America's Children and the Environment, Third Edition

DRAFT Indicators

Environments and Contaminants: Food Contaminants

EPA is preparing the third edition of *America's Children and the Environment* (ACE3), following the previous editions published in December 2000 and February 2003. ACE is EPA's compilation of children's environmental health indicators and related information, drawing on the best national data sources available for characterizing important aspects of the relationship between environmental contaminants and children's health. ACE includes four sections: Environments and Contaminants, Biomonitoring, Health, and Special Features.

EPA has prepared draft indicator documents for ACE3 representing 23 children's environmental health topics and presenting a total of 42 proposed children's environmental health indicators. This document presents the draft text, indicator, and documentation for the food contaminants topic in the Environments and Contaminants section.

For more information on America's Children and the Environment, please visit www.epa.gov/ace. For instructions on how to submit comments on the draft ACE3 indicators, please visit www.epa.gov/ace/ace3drafts/.

Food Contaminants

Children's diets are an important pathway for exposure to some environmental contaminants. Children may be at a greater risk for exposures to contaminants because they consume more food relative to their body weight than do adults. Additionally, children's dietary patterns are often less varied than those of adults, suggesting that there are greater opportunities for continuous exposure to a foodborne contaminant than in adults.[1]

Food contamination can come from multiple sources, including antibiotics and hormones in meat and dairy products, as well as microbial contamination that can lead to illness. A wide variety of chemicals from man-made sources may be found in or on foods. Contaminants in foods may come from application of pesticides to crops, from transport of industrial chemicals in the environment, or from chemicals used in food packaging products. A number of persistent environmental contaminants tend to accumulate in all types of animals, and are frequently found in meat, poultry, fish, and dairy products. Other contaminants, such as perchlorate and a variety of pesticides, are often found in fruits, vegetables, and other agricultural commodities. Some chemicals in food, such as mercury and perchlorate, have naturally occurring as well as man-made sources.

Following this text, an indicator is presented for organophosphate pesticides in selected foods. Many chemicals of concern in food lack sufficient data to generate reliable, nationally representative indicators for those contaminants, particularly for children. Selected chemicals that are frequently found in foods are summarized below.

Methylmercury

Mercury is a naturally occurring element that is released to the environment from the combustion of coal, from the use of mercury in industrial processes, and from breakage of products such as mercury thermometers and fluorescent lighting, as well as from natural sources such as volcanoes. Mercury may enter water bodies through direct release or through emissions to the atmosphere that are subsequently deposited to surface waters. Bacteria in water bodies convert metallic or elemental forms of mercury into methylmercury.[2] Methylmercury can be absorbed by small aquatic organisms that then are consumed by predators, including fish.[3] As each organism builds up methylmercury in its own tissues, and as smaller fish are eaten by larger fish, concentrations of methylmercury can accumulate, particularly in large fish with longer lifespans[4-6] such as sharks and swordfish.[7]

The primary risks to children's health from exposure to methylmercury are effects on neurological development that may occur from prenatal and early-life exposure.[8] Although fish consumption is the primary source of methylmercury exposure in the U.S. population, it is also a leading source of omega-3 fatty acids, which are beneficial to neurological development, and may reduce the risk of cardiovascular disease.[9] For this reason, EPA and the U.S. Food and Drug Administration (FDA) provide fish consumption guidance to females who are pregnant, breastfeeding, or of childbearing age, and to young children. The guidance encourages consumption of up to 12 ounces per week of a variety of fish and shellfish that are lower in mercury, or, in the absence of a local advisory, consumption of up to 6 ounces per week of fish caught from local waters and no other fish that week. EPA and FDA also recommend that these categories of women avoid consuming large predatory fish such as shark, swordfish, tile fish, or king mackerel that may contain high levels of methylmercury.[10] Fish that are high in omega-3 fatty acids and low in mercury are expected to offer the greatest health benefits.[7,9,11] More information regarding current fish advisories, and links to lists of fish and shellfish typically containing lower levels of mercury, can be found at http://water.epa.gov/scitech/swguidance/fishshellfish/fishadvisories/basic.cfm. Tribal and state-specific fish advisories can be found at http://water.epa.gov/scitech/swguidance/fishshellfish/fishadvisories/states.cfm.

