Biomonitoring of Pesticide Exposure among the U.S. Population: 1996-2004

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Biomonitoring

- direct measurement of human exposure to toxic substances in the environment by measuring the substances or their metabolites in human specimens, such as blood or urine.

Pesticide Biomonitoring

CDC's Major Biomonitoring Initiatives

- CDC's National Reports on Human Exposure to Environmental Chemicals
- Large-scale cohort studies
- Smaller hypothesis-generating studies

National Report on Human Exposure to Environmental Chemicals

What it is:

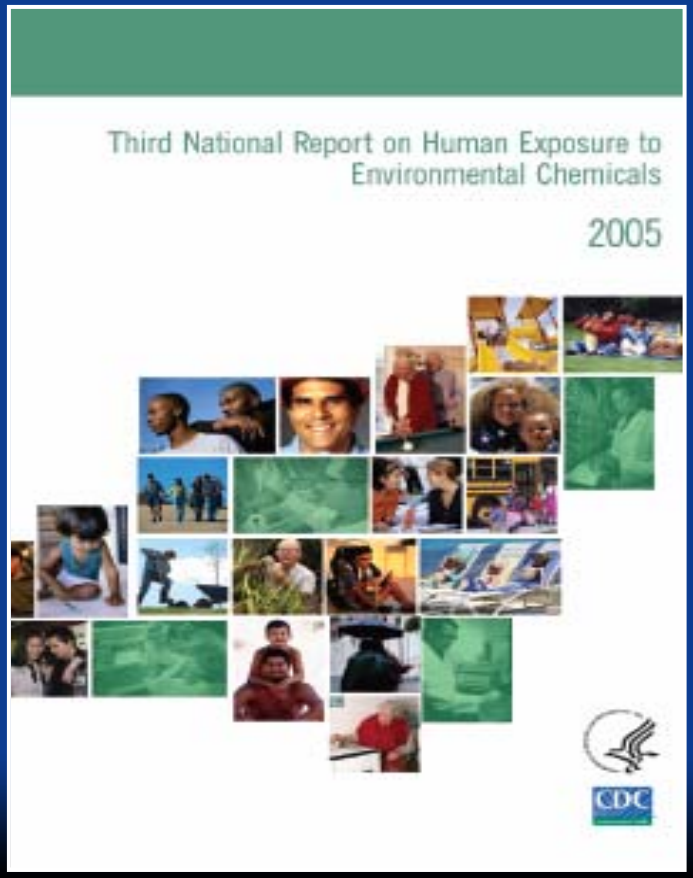
An ongoing (every 2 years) biomonitoring assessment of the exposure of the U.S. population to selected environmental chemicals

Matrices monitored: Urine; blood and its components

Chemicals in *4th Report*

~265 chemicals

- Metals
- Polychlorinated biphenyls, dioxins and furans
- Organochlorine pesticides
- Carbamate pesticides
- Organophosphorous pesticides
- Pyrethroid pesticides
- Herbicides
- Polycyclic aromatic hydrocarbons
- Phthalates
- Phytoestrogens
- Pest repellants
- Cotinine
- Perfluorinated chemicals
- Brominated flame retardants
- VOCs
- Perchlorate
- Bisphenol A & Alkylated phenols
- Triclosan
- Sunscreen agent
- Speciated arsenic
- Acrylamide



www.cdc.gov/exposurereport

Public Health Uses of these Data

- Estimates ***prevalence*** of exposure in U.S. population.
- Provides a way to **compare prevalence** estimates across various population subgroups
- Monitors **changes** in exposure over time of U.S. population
- Provides a way to **estimate impact** of policies/programs on human exposures
- Provides exposure data for risk assessment
- Helps set priorities for human health effects research

National Health and Nutrition Examination Survey

- Conducted by the National Center for Health Statistics/CDC
- Population is a stratified, complex, multistage probability sample of the civilian, noninstitutionalized U.S. population
- Estimates are probability based for the U.S. population
- Includes detailed history, physical, and laboratory exam

History of NHANES

Administered by National Center for Health Statistics (NCHS), CDC

NHANES I	1971-1975	No env'l chemicals monitored
NHANES II	1976-1980	Lead, OC pesticides, pesticides
HHANES	1982-1984	Lead, OC pesticides, pesticides
NHANES III	1988-1994	Pb, Cd, Se; cotinine, PTRSS
NHANES 99+	1999-2000	116 environmental chemicals
NHANES 99+	2001-2002	148 environmental chemicals
NHANES 99+	2003-2004	~250 environmental chemicals

NHANES 1999-2004

- About 5000 participants annually from 15 locations
- Continuous annual survey
- Includes home interview
- Oversampled African Americans, Mexican Americans, adolescents (12-19 years), older Americans (≥ 60 years); pregnant women. In 2000 also low income whites

- More information: www.cdc.gov/nchs/nhanes/htm

Biological Matrices and Env'l Chemicals Monitored in NHANES

Two primary matrices used for NHANES biomonitoring are blood (or its components) and urine. Limited amount of blood is available; urine limited by age group.

