Ministry of Health Report:

Human Biomonitoring of Environmental Chemicals in Israel

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1. Introduction

The objective of this report is to present the results of the Israel Ministry of Health Human Biomonitoring Study on exposure of Israeli adults from the general population to environmental chemicals and/or their metabolites. The term *environmental chemical* refers to a chemical compound or chemical element present in air, water, food, soil, dust, or other environmental media (*e.g.* consumer products). In this study, environmental chemicals and/or their metabolites were measured in urine samples in adults from the general population in Israel. The data presented in this report refer to the urinary concentrations of environmental chemicals and/ or their metabolites measured in individuals in the study population.

The data presented in this report can provide information on exposure to environmental chemicals in Israel and can provide information for assessing policies to reduce exposure to chemicals for the protection of public health. Specific uses of the data included in this report are:

- ✓ To determine the average (and range of) exposure concentrations of environmental chemicals in individuals in the study population, which could allow for comparisons between subpopulations in Israel and comparisons with other countries;

- ✓ To establish baseline levels of exposure to environmental chemicals, so as to track trends of exposure levels in Israelis over time;

- ✓ To provide information for setting priorities and taking action to protect the health of the population in Israel from exposure to environmental chemicals;

- ✓ To support future research on potential links between exposure to certain chemicals and specific health effects;

- ✓ To determine whether exposure levels are higher among potentially vulnerable groups (such as minorities and the elderly).

Environmental chemicals included in the study were selected on the basis of known or suspected health effects; suspected widespread exposure in the Israeli population based on previous pilot studies in Israel or findings in other populations; suspected or known association with dietary intake; inclusion in other national human biomonitoring programs. In addition, environmental chemicals were included in the study if urine was the relevant biological matrix.

The study was carried out by the Department of Environmental Health, the Nutrition Department, and the Israel Center for Disease Control at the Ministry of Health.

Table 1: Chemicals Measured in the Israel Ministry of Health Human Biomonitoring Study

Cotinine
Bisphenol A
Organophosphate Pesticide Metabolites
Diethylphosphate (DEP)
Diethylthiophosphate (DETP)
Diethyldithiophosphate (DEDTP)
Dimethylphosphate (DMP)
Dimethylthiophosphate (DMTP)
Dimethyldithiophosphate (DMDTP)
Phthalate Metabolites
Mono-n-butylphthalate, MnBP
Mono-i-butylphthalate, MiBP
Mono-benzylphthalate, MBzP
Mono(2-ethylhexyl)phthalate, MEHP
Mono(2-ethyl-5-hydroxyhexyl)phthalate, 5-OH-MEHP
Mono(2-ethyl-5-oxohexyl)phthalate, 5-oxo-MEHP
Mono(2-ethyl-5-carborypentyl)phthalate, 5-cx-MEPP
Mono(2-carboxymethyl-hexyl)phthalate, 2-cx-MMHP
Mono(4-methyl-7-hydroxyoctyl)phthalate, 7-OH-MMOP
Mono(4-methyl-7-oxooctyl)phthalate, 7-oxo-MMOP
Mono(4-methyl-7-carboxyheptyl)phthalate, 7-cx-MMHpP
Polycyclic Aromatic Hydrocarbon Metabolites
1-Hydroxypyrene
1-Hydroxyphenanthrene
2-Hydroxyphenanthrene
3-Hydroxyphenanthrene
4-Hydroxyphenanthrene
Phytoestrogens
Genistein
Daidzein

2. Study Methods

2.1 Recruitment of Study Participants

The study sample consisted of 249 individuals out of 300 individuals who were recruited to the study to allow for missing data, incomplete questionnaires and invalid urine samples. Recruitment and interviewing took place between February and June 2011.

The parameters for defining the sample were selected so as to represent the population distribution of urban vs rural dwelling and the two major ethnic groups in Israel (Jews and Arabs. The parameters were as follows:

- Age group- 25-64 with two subgroups 25-44, 45-64
- Representation of at least 4 of the 7 geographical districts
- Proportional representation of urban vs rural populations
- 20 cities/towns were selected, with 4 representing the Arab sector (3 urban, 1 rural) and the other the Jewish sector (15 urban, 1 rural). In each town/city, interviewers were requested to interview 15 people.