Polychlorinated biphenyls

Polychlorinated biphenyls (PCBs) are a group of persistent chemicals used in electrical transformers and capacitors for insulating purposes, in gas pipeline systems as a lubricant, and in caulks and other building materials. The sale and new use of PCBs were banned by law in 1979, although continued use in existing electrical equipment is allowed and large reservoirs of PCBs remain in the environment. PCBs easily accumulate in fat tissue, so they are commonly found in foods derived from animals. Consumption of fish is an important source of PCB exposure, but other foods with lower PCB levels that are consumed more frequently, including meat and poultry, are also important contributors to PCB exposure.[12] Some research has found that dairy products can contribute to PCB exposure.[13] Exposure to PCBs remains widespread;[14,15] however, declining environmental levels of PCBs mean that children exposed to PCBs through their diet today are being exposed to lower levels compared with children in previous generations.[16]

Prenatal exposure to PCBs has been associated with adverse effects on children's neurological development and impaired immune response, primarily through studies of populations that consume fish regularly.[17-19] Not all studies have found effects on neurodevelopment, but overall the epidemiologic studies suggest that prenatal PCB exposures are likely to be associated with deficits in cognition, attention, and behavior.[17,18,20] Some studies have also detected associations between childhood exposure and adverse health effects.[18,21-23] In addition to PCBs, many other organochlorine chemicals, including dioxins and organochlorine pesticides, are persistent and bioaccumulative and are frequently found in foods derived from animals.[24]

Polybrominated diphenyl ethers

Polybrominated diphenyl ethers (PBDEs) are a class of flame retardants used in furniture foam, small appliances, and electronic products. PBDEs are intended to slow the ignition and rate of fire growth. Of three forms of PBDEs once used in the United States (pentaDBE, octaDBE, and decaDBE), only the decaBDE form, used primarily in televisions and personal computers, is still in production. Manufacturers of decaBDE have agreed to phase out all uses of the chemical by the end of 2013.[25] However, products manufactured prior to the elimination of the pentaBDE and octaBDE forms in 2004, and products manufactured prior to the phase out of decaBDE in 2013, can remain in use and contribute to the presence of PBDEs in the environment.

Like PCBs, PBDEs are persistent in the environment, accumulate in fat tissue, and have been found in a variety of foods, including fish, meat, poultry, and dairy products.[26,27] PBDE toxicity to the developing nervous system has been identified as an area of concern.[28-31]

Bisphenol A

Bisphenol A (BPA) is an industrial chemical used in the production of epoxy resins used as inner liners of metallic food and drink containers to prevent corrosion. BPA is also used in the production of polycarbonate plastics that may be used in food and drink containers. The primary route of human exposure to BPA is through diet, when BPA migrates from food and drink containers, particularly when a container is heated.[32-34] BPA is a suspected endocrine disruptor, which may act by interfering with the biosynthesis, secretion, action, or metabolism of naturally occurring hormones.[35-37] BPA has demonstrated developmental effects in laboratory animals at high doses, though the effects of lower doses similar to typical human exposure levels are the subject of scientific debate.[33,38-41] Although there is uncertainty regarding the effects in humans of BPA at typical exposure levels, several retailers and manufacturers have begun phasing out baby products such as bottles and sippy cups that contain BPA. Several states have also introduced legislation to ban or limit BPA in food containers and consumer products.

Phthalates

Phthalates are a class of chemicals commonly used to increase the flexibility of plastics in a wide array of consumer products, including food packaging.[42-45] Phthalates in food packaging have the potential to migrate out of the packaging and into food products. Fatty foods stored in containers with phthalates, such as dairy products, fish, seafood, and oils, are most likely to absorb phthalates.[45] Ingestion of breast milk and infant formula containing phthalates may also contribute to infant phthalate exposure. Phthalates are suspected endocrine disruptors, and have shown a number of reproductive and developmental effects in laboratory animal studies[46-55] as well as some associations in human epidemiological studies.[56-59]