Age (years)	Blood (mL)	Env'l Analytes	Urine	Env'l Analytes
1-2	9	Pb, Cd, Hg	Not Sampled	NA
3-5	22	Pb, Cd, Hg, Cot	Not Sampled	NA
6-11	38	Pb, Cd, Cot	Sampled	Phthalates, NPP, PAHs, metals, Phytoestr
12+	89-92	Pb, Cd, Hg*, Cot, POPs	Sampled	Phthalates, NPP, PAHs, metals, Phytoestr

*Only in females 16-49 years

Strengths of NHANES

- Provides prevalence estimates of exposure in general population
- Allows us to examine exposure trends across variable time increments
- Provides a metric for evaluating the impact of regulatory actions

Limitations of NHANES

- Lack of geographic, temporal, and population generalizability
- Spot samples
- Contributions of exposures to metabolites in the environment not considered

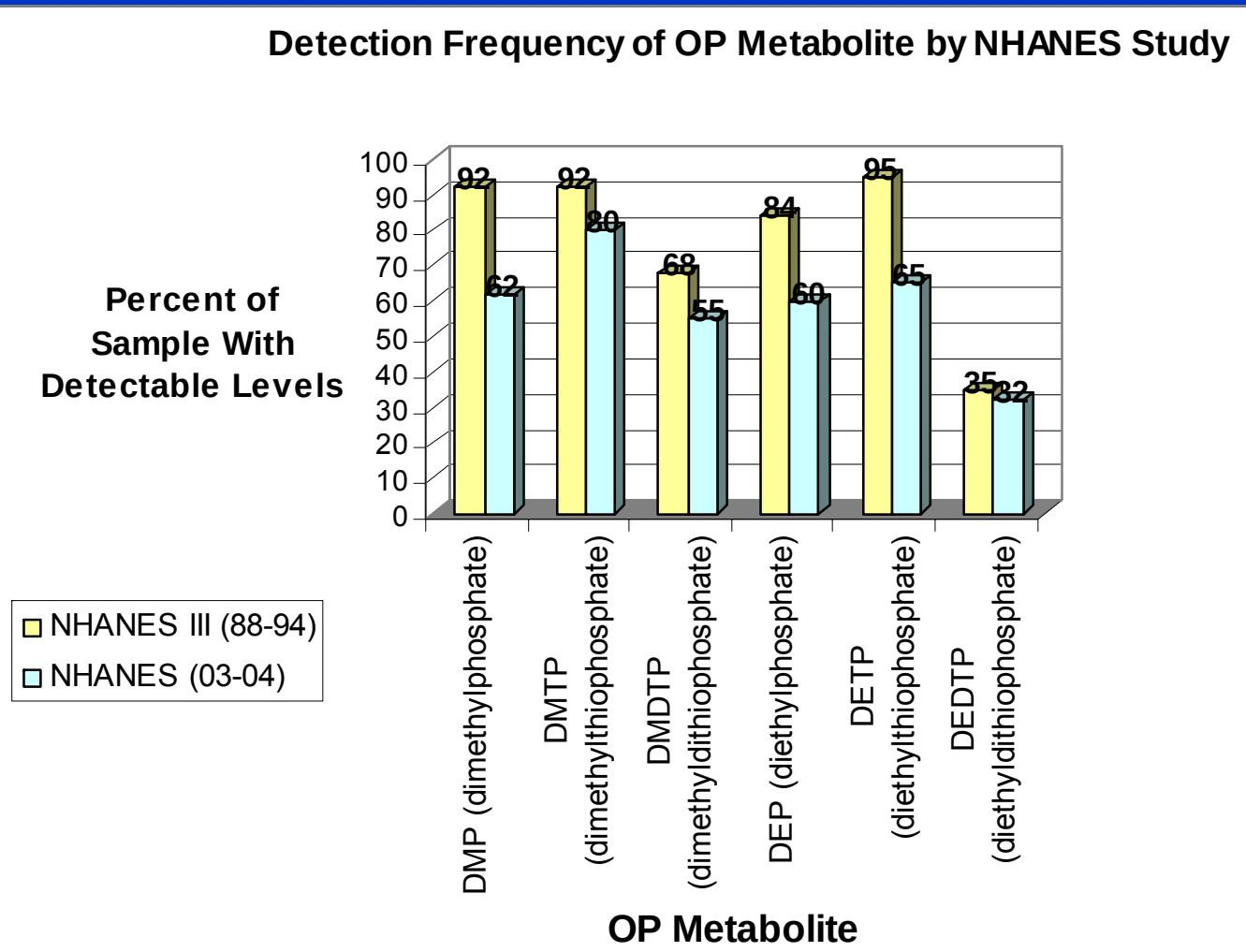
Pesticides Assessed as a Part of NHANES

- Insecticides
  - **Organophosphorus**
  - Carbamate
  - Pyrethroid
- Herbicides
  - Phenoxy acid
  - Triazine
  - Chloroacetanilide
- Repellents
- Fungicides
- Fumigants