Within each city/ town, interviewers were required to select 5 separate areas. Within each area, recruitment was done by "knocking on doors" and interviewing those who met the inclusion criteria and agreed to participate, including providing a urine sample. For each address visited, where there were individuals who refused to participate in the study or were not at home, this was documented. Although the target age range for the population was 25-64, the ages of individuals in the recruited sample ranged from 20-73. The response rate was 29%, excluding individuals not eligible for the study and individuals not home at the time of the visit.

Participants were not targeted for specific exposure scenarios and were not included or excluded on the basis of their potential for low or high exposures to environmental chemicals.

2.2 Interview and urine sample collection

Study participants were interviewed using a structured questionnaire. The interviews were administered by trained interviewers, and were carried out in Hebrew or Arabic. The interview consisted of the following: (see Appendix A for full questionnaire)

- A 24 hour dietary recall, carried out using the Israeli Food and Food Quantities Guide (pub. no 320, ICDC 2009), and aids (teaspoon, tablespoon, measuring cup)
- A food frequency questionnaire, specially adapted to enable better information on consumption of soy products, fruit and vegetables.
- Health and lifestyle questionnaire
- Demographic questionnaire.

The 24 hour dietary recall was carried out using the multiple pass method used in all Mabat National health and Nutrition surveys (Israel) , and extensively used worldwide and validated for dietary studies.

For logistical purposes, spot samples were collected rather than 24-hour urine samples. Urine samples were collected in 120-mL urine specimen containers. All urine samples were maintained at 4°C for a maximum of 24 hours until they were transported to the Sheba Medical Center (SMC) at Tel Hashomer. Urine samples were aliquoted at SMC and frozen at – 20°C. Within

four months of collection, urine samples were shipped to the University of Erlangen – Nuremberg in Germany on dry ice (-70°C), where they were analyzed. Analytical methods employed for analysis of contaminants in the study are listed in Appendix B.

2.3 Informed consent and ethical considerations

Ethics approval for the study was obtained from the Sheba Tel Hashomer Helsinki Committee. Informed written consent was obtained for all respondents. Participation in the study was voluntary. At the time of recruitment participants received a letter explaining that they would receive individual results on urinary concentrations of environmental contaminants if a) they requested it at the time of their interview or b) their individual urinary metabolite results were unusual.

Urine samples were sent to the laboratory at the University of Erlangen- Nuremberg in Germany without details on the identity of the study participants and all analysis of data for the study was conducted without details on the identity of the participants.

2.4 Data Analysis

All completed questionnaires were returned to the Israel Center for Disease Control for data entry, quality assurance and analysis. Following quality assurance, all 24 hour dietary recall data were entered into the Tzameret computerized dietary analysis program and Excel spreadsheets of all foods and beverages consumed were produced.

Urinary analyte concentrations were provided in units (mcg or ng) per liter of urine. These concentrations were divided by urinary creatinine concentrations (g creatinine/L urine) to generate creatinine-adjusted analyte concentrations. Concentrations below the limit of quantification (LOQ) for an analyte were replaced by the limit of detection (LOD) for that analyte, and concentrations below the LOD were replaced with the LOD divided by the square root of 2.

Geometric means and 95th percentile confidence intervals were calculated for urinary analyte concentrations and for creatinine-adjusted analyte concentrations using the ameans command in Stata v. 12.1 (StataCorp, 4905 Lakeway Drive, College Station, Texas 77845, USA). Percentiles (50th, 75th, 90th) and their confidence intervals were estimated using the Stata centile command.

Analytical data were obtained for at least one contaminant for 249 study participants. In some cases the urine volume was insufficient for analysis of all the contaminants/analytes. The total number of urine samples analyzed for the different contaminants in this study ranges between 241 and 249.