Perfluorinated Chemicals

Perfluorochemicals (PFCs) are a group of chemicals used in a variety of consumer products, including food packaging, and in the production on nonstick coatings on cookware.[60,61] Long-chain PFCs, including perfluorooctane sulfonic acid (PFOS) and perfluorooctanoic acid (PFOA), have already been or will be phased out by the chemical industry by 2015, although the persistence of these chemicals means that they will remain in the environment for several years, despite reductions in emissions. While the routes of human exposure to PFCs are not fully understood, two recent studies have identified food consumption as the primary exposure pathway.[62,63] PFC-treated food-contact packaging, such as microwave popcorn bags, may be a source of PFC exposure.[64,65] Heating these materials may cause PFCs to migrate into food, or into the air where they may be inhaled. PFCs are persistent and bioaccumulative, and may accumulate in foods derived from animals prior to storage and cooking.[65-67] PFCs have also been detected in some plant-based foods.[63] Studies in laboratory animals have demonstrated reproductive and developmental toxicity of PFCs,[68,69] and some human health studies have found associations between prenatal exposure to PFCs and reduced fetal growth.[70-73] There is also evidence in human studies of an association between PFC exposure and changes in thyroid function.[74-76]

Perchlorate

Perchlorate is a naturally occurring and man-made chemical that has been detected in surface and ground water in the United States.[77-79] Perchlorate is used in the manufacture of fireworks, explosives, flares, and rocket propellant.[79] Infant formulas have been found to contain perchlorate, and the perchlorate content of the formula is increased if it is prepared with perchlorate-contaminated water.[80-82] Perchlorate has also been detected in human breast milk, dairy products, as well as in leafy vegetables and other produce.[78,83-87]

Exposure to high doses of perchlorate has been shown to inhibit iodide uptake into the thyroid gland, thus disrupting the functions of the thyroid and potentially leading to a reduction in the production of thyroid hormone.[88-90] Thyroid hormones are particularly important for growth and development of the central nervous system in fetuses and infants.[91] Due to the sensitivities of the developing fetus, perchlorate exposures among pregnant women, especially those with preexisting thyroid disorders or iodide deficiency, carry the potential for risk of adverse health effects.

Organophosphate Pesticides

Agricultural crops are frequently treated with pesticides to control insects and other pests that may affect crop growth. Some of the most prevalent classes of pesticides used in agriculture are the carbamates, pyrethroids, and the organophosphates. After crops are harvested, they may retain residues of these pesticides. Apples, corn, oranges, rice, and wheat are among the agricultural commodities consumed in large amounts by children.

Organophosphates are one class of pesticides that are of concern for children’s health. These pesticides are frequently applied to many of the foods important in children’s diets, and certain organophosphate pesticide residues can be detected in small quantities on these foods. Organophosphates can interfere with the proper function of the nervous system when exposure is sufficiently high.[92] Childhood is a period of increased vulnerability, because many children may have low capacity to detoxify organophosphate pesticides through age 7 years.[93] Examples of organophosphate pesticides include chlorpyrifos, azinphos methyl, methyl parathion, and phosmet. Since 1999, EPA has imposed restrictions on the use of the organophosphate pesticides azinphos methyl, chlorpyrifos, and methyl parathion on certain food crops and around the home, due largely to concerns about potential exposures of children.[94-96]

The 1996 Food Quality Protection Act required EPA to identify and assess the extent of dietary pesticide exposure in the United States, and to determine whether there was a “reasonable certainty of no harm” to vulnerable populations including infants and children.[97] The U.S. Department of Agriculture’s Pesticide Data Program (PDP) provides data annually on pesticide residues in food, with a specific focus on foods often consumed by children.[98] Other researchers have supplemented the PDP with their own analyses. A recent study measured pesticide residues in 24-hour duplicate food samples of fruits, vegetables, and juices served to children, and found that 14% of the samples contained at least one organophosphate pesticide.[99] When data from the PDP and independent studies such as these are combined with dietary consumption surveys, it can be possible to estimate pesticide exposure from dietary intake.

Indicator E8 presents the percentage of samples of two fruits and two vegetables analyzed by the USDA PDP that have detectable residues of organophosphate pesticides. This indicator allows for a general comparison of the frequency of organophosphate detection over time for four foods typically consumed by children, although data are not available on each fruit or vegetable for every year.

