

CDC's National Exposure Report

Larry Needham, Ph.D. (CDC, Atlanta, GA)

Biomonitoring in NHANES

3rd report is coming soon

Exposure pathway – from chemical source to matrix exposure (except direct applications: personal care products, drugs, etc) to person (external) portion to absorbed (internal dose); when in body, eliminated, distributed, metabolized, to target organ – may or may not have an effect.

Biomonitoring is the measure of those chemicals in human matrices – blood, blood components, urine, other tissues or fluids.

2nd report 116 chemicals in urine and blood – measured various chemicals and naturally occurring chemicals - can get more information from website

Report is ongoing every 2 years. US population – reported as geometric mean and percentiles (2nd report), stratified among age, race (3 primary separations), sex. Population is a stratified complex multistage probability sample of civilians non-institutionalized (no jail or college students). Estimates are probability based. Primary use of NHANES data is for developing clinical data, but this data can be linked to exposure/nutritional data. There are 5,000 participants annually; survey includes a home interview. Population for 1999/2000 was over sampled for African Americans, Mexican Americans, adolescents, older people, pregnant women, and low-income whites. Data has to be adjusted back to actual population demographics. Can get more info on website.

Goals: American population and subpopulations – assess exposure to certain chemicals (nominated in process described in the Federal Register), establish reference ranges, track trends of ranges over time (increasing / decreasing), set priorities in linking exposures to disease – research direction.

Uses: tracks from source to internal effects, reduce exposure (ex. lead), can provide data (rare) on source by using pattern recognition, for example VOCs from internal combustion or other sources also with dioxins/furans; Report provides data for risk assessment, dose response, get entire picture of human exposure.

Presence of a chemical in the body does not mean it causes disease. Technical ability to detect really low levels, does not necessarily cause anything.

NHANES I started in 1971 – did not measure environmental chemicals. Lead, organochlorine pesticides, and selected nonpersistent pesticides were measured in II. Lead is the signature chemical for NHANES – lead removal from gasoline resulted in significant reduction in blood lead levels, more than models predicted. No NHANES data from 1981-1987. NHANES 1988-1994, lead continued to decrease as the lead was taken out of gasoline, also taken out of solder in food cans. NHANES II also showed a

continued decrease. 1999-2000 percentage above the action level was cut in half in children – low income children mostly from ingestion of paint chips.

Dioxins – 75 PCDDs, 135 PCDFs, 209 PCBs, 29 of these have TEQs and are classified as dioxin-like. They are lipophilic and bioaccumulate in food chain. Travel with lipids – must adjust samples for lipid content to compare results across matrices. Swedish breast milk pools have shown a decrease in the TEQ in the Swedish population over time; and an increase in PBDEs followed by a decrease after environmental regulation. NHANES 99-00 – only had 5mL serum per person, not enough to get data from each individual for each dioxin congener. Pooled samples based on age, race and sex but not weighted. Data showed that older population has the highest PCDD/PCDF levels – would expect that as they bioaccumulate and were exposed when environmental levels were higher. Females tend to have higher levels due to longer half-lives.

Perfluorinated chemicals – Scotchgard, paper product protections (pizza, popcorn). Have a lipophilic and lipophobic moiety – do not usually bioaccumulate. The carbon – fluorine bond is strong and thus these chemicals do not readily degrade. Sampled same pools as above for perfluorinated chemicals. Saw varying trends in different race groups. More questions than answers.

Environmental tobacco smoke – cotinine is measured – metabolite of nicotine. Data shows bimodal distribution based on non-smokers and smokers. 99-00 data shows levels of serum cotinine had decrease in children, adolescents, and adults and elderly – non-smokers compared to NHANES III.

DDT – in the environment is transformed to DDE (also metabolized to DDE in the body). Should see bioaccumulation with age, that is what the data shows. In non-hispanic whites and blacks see a decreasing level with decreasing age. Mexican Americans have 3 times the background level – legal or illegal use of DDT is probable in Mexico.

OCPs, OPs, herbicides, PCAH, PCBs, and phthalate metabolites are included in NHANES III. Chlorpyrifos (OP) has many food uses and termiticide – used in and around homes. Oxon is the metabolite that is most active. Urinary metabolites can be from direct exposure to parent compound or from degradates in the environment. Can't be sure of exposure situation from metabolite profile. Exposure data gained specificity from measuring parent chemical in blood serum - shows no difference between race or genders, but concentrations are slightly higher in younger people.

Dioxins – in Seveso Italy – explosion of trichlorophenol facility. Exposure rated in different zones, highest measured level in A zone was 56,000 ppm TCDD. Chloracne developed in highest exposed in zone A. Exposure was for everyone – all genders, sexes, ages – serum samples were saved and eventually measured. Divided samples by zone and development of chloracne. Saw that the highest TCDD levels were in zone A in residents that had chloracne, but there was sufficient cross-over with high levels in people that did not develop chloracne – susceptibility issue? Planned to do second generation study. Number of births were low because abortion were legal. Before explosion sex

ratio was normal. From 9 months after accident to December 1984 (one half life of dioxin), there was an excess of females born 26M:48F. 1985-1994 ratio returned to near 1:1. Parents with highest levels of dioxin had all female children. Was able to get some dose-response data. Would only have this information with biomonitoring.