Available data on urinary concentrations of environmental chemicals and/ or their metabolites in the adult general population in the US, Canada, and France are presented in this report, to give context to the study results. Data, were not, however, available for all the contaminants in these populations, and in some cases the environmental contaminant/metabolite was measured in a biological medium other than urine. Available data on urinary concentrations of the contaminant/ metabolite in the general population in US, Canada, or France are reported below.

3. Considerations for Interpreting the Data in this Report

3.1 This report provides information on exposure, not human health effects.

Additional research is required for determining whether exposure levels documented in this report are safe or are associated with disease or adverse effects. The measurement of an environmental chemical in a person's urine does not by itself mean that the chemical causes disease or adverse health effects. Advances in analytical methods allow measurement of very low levels of environmental chemicals in people, but separate studies of varying exposure levels and health effects are needed to determine whether such urine levels are likely to result in disease. Factors such as the dose, the duration and timing of exposure, and the toxicity of the chemical are important to determine whether adverse health effects may occur.

3.2 Most measurements in urine quantify chemical metabolites of nonpersistent chemicals (those that do not stay in the body a long time).

Many of the chemicals discussed in this report have very short biological half lives. The detection of the environmental chemical in an individual's urine reflects very recent exposure and does not provide information about long term exposure.

3.3 Differences in urinary concentrations in age, gender and ethnic subgroups in this report are not adjusted for confounding factors.

Levels of chemicals are provided for the demographic groups as stratified by age, gender, and ethnicity. Demographic groups may not be equal in their composition with respect to other variables. Therefore reported differences in average concentrations in these subgroups do not necessarily reflect true differences in exposure. The Ministry of Health is currently analyzing these data.

3.4 It is unclear to what extent the study population is representative of the general population in Israel

The study population includes individuals from five geographic regions in Israel, from different age, gender and ethnic subgroups. However, it is not a random sample, and the distribution of ages and other demographic characteristics in the study population differs somewhat from that in the general population in Israel. In the study sample, 66% of individuals were 20-44 years and 34% were 45-73 years, while in the 2010 general population 20-73 years of age, 58% were 20-44

years and 42% were 45-73 years (Central Bureau of Statistics 2011). In addition, in the study population, 75% of individuals were Jews and 25% were Arabs, while in the 2010 general population ages 20-73 years of age, 82% of individuals were Jews and 18% were Arabs (Central Bureau of Statistics, 2011).

3.5 There are important differences in methods used in national biomonitoring studies, including participant selection, urine sampling, and analytical methods. Therefore differences in reported urinary concentrations do not necessarily reflect differences in exposure.

Data on exposure levels in other populations (US, Canada, France) are provided in this report to give context for the urinary environmental chemicals concentrations in the study population. It is important to note, however, that factors such as participant selection, urine sampling, and analytical methods can differ between the national studies. Therefore differences in reported urinary concentrations between different populations do not necessarily reflect true differences in body burden. In addition, the number of participants in this study (249) is small compared to other national biomonitoring studies.

4. Study Population

Participants in the study came from five geographic regions in Israel: Northern region (N= 15), Haifa region (N=74), Central region (N=49), Tel Aviv region (N=61), and the Southern region (N=50).

Table 2: Distribution of Demographic Variables in Total Survey Population (N=249)

	N	%
AGE RANGE		
20-44 years	164	65.9
45-73 years	85	34.1
GENDER		
Males	132	53
Females	117	47
ETHNICITY		
Jews	184	73.9
Arabs	61	24.5
Other	4	1.6
URBANICITY		
Urban	219	88
Rural	30	12
BIRTH COUNTRY		
Born in Israel	215	86.3
Born outside Israel	22	8.8

Birthplace not provided	12	4.8
EDUCATION		
Matriculation certificate	90	36.1
Vocational certificate	65	26.1
College/university/yeshiva study	57	22.9
Other (no certificate or not provided)	37	14.9
AVERAGE MONTHLY HOUSEHOLD INCOME (NIS)		
0-5,000	28	11.2
5,001-10,000	74	29.7
Over 10,000	73	29.3
Other (not relevant or not provided)	74	29.7

5. Results by Chemical Group

5.1 Cotinine

Cotinine is the primary metabolite of nicotine, a major component of tobacco and tobacco smoke. Although it is possible to assess exposure to tobacco smoke by measuring blood nicotine concentrations, cotinine persists longer in the body and therefore is the preferred biomarker of exposure to tobacco smoke in active smokers and in nonsmokers exposed to environmental tobacco smoke (ETS) (CDC, 2009).