Indicator E8: Percentage of apples, carrots, grapes, and tomatoes with detectable residues of organophosphate pesticides, 1998-2008

Overview

Indicator E8 presents the percentage of apples, carrots, grapes, and tomatoes that were found to contain detectable residues of organophosphate pesticides from 1998–2008. These foods were selected because they are frequent components of children's diets, and because data for these foods were available for multiple years. The data are from an annual analysis of pesticide residues conducted by the U.S. Department of Agriculture.

Pesticide Data Program

The U.S. Department of Agriculture (USDA) collects data on pesticide residues in food annually. USDA's Pesticide Data Program (PDP), initiated in 1991, focuses on measuring pesticide residues in foods that are important parts of children's diets, including apples, apple juice, bananas, carrots, grapes, green beans, orange juice, peaches, pears, potatoes, and tomatoes.

Samples are collected from food distribution centers in 10 states across the country, representing approximately half of the U.S. population.[100] Different foods are sampled each year. In its history, the PDP has tested for more than 440 different pesticides.[98] In 2008, the PDP analyzed fruit and vegetables for 314 pesticides and related chemicals. Prior to analysis, the PDP processes samples by following the preparations an average individual would use before consuming an item. This includes washing fruits and vegetables, as well as removing inedible portions of a food item. For example, tomatoes and grapes are washed with the stems and other materials removed, while apples are washed and the stems and cores are removed.

Data Presented in the Indicator

Indicator E8 displays the percentage of apples, grapes, carrots, and tomatoes with detectable organophosphate pesticide residues reported by the PDP from 1998–2008. These four foods are frequently consumed by children, and were chosen for the indicator because they were sampled by the PDP in at least four years from 1998-2008. Other foods not shown here may have either greater or lesser frequencies of organophosphate pesticide residue detection than the four foods presented in this indicator.

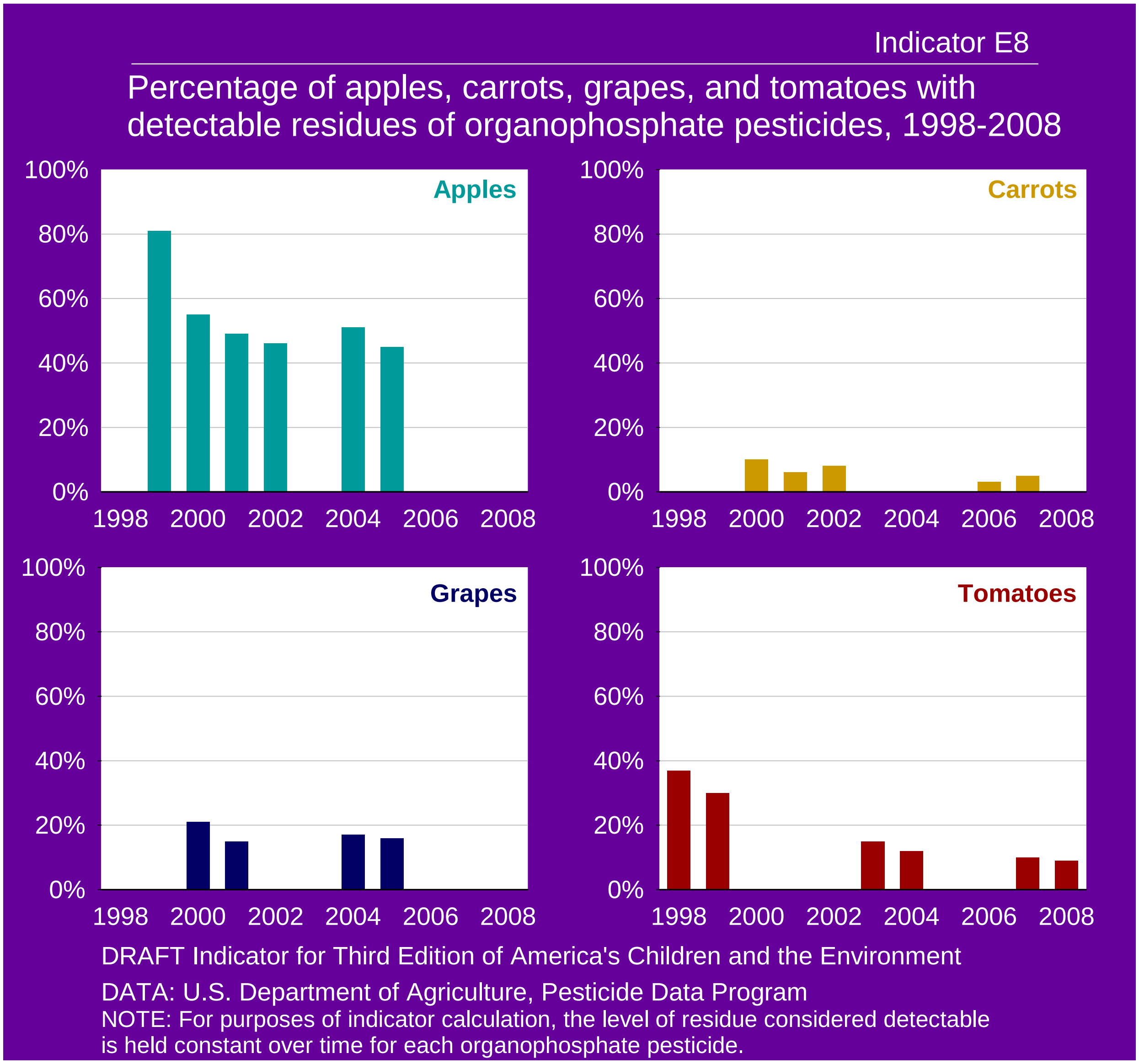
The 43 organophosphates that were sampled in every one of the years 1998–2008 are included in calculation of the indicator; 52 other organophosphates that were added to or dropped from the program in these years are excluded so that the chart represents a consistent set of pesticides for all years shown. Some aspects of trends in organophosphate residues could be missed by the indicator if any organophosphates other than the 43 considered in the indicator had substantial changes in use on the four selected foods during the years 1998–2008.

