticides are found in only a small percentage of agricultural products and even in these cases at levels well below concentrations considered by governmental organizations to pose any risk.(5) Thus, historical and recent data confirm that while humans are exposed to trace levels of chemicals in their food, these exposures occur only in a limited number of foods and at concentrations generally well below levels thought to be of concern. Thus, the presence of these chemicals in the food supply is not expected to pose a risk to human health.

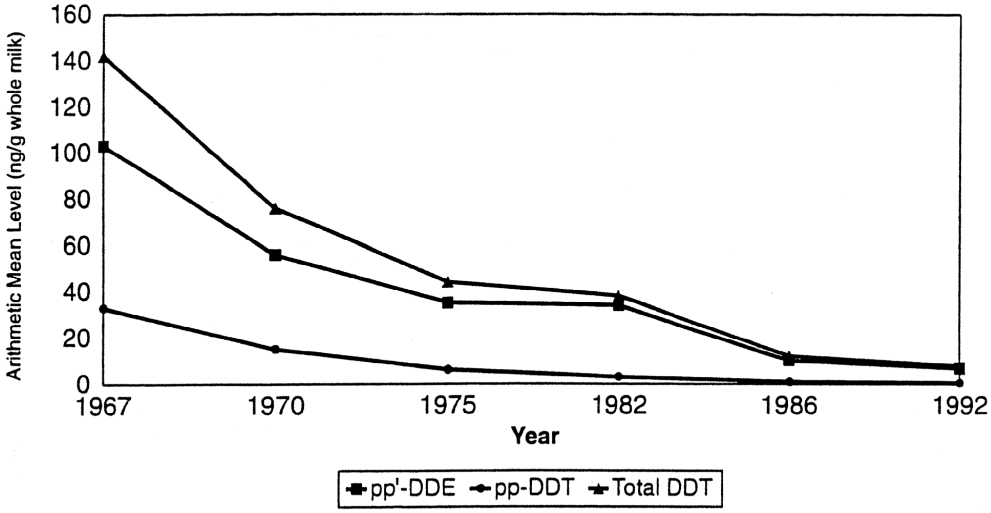
B. Trends from human tissue and fluid analyses

The environmental chemical that has been studied most intensively in the United States during the past thirty years is undoubtedly lead, and the biomarker in this case is blood-lead levels in young children. These levels decreased dramatically from the late 1970s until the early 1990s and then more slowly during the past decade. The most recent data, from NHANES, comparing information from 1991-1994 with that from 1999, show that blood lead levels in children decreased from a mean of 2.7 µg/dl (micrograms per deciliter) to 2.0 µg/dl. These data are supported by state surveillance studies showing that the percentage of children with blood lead levels equal to or above 10 µg/dl decreased from 10.5% in 1996 to 7.6% in 1998.(6)

Another environmental chemical that has been studied in detail is DDT, and the biomarker most often utilized is breast milk levels. Studies in Sweden spanning over thirty years documented a greater than 90% decrease in DDT breast milk levels between the late 1960s and the early 1990s. While the rate of decline has decreased in the last decade, it appears that DDT breast milk levels have declined by about 50% during this time.(7) Studies in Canada have shown a similar decline in DDT levels in breast milk.(8) (See Figure 2.) Data collected in many other countries also reflect a similar trend in DDT breast milk concentrations, suggesting that these declines reflect worldwide phenomena.(9)

A third persistent chemical that has been studied extensively is dieldrin, and the biomarker in this case is also breast milk levels. Data from Canada show about a 90% decline in breast milk dieldrin concentrations from the mid-1960s to the mid-1980s.(10-12) Similar measurements in Sweden, Denmark, Germany, and Japan over the same timeframe show the same result, about a 90% decline.(12, 13) These data again suggest

Figure 2. **National Trends in Mean Levels of Total DDT, pp'–DDE, and pp–DDT in Human Whole Milk (ng/g, or ppb)—Canada, 1967–1992.**



Source: Health Canada. *State of Knowledge Report on Environmental Contaminants and Human Health in the Great Lakes Basin.* ISBN 0-662-26-169-0; 1998.

that the trends are worldwide in nature.