Tobacco smoke is a complex matrix consisting of thousands of compounds. Many constituents of tobacco smoke, including nicotine, are found in the tobacco plant, while other smoke constituents are formed during combustion of tobacco (IARC, 2004). The main source of exposure to nicotine and to other substances in tobacco smoke is inhalation by active smokers or via ETS. Potatoes, tomatoes, eggplants, and peppers contain nicotinic acid, but concentrations are extremely low, and dietary intake of nicotine from these sources is likely to be minimal (Siegmund et al. 2001).

At least 50 of the constituents in tobacco smoke have been shown to cause, initiate, or promote cancer (IARC, 2004). Exposure to second hand tobacco smoke contributes to cardio-pulmonary disease risk, and can lead to adverse reproductive consequences (DHHS, 2004).

In 2011 the smoking rate in Israel (ages 21 and older) was 20.6%. The Government of Israel has taken several steps to reduce exposure to environmental tobacco smoke. These include initiatives to reduce or eliminate smoking in workplaces and other public locations (Israel Ministry of Health, 2011).

Data are presented in this report for individuals who reported that they do not smoke.

Table 3: Geometric mean and selected percentiles - urinary cotinine concentrations in 153 **non-smoking** study participants (ug/L)

	N	% ≥ LOQ	Geometric Mean (95th CI)	50th Percentile (95th CI)	75th Percentile (95th CI)	90th Percentile (95th CI)
Total	153	63	2.0 1.5 – 2.7	1.3 1.1 – 1.5	2.8 2.0 – 4.7	40.5 8.6 – 95.0
20-44	94	69	2.2 1.5 – 3.2	1.5 1.2 – 1.7	2.7 2.0 – 6.0	42.5 6.1 – 189.5
45-73	59	54	1.8 1.1 – 2.9	1.0 0.5 – 1.6	3.0 1.6 – 8.8	44.7 5.2 – 162.6
Males	69	78	3.5 2.2 – 5.6	1.8 1.4 – 2.5	7.4 3 – 51.9	84.5 37.7 – 212.7
Females	84	51	1.3 0.9 – 1.8	1.0 0.5 – 1.3	1.9 1.5 – 1.3	7.0 2.6 – 31.2
Jewish	105	67	2.2 1.5 – 3.2	1.4 1.1 – 1.7	3.3 2.0 – 8.4	39.3 8.6 – 161.9
Arab	45	53	1.7 1.0 – 2.9	1.0 0.5 – 1.5	2.4 1.3 – 21.9	56.8 3.1 – 440.7

Table 4: Geometric mean and selected percentiles - creatinine adjusted urinary cotinine concentrations in 153 **non-smoking** study participants (ug/g creatinine)

	N	% ≥ LOQ	Geometric Mean (95th CI)	50th Percentile (95th CI)	75th Percentile (95th CI)	90th Percentile (95th CI)
Total	153	63	1.6 1.2 – 2.2	1.1 0.8 – 1.4	2.3 1.9 – 4.6	25 5.6 – 52.2
20-44	94	69	1.6 1.1 – 2.4	1.0 0.8 – 1.5	2.2 1.9 – 6.1	25 6.2 – 100.0
45-73	59	54	1.6 1.0 – 2.6	1.2 0.8 – 1.5	2.6 1.5 – 4.8	47.6 3.3 – 116.1
Males	69	78	2.4 1.5 – 3.9	1.5 0.9 – 2.1	7.3 2.2 – 31.6	50.6 25.0 – 169.8
Females	84	51	1.2 0.9 – 1.7	0.9 0.7 – 1.2	1.9 1.5 – 2.6	4.7 2.5 – 18.6
Jewish	105	67	1.8 1.2 – 2.6	1.2 0.8 – 1.5	2.4 1.9 – 5.0	23.4 5.7 – 115.9
Arab	45	53	1.3 0.8 – 2.3	0.7 0.5 – 1.6	2.2 1.5 – 16.5	45.2 2.5 – 237.3