The indicator also defines "detectable" based on the ability to measure residues in the PDP in 1998, so that introduction of more sensitive measurement techniques over time does not affect the indicator, and allows for direct comparison of data collected in previous years with those collected today. This means that some produce samples analyzed in recent years with improved detection technology would, for purposes of indicator calculation, be considered to have non-detectable organophosphate residues based on comparison with the older, higher limit of detection.[i]

The fruits and vegetables shown in this indicator were each sampled in four to six years between 1998 and 2008. Gaps in the percentage of residue detections from year to year thus represent missing information, rather than an absence of organophosphate residues.

This indicator is a surrogate for children's exposure to pesticides in foods: If the frequency of detectable levels of pesticides in foods decreases, it is likely that exposures will decrease. However, the indicator does not account for many additional factors that affect the risk to children. For example, some organophosphates pose greater risks to children than others do, and residues on some foods may pose greater risks than residues on other foods due to differences in amounts consumed. The indicator also does not distinguish between residue levels that are barely detectable and those that are much higher. Finally, exposures to organophosphate pesticides may also occur by pathways other than the diet, such as ingestion of pesticides present in house dust and drinking water.

[i] An alternate analysis of the data that considered all detectable residues, without holding the limit of detection constant at 1998 levels, resulted in percentages of food samples with detectable organophosphate pesticide residues very similar to those shown in the indicator.



Percentage of apples, carrots, grapes, and tomatoes with detectable residues of organophosphate pesticides, 1998-2008

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DATA: U.S. Department of Agriculture, Pesticide Data Program

NOTE: For purposes of indicator calculation, the level of residue considered detectable is held constant over time for each organophosphate pesticide.

- In 1999, approximately 81% of apples had detectable organophosphate pesticide residues. In 2005, about 45% had detectable residues.

- In 2000, approximately 10% of carrots had detectable organophosphate pesticide residues. In 2007, about 5% had detectable residues.

- In 2000, approximately 21% of grapes had detectable organophosphate pesticide residues. In 2005, about 16% had detectable residues.