In addition to these population-based studies, research has also been performed on sub-populations. Not surprisingly, levels tend to be higher, and declines over time lower, in sub-populations that have continuing significant exposures. For example, breast milk samples from women living in an area of Mexico where DDT is still in use for malaria control show much higher DDT levels than is found in breast milk from women in areas where this pesticide is not used.(14)

What can we learn from these trend data?

The population trend data provide very good indicators of the effects of actions that have been taken to reduce exposures to particular environmental chemicals. In the case of lead, when the blood lead level data from the 1970s to the early 1990s are compared to the levels of lead in gasoline, it is clear that the two decline in unison and that the removal of lead from gasoline was the main contributor to the decline. One reason for the leveling off of the decline may be that other sources still persist and, indeed, lead in paint in older housing has been identified as the main remaining source. To the degree that the more recent declines reflect decreases in exposures to old lead-containing paint, future trends will likely reflect how successful current and future efforts are in minimizing this source.

In the cases of DDT and dieldrin, the dramatic decreases reflect the banning of the uses of these substances in many parts of the world, and reduced use in others. However, in contrast to lead, remobilization (the slow release of persistent substances from fatty tissue storage areas within the body back into the bloodstream) of these very persistent chemicals is probably a significant contributor to the flattening out of the decline curve currently observed(15). Because such chemicals are still in use in some places in the world, the rate of decline of the body burdens of these compounds will probably continue to lessen.

The trends in sub-populations showing lower rates of decline generally reflect local conditions where sources still persist. In many cases, the sources are obvious, e.g., continuing use of large amounts of DDT or deteriorating dwellings containing lead paint flakes and lead-contaminated dust. In other cases, these anomalous rates of decline may point to previously undetected sources or to effects of unique environmental circumstances that were not previously identified.

What is the human health significance of these trace levels?

A. Establishing links between environmental exposures and health effects

Two lines of evidence are used in establishing connections between exposures to environmental contaminants and human health effects. The first is based on toxicology data generated from studies on laboratory animals and the second is based on epidemiological studies of human populations—often in occupational situations.

A cornerstone of toxicological science is the ability to demonstrate a relationship between the dose of a chemical (a reflection of exposure) and the response of the body following this exposure. The demonstration of a dose-response relationship is an essential criterion for establishing that the chemical is responsible for the effects measured. For most chemicals, exposure to low doses of an agent does not lead to any observable effect; it is only after a threshold is reached that effects can be detected. These effects may or may not be adverse. For example, exposure to low levels of a chemical may mobilize the body's defenses to eliminate the compound from the body—clearly not an adverse effect. Exposure to higher levels of the same chemical may overwhelm this defense mechanism, and the chemical may remain in the body rather than be eliminated and cause damage to one or more organs—clearly an adverse effect.

Laboratory animal toxicology studies are designed to elicit an adverse effect, since the purpose is to determine the magnitude of the dose required for such an effect to occur. Such studies are performed under special conditions, such as use of groups of animals that contain genetically uniform individuals and administration of the same dose daily for up to a lifetime. These studies are generally the ones that form the bases for regulatory levels set to protect human health. For regulatory purposes, the highest level at which no effect is observed or the lowest level at which an effect is observed is most often used as the starting point for setting an acceptable exposure limit. Factors, generally known as uncertainty or safety factors, are applied to these levels to incorporate a significant margin of safety to account for uncertainties in applying controlled laboratory animal data to uncontrolled human environmental exposures. The use of these factors also reflects the fact that absolute safety cannot be achieved. There is no such thing as zero risk, and the best that can be done is to limit exposures as much as possible based on the best available science.

A different approach is applied to chemicals that are thought to cause cancer. For these agents, very high doses are administered to the laboratory animals so that the cancer will be detectable in the small number of animals that it is feasible to study in the laboratory. Generally, some percent of the animals in every dose group will have cancer, so the approach described above for non-cancer causing chemicals (finding a no effect level) will not work. Instead, mathematical models are used to extrapolate from the incidence of cancer at the high doses to what the incidence might be at very low, possibly environmentally relevant doses.