Organophosphate Pesticides

- Widely used insecticides
  - 8% total pesticide use in US
  - Used in treatment of over ½ insecticide-treated areas
  - About ⅔ of total insecticide used in agriculture
- Potent neurotoxicants
- 1st class of chemicals whose tolerances were reevaluated as a part of the FQPA of 1996

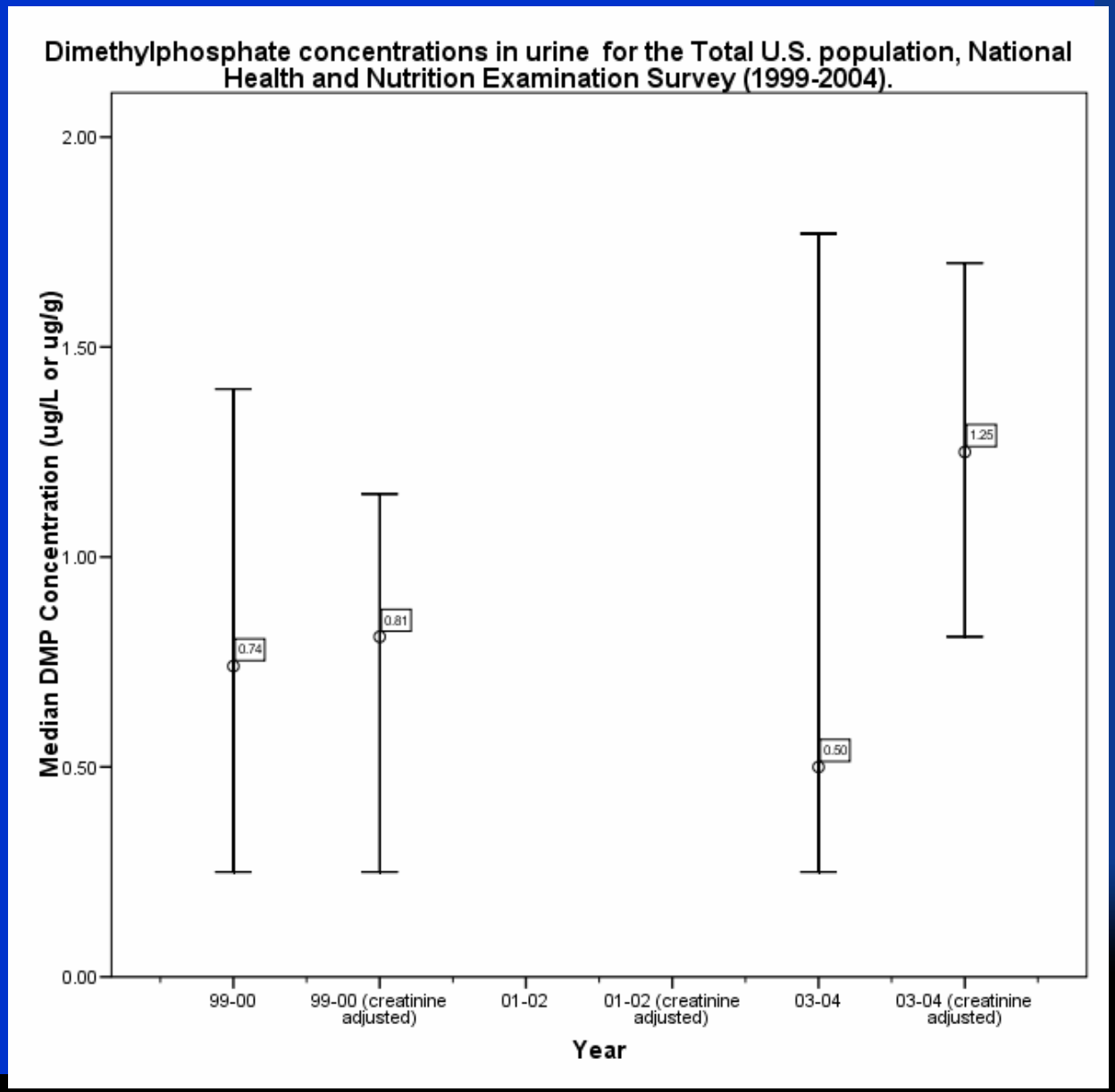
OP Exposure By Year



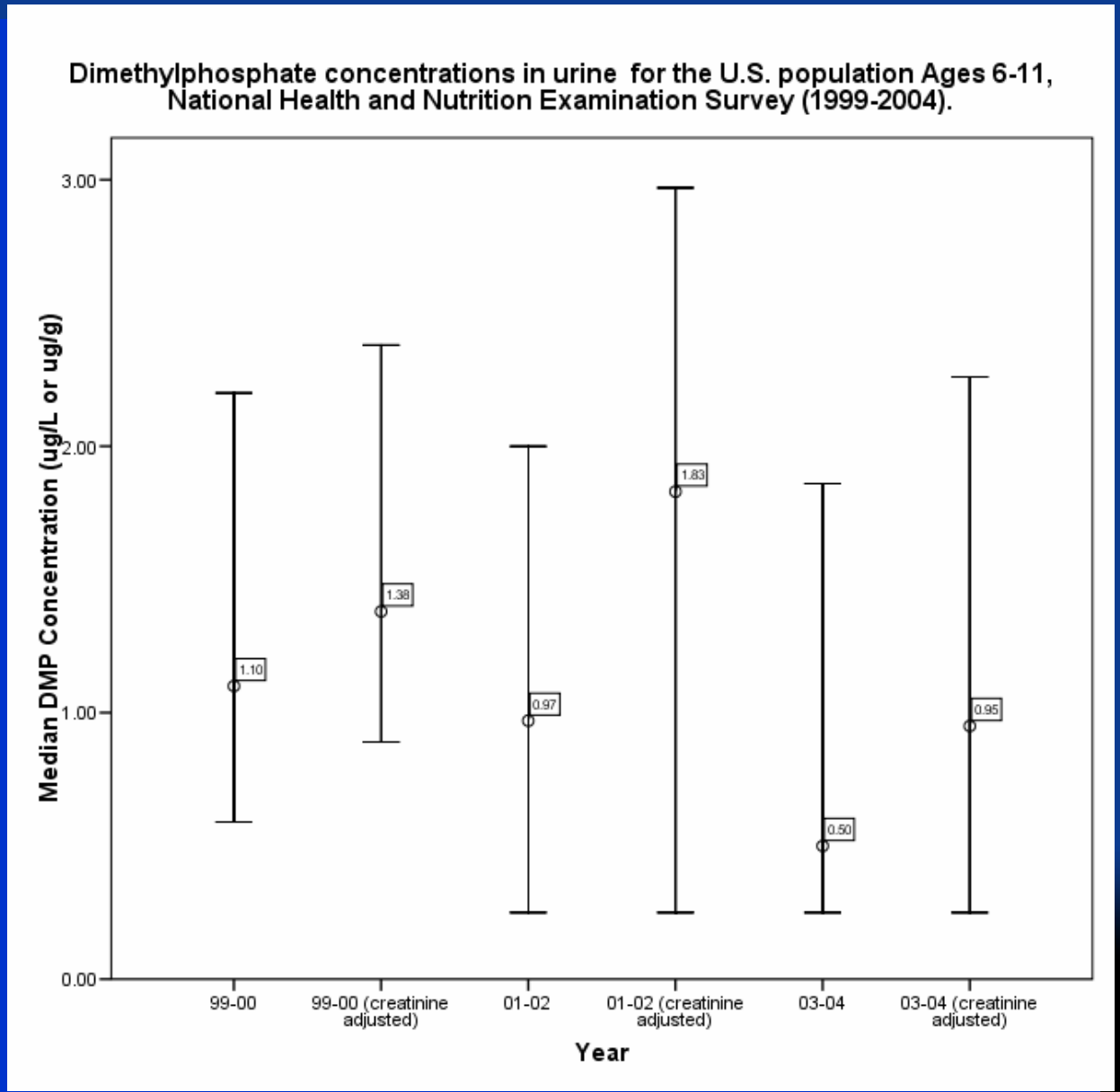
Percent Reduction from NHANES (89-94) to NHANES (03-04)

Metabolite	% Reduction
DMP (dimethylphosphate)	-32.61
DMTP (dimethylthiophosphate)	-13.04
DMDTP (dimethyldithiophosphate)	-19.12
DEP (diethylphosphate)	-28.57
DETP (diethylthiophosphate)	-31.58
DEDTP (diethyldithiophosphate)	-8.57

Estimates of OP Exposure



Estimates of OP Exposure in Children



Observations

- most vulnerable segments of our population, children and elderly adults, appear to have higher exposures to OP pesticides than do other population segments

- Overall exposures to OP pesticides appear to have declined over the last few decades suggesting that exposure mitigation strategies resulting from regulatory efforts have been effective

Conclusions

- Biomonitoring data are useful for following trends in exposure
- Long-term stability of methodology is required
- Exposure reduction efforts appear effective
- Human data can markedly decrease the uncertainties associated with exposure assessment

Awareness?