- In 1998, approximately 37% of tomatoes had detectable organophosphate pesticide residues. In 2008, about 9% had detectable residues.

Data Tables

Table E8: Percentage of apples, carrots, grapes, and tomatoes with detectable residues of organophosphate pesticides, 1998-2008

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Apples		80.7%	54.9%	49.3%	45.5%		50.5%	45.0%			
Carrots			10.3%	6.2%	8.3%				3.5%	5.4%	
Grapes			20.6%	14.8%			16.5%	16.2%			
Tomatoes	37.4%	29.9%				14.6%	11.8%			9.7%	9.5%

DATA: U.S. Department of Agriculture, Pesticide Data Program

NOTE: For purposes of indicator calculation, the level of residue considered detectable is held constant over time for each organophosphate pesticide. Improvements in measurement technology increase the capability to detect pesticide residues in more recent samples. In this analysis, limits of detection are held constant so that indicator data are comparable over time. A separate analysis found that actual detections of pesticide residues were similar or only slightly greater than the values shown in this table. For purposes of indicator calculation, only the 43 organophosphate pesticides measured by the pesticide data program in each year 1998-2008 were considered, so that indicator data are comparable over time.

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Metadata

Metadata for	Pesticide Data Program (PDP)
Brief description of the data set	The Pesticide Data Program (PDP), initiated in 1991, focuses on measuring pesticide residues in foods that are important parts of children's diets, including apples, apple juice, bananas, carrots, grapes, green beans, orange juice, peaches, pears, potatoes, and tomatoes. Samples are collected from food distribution centers in 10 states across the country. Different foods are sampled each year and then analyzed in various state and federal laboratories for the presence of residues of about 300 pesticides and similar chemicals.
Who provides the data set?	U.S. Department of Agriculture, Agricultural Marketing Service.
How are the data gathered?	Food and water samples are collected by the participating states. Food samples are prepared as if for consumption (washed, peeled, etc.). The pesticide residues are measured at state and federal laboratories, and compiled into a database managed by USDA.
What documentation is available describing data collection procedures?	Standard operating procedures, including data collection, are described here: http://www.ams.usda.gov/AMSv1.0/ams.fetchTemplateData.do?template=TemplateG&topNav=&leftNav=ScienceandLaboratories&page=PDPProgramSOPs&description=PDP+Standard+Operating+Procedures+(SOPs)&acct=pestcddataprg.
What types of data relevant for children's environmental health indicators are available from this database?	Pesticide residue concentrations measured in samples of fruits, vegetables, grains, and other food and drink products, particularly foods most likely consumed by infants and young children.
What is the spatial representation of the database (national or other)?	National. In 2008, sampling services for food samples were provided by 10 states (California, Colorado, Florida, Maryland, Michigan, New York, Ohio, Texas, Washington, and Wisconsin). Approximately half of the U.S. population resides in these 10 states.
Are raw data (individual measurements or survey responses) available?	Individual food and drink sample data are available.
How are database files obtained?	Data files are freely available from: http://www.ams.usda.gov/AMSv1.0/ams.fetchTemplateData.do?template=TemplateG&topNav=&leftNav=ScienceandLaboratories&page=PDPDownloadData/Reports&description=Download+PD

Metadata for	**Pesticide Data Program (PDP)**
	P+Data/Reports&acct=pestcddataprg.
Are there any known data quality or data analysis concerns?	Detection limits vary by pesticide, laboratory, commodity and over time. The list of commodities sampled varies from year to year. The set of pesticides analyzed has expanded over time.
What documentation is available describing QA procedures?	http://www.ams.usda.gov/AMSv1.0/ams.fetchTemplateData.do?template=TemplateG&topNav=&leftNav=ScienceandLaboratories&page=PDPProgramSOPs&description=PDP+Standard+Operating+Procedures+(SOPs)&acct=pestcddataprg includes documentation on quality assurance/quality control.
For what years are data available?	1992–present.
What is the frequency of data collection?	Annually.
What is the frequency of data release?	Annually.
Are the data comparable across time and space?	Detection limits vary by pesticide, laboratory, commodity and over time. The list of commodities sampled varies considerably from year to year. The set of pesticides analyzed has expanded over time.
Can the data be stratified by race/ethnicity, income, and location (region, state, county or other geographic unit)?	State where sample is collected. State or country of origin.