Because of the great uncertainty in extrapolating from very high to very low doses, a large margin of safety is built into the extrapolation process when it is used for regulatory purposes. In addition, because some regulatory agencies assume that no level of exposure is absolutely safe, some acceptable incidence of cancer has to be established to set quantitative exposure limits. Generally, this is in the range of one in ten thousand to one in one million additional cancer cases. This approach often overstates the risk since it is known that for some carcinogens there is a threshold below which cancer will not occur. Many of the trace chemicals discussed here, such as DDT, appear to be threshold carcinogens so it is not surprising that increased cancer incidence has not been detected in environmentally exposed populations.

Epidemiological data are collected to see if a correlation can be established between human exposures and adverse health effects. This is generally very difficult when dealing with environmental exposures because each individual is exposed to differing amounts of a large number of agents on a daily basis, making it very difficult to establish a connection between just one of these and an adverse effect. Most of the epidemiological data that are used in assessing the dangers of environmental chemicals are based on occupational studies, since worker populations' exposures are much more regular and much higher than environmental exposures, and direct exposure measurements over a significant period of time are more readily available.

Even so, because a range of worker exposures is generally not available, it is most often impossible to establish a quantitative dose-response relationship from such epidemiological data. Rather, occupational epidemiological studies are used qualitatively to suggest controlled laboratory studies that should be performed, or to support the results of laboratory studies that have already been performed.

Recent research suggests that assessing the risk from trace elements in human tissues and fluids is even more complex than the above analysis indicates. These studies reveal the existence of "hormesis," a dose-response relationship that reflects beneficial effects of a chemical at very low doses as well as adverse effects at high ones.(16) Hormesis has been recognized for a long time with respect to essential nutrients that are necessary for good health at low doses but cause toxic effects when levels are too high, such as vitamins A and D and trace minerals. However, it is not clear if this phenomenon also applies to the environmental contaminants of most concern. It is evident that if this is the case, it will require a re-evaluation of the risks (vs. possible benefits) from the presence of low levels of trace substances in humans.

Another new field of research that should provide additional insights into human responses to xenobiotics is toxicogenomics. This is the study of the ways in which genetic differences affect individual responses to foreign chemicals. While this research may provide a way to predict individual responses more accurately, it does not alter the well-established fact that human responses vary due not only to genetic differences but also due to other factors such as age and health status. This variability has been taken into account in the safety factors that have been used to establish acceptable levels of exposure to environmental contaminants. Thus, the outcomes of toxicogenomics research will probably not affect the conclusion that current trace levels of environmental contaminants are unlikely to affect public health.

B. Applying these approaches to trace chemicals

In general, the toxicological studies described previously (i.e., those performed on laboratory animals) are used to estimate an acceptable daily intake—that is, the maximum amount of daily exposure to an agent, including a margin of safety, that is thought to be without harm. This value, in turn, is the basis for calculating the maximum acceptable amounts of the agent in air, water, food, etc. The relationship between exposure and levels in body tissues and fluids is a complex one. Thus, it is difficult to estimate the latter from the former, and so regulators have not set acceptable limits for fluid and tissue levels of most environmental contaminants.

However, breast milk is a special case: the World Health Organization has set acceptable intake values for persistent chemicals, such as DDT and dieldrin, and acceptable breast milk levels can be calculated based on these values. An acceptable concentration in breast milk can be calculated based on the acceptable daily intake value. Comparing these acceptable levels with those measured in populations worldwide, it is clear that DDT and dieldrin concentrations in breast milk are much lower than the acceptable values and have been for some time. As noted before, it is possible that there are individuals in less developed countries who may be highly exposed and whose breast milk DDT levels may be above acceptable limits.