Methods

Indicator

E8. Percentage of apples, carrots, grapes, and tomatoes with detectable residues of organophosphate pesticides, 1998-2008.

Summary

The U.S. Department of Agriculture (USDA) has been conducting the Pesticide Data Program (PDP) since 1991. Since 1998 the PDP has measured pesticide residues on fresh fruits and vegetables, canned and frozen fruits and vegetables, fruit juices, whole milk, wheat, soybeans, oats, corn syrup, peanut butter, poultry, beef, pork, drinking water, bottled water, and groundwater. In order to maintain comparability across the years 1998 to 2008, the organophosphate detection rates reported in this indicator include only detections of the 43 organophosphate pesticides and metabolites that were included in the PDP for each and every year from 1998 to 2008 and were above the minimum of the limits of detection available in 1998. Indicator E8 is the percentage of apples, carrots, grapes, and tomatoes with detectable residues of organophosphate pesticides. For each of these commodities, this indicator is calculated as the number of food samples with a detectable residue divided by the total number of food samples analyzed for one or more of the 43 pesticides.

Data Summary

Indicator	E8. Percentage of apples, carrots, grapes, and tomatoes with detectable residues of organophosphate pesticides, 1998-2008.										
Time Period	1998-2008										
Years	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
	Number of samples										
Apples		379	184	736	556		744	743			
Carrots			184	739	554				744	744	
Grapes			741	705			738	739			
Tomatoes	717	364				742	744			740	737

Overview of Data Files

The following files are needed to calculate this indicator. They were all obtained from the Pesticide Data Program website:

http://www.ams.usda.gov/AMSv1.0/ams.fetchTemplateData.do?template=TemplateG&topNav=&leftNav=ScienceandLaboratories&page=PDPDownloadData/Reports&description=Download+PDP+Data/Reports&acct=pestcddataprg.

This webpage contains downloadable, zipped, database files in the MDB (MS ACCESS 2000) format with pre-written macros and instructions to assemble the various component text files into a single database for each calendar year. In each assembled year's database file are two data files describing the sample data and testing results and translations for all fields used in the database.

Two files are used to perform the analysis here:

- Pesticide Reference Tables 1998.xls: Excel file with Pesticide Data Program summary information for 1998 including pesticide names and codes for 1998 (Pest Code worksheet). The three-digit pesticide codes are used to extract the data for the 43 pesticides from the Analytical Results data files.

- Current Year Database Tables (XXResultsData and XXSampleData within the database, PdpXXSamples.txt and PdpXXResults.txt as text files outside of the database): Pesticide Data Program Analytical Results data for calendar year (XX). Each record is for a single sample and pesticide. The sample is identified by the combination of the following codes: STATE, YEAR, MONTH, DAY, SITE, COMMOD (commodity), LAB (laboratory), and SOURCE_ID (Code to make sample ID unique). The pesticide analyzed is given by the pesticide code (PESTCODE). For these analyses we also needed the level of detection (LOD) and the measured concentration (CONCEN); the concentration value is missing if it is at or below the level of detection.

Pesticide Data Program

Pesticide residue data for the years 1998 to 2008 were obtained from the Pesticide Data Program website:

http://www.ams.usda.gov/AMSv1.0/ams.fetchTemplateData.do?template=TemplateG&topNav=&leftNav=ScienceandLaboratories&page=PDPDownloadData/Reports&description=Download+PDP+Data/Reports&acct=pestcddataprg

For each year, the analytical results data are reported in the ASCII files PdpXXResults.txt and PdpXXSamples.txt, where "XX" denotes the last two digits of the calendar year. A single sample is defined by the combination of the variables STATE, YEAR, MONTH, DAY, SITE, COMMOD (commodity), LAB (laboratory), SOURCE_ID (Sample Source ID). The same sample can be measured for pesticide residues of one or more pesticides or metabolites, as defined by the three digit pesticide code (PESTCODE). The pesticide codes and names are reported in the table PesticideRef inside the assembled database. For these analyses we extracted only those sample/pesticide combinations where the pesticide compound was one of the 43 organophosphate (OP) compounds in the following list of compounds analyzed each year from 1998 to 2008:

43 OP Compounds Analyzed in 1998 to 2008

OP Compound	Limit of Detection (ppm)	OP Compound	Limit of Detection (ppm)
Acephate	0.001	Malathion	0.001
Azinphos methyl	0.003	Malathion oxygen analog	0.001
Carbophenothion	0.001	Methamidophos	0.001
Chlorpyrifos	0.001	Methidathion	0.001
Chlorpyrifos methyl	0.001	Mevinphos Total	0.003
Coumaphos	0.002	Omethoate	0.001
Coumaphos oxygen analog	0.003	Oxydemeton methyl sulfone	0.001
DEF (Tribufos)	0.001	Parathion ethyl	0.001
Diazinon	0.001	Parathion methyl	0.001
Dichlorvos (DDVP)	0.001	Phorate	0.001
Dimethoate	0.001	Phorate oxygen analog	0.001
Disulfoton	0.001	Phorate sulfone	0.001
Disulfoton sulfone	0.001	Phorate sulfoxide	0.002
Ethion	0.001	Phosalone	0.003
Ethoprop	0.003	Phosmet	0.002
Fenamiphos	0.001	Phosphamidon	0.001
Fenamiphos sulfone	0.002	Pirimiphos methyl	0.001
Fenamiphos sulfoxide	0.002	Profenofos	0.001
Fenitrothion	0.001	Sulprofos	0.001
Fenthion	0.001	Terbufos	0.001
Fonofos	0.001	Terbufos sulfone	0.001
		Tetrachlorvinphos	0.001

For all years, we compared the measured values with the 1998 minimum detection limit. For each pesticide, the 1998 minimum detection limit is defined as the minimum of all the detection levels (LOD) for that pesticide in the 1998 analytical results file, across all samples, laboratories, and commodities. This minimum detection limit was calculated across all 30 commodities sampled in 1998.

In addition to the 43 OPs measured by the PDP every year from 1998-2008, an additional 52 OPs were measured in one or more of these years. Between 13 and 37 of these additional OPs were measured in any one year during the 1998-2008 period.

Calculation of Indicator

Indicator E8 is calculated as follows.

The following steps were applied separately to the samples from each of the four commodities of interest: apples (commodity code COMMOD = AP), carrots (code CR), grapes (code GR), and tomatoes (code TO).

1. The number of unique samples is calculated for each year: Each sample is defined by the combination of the variables STATE, YEAR, MONTH, DAY, SITE, COMMOD (commodity), LAB (laboratory), and SOURCE_ID (Sample Source ID). The same sample can appear multiple times in the database. For each sample, we only count the first of the records where one of the 43 pesticide compounds listed above was measured. Samples where none of the 43 pesticide compounds listed above were measured are not included.

2. The number of unique samples with a detectable residue is calculated for each year: For this step, we first list the subset of records where the measured pesticide compound was among the 43 compounds tabulated above, the concentration was above the detection limit for that laboratory measurement (i.e., the concentration field is not blank), and the concentration is greater than and not equal to the 1998 minimum detection limit for the same pesticide. Note that a measured value might exceed the detection limit for that pesticide compound, measurement year, laboratory, and commodity, but not exceed the 1998 minimum detection limit for the compound. Note also that to compare to 1998 thresholds, all reported concentrations are converted to ppm before comparison. The number of unique samples with a detectable residue is the number of distinct samples in this subset.

3. The percentage of a commodity with detectable residues is calculated by dividing the total number of food samples of that commodity with detectable residues (step 2) by the total number of samples of that commodity analyzed (step 1):

> Percentage of commodity C (apples, carrots, grapes, or tomatoes) with detectable residues =
>
> [Number of unique samples of commodity C with a detectable residue / Number of unique samples of commodity C] × 100 %

Questions and Comments

Questions regarding these methods, and suggestions to improve the description of the methods, are welcome. Please use the “Contact Us” link at the bottom of any page in the America’s Children and the Environment website.