Lead represents another special case. While there is scientific dispute about the “safe” level of lead, the U.S. Centers for Disease Control and Prevention considers blood lead levels of over 10 μg/dl as elevated and thus of concern. As the data presented indicate, the average blood lead levels are now about 2 μg/dl. This represents a dramatic decline during the last quarter of the 20th century, a decline that had clear benefits to children’s health, as the higher levels were clearly linked to adverse effects. (See the ACSH publication: “Lead and Health: An Update, 2001.”)

However, the exposure data also show that currently a small but significant percentage of children have elevated blood lead levels and are thus at increased risk of adverse effects. Thus, these data suggest that while lead exposure is not a general problem, there are populations of children whose blood lead levels are of concern.

As indicated earlier, advances in analytical techniques have made it possible to detect smaller and smaller amounts of trace contaminants in human fluids and tissues. The mere presence of such substances should not be equated to toxicity from these agents. Even for DDT and dieldrin, substances that were applied to many areas in large amounts for many years, current levels in the developed world are much too low to be of concern.

While acceptable daily intakes used to evaluate the risks from environmental chemicals are almost always derived by applying a margin of safety to the results of laboratory animal studies, epidemiological evidence also can assist in assessing the risks from trace contaminants. Since cancer is commonly the toxic effect of most concern, especially for organic chemicals such as dioxins, DDT, and dieldrin, it is instructive to examine cancer incidence as trace levels of these chemicals in humans first rose and then declined precipitously. What is seen is that the incidence of most cancers has remained essentially the same with the exception of lung cancer where the incidence changed in response to tobacco consumption patterns. Thus cancer incidence data do not appear to provide any support for a connection between trace levels of environmental contaminants and that human disease.

While there have been occasional reports questioning this conclusion, further study has not borne out claims of a connection. For example, some epidemiological studies in the early 1990s claimed to show an association between cancer, particularly breast cancer, and levels of organochlorine compounds, mainly DDT and PCBs, in human tissues and fluids. The resulting public concern spurred further work, including a very well publicized large-scale study of women living on Long Island, where the incidence of breast cancer in certain regions is above average. Careful evaluation of the outcomes of about 30 epidemiological studies on the relationship between organochlorines and breast cancer(17), as well as the recently published results of the Long Island research(18), reveals that an association between organochlorine compounds and elevated rates of breast cancer could not be established.

With regards to possible adverse effects of the levels of trace metals in humans, epidemiological data do not reflect any change in the incidence of neurobiological effects in children or adults associated with the very significant decreases in blood lead levels and levels of mercury in human food. This suggests that any effects of this type were small or limited to a small sector of the population even when exposures were high. Thus, they are unlikely to be detectable now in the general population given the significant decreases in these trace levels of metal elements and compounds that have occurred.

Summary and Conclusions

The continuing detection of synthetic chemicals in human tissues and fluids has led to legitimate concern about the possible health effects of the presence of such chemicals in the human body. To evaluate this concern, it is important to understand how these chemicals are detected, what the trends are in the levels of such compounds, and what is known about the health impacts of the levels that have been detected.

Advances in analytical capabilities have made it possible to detect lower and lower levels of these contaminants in humans—down to parts per trillion and lower—so that new compounds are identified regularly, and older compounds continue to be detected even though these chemicals are no longer in use and even when their levels have declined drastically. The significance of these detections can only be understood by looking at how these levels have changed over time and how the concentrations compare to those considered capable of causing adverse health effects in humans.

Studies of contaminants in the food supply and direct measurements of human fluids and tissues reveal that the levels of contaminants of concern, such as lead and DDT, have declined more than 90% in the general populations during the past few decades. The declines appear to be continuing but at a slower rate. These studies also reveal that there are some special populations that continue to show high levels of contamination, generally because of local use of the chemical of concern.

Comparison of the current low levels with the lowest levels thought to be of concern by international and national regulatory agencies reveals that the trace amounts in humans are well below the levels of concern for the general public. Thus, efforts to decrease these levels further are unlikely to improve public health; instead, efforts should focus on those populations that still experience high exposures. The most important point to bear in mind is that detecting minuscule amounts of a substance in our bodies is not equivalent to finding an adverse effect on our health.

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