The percent of non – smoking individuals with urinary cotinine concentrations at or above the level of detection (LOD) (1.1 ug/L) in the study population can be compared with the percent above the LOD in the Canadian general population (Health Canada, 2010). Median levels cannot be compared since these were not calculated in the Canadian study (since more than 40% of the samples were below the LOD). In the study population, 67% of non – smokers ages 20 – 39 had urinary concentrations above the LOD whereas 52% non – smokers ages 40 – 59 had urinary concentrations above the LOD. In the general Canadian population, 14.7% of non – smokers ages

20 – 39 had urinary concentrations above the LOD whereas 11% non – smokers ages 40 – 59 had urinary concentrations above the LOD.

5.2 **Bisphenol A**

Bisphenol A (BPA) is used in the production of polycarbonate (used in the manufacture of food and beverage containers) and as a precursor for monomers of certain epoxy-phenolic resins (used as an interior protective lining for food and beverage cans). Plastics and resins made from bisphenol A can also be used in a range of other products including medical devices, some dental fillings and sealants, sporting and safety equipment, electronics, and automotive parts (CDC, 2009).

The primary route of exposure to BPA for the public is through dietary intake (*e.g.*, migration from food packaging and repeat-use polycarbonate containers). Exposure can also occur from contact with environmental media (*i.e.*, ambient air, indoor air, drinking water, soil, and dust) and from the use of consumer products and other sources. Additional exposure can occur from dermal absorption of BPA present in thermal paper (Geens T *et al* 2011).

Human health effects from bisphenol A at low environmental doses or at biomonitored levels from low environmental exposures are unknown. The European Chemicals Bureau has classified BPA as a Category 3 reproductive toxicant, that is, a substance that causes concern for human fertility based on sufficient evidence of reproductive toxicity in laboratory animals (ECB, 2003). BPA is considered to be a weak environmental estrogen based on traditional bioassays; however, limited evidence suggests that BPA can stimulate cellular responses at very low concentrations (Health Canada, 2008a). There is some evidence from animal studies to suggest that low-level exposure to BPA, particularly at sensitive life-cycle stages, may lead to persistent alterations in hormonal, developmental, metabolic, and/or reproductive processes later in life (Health Canada, 2008a). There is some uncertainty regarding the relevance of these studies to human effects. Human studies of BPA remain limited, although in adults there have been suggestive relationships with male and female reproductive end points, altered thyroid hormone levels and liver function, cardiovascular disease, and diabetes (Meeker J, 2012).

Finding a measurable amount of BPA in urine does not necessarily mean that the levels of bisphenol A cause an adverse health effect.

Table 5: Geometric mean and selected percentiles - urinary bisphenol A concentrations in 246 study participants (ug/L)

	N	% ≥ LOQ	Geometric Mean (95th CI)	50th Percentile (95th CI)	75th Percentile (95th CI)	90th Percentile (95th CI)
Total	246	89	2.4 2.0- 2.9	3.0 2.4- 3.4	6.9 5.3-8.5	12.7 10.1- 17.8
20-44	163	90	2.6 2.1- 3.3	3.1 2.4-3.9	6.9 5.3-8.7	12.8 9.8-18.6
45-73	83	88	2.0 1.4-2.9	3.0 1.8-3.4	7.0 3.7-9.5	11.7 9.3-20.8
Males	131	86	2.3 1.7-3.0	3.2 2.4-4.0	7.0 5.1-9.1	12.7 9.7-18.3
Females	115	92	2.5 1.9-3.2	2.7 2.1-3.2	6.7 4.8-8.9	12.9 9.0-20.7
Jewish	183	92	3.1 2.5-3.8	3.4 3.0-4.2	8.0 6.8-9.4	14.9 11.0-19.7
Arab	59	78	1.0 0.7-1.5	1.4 0.8-1.8	3.2 1.8-5.3	6.5 4.4-10.0

Table 6: Geometric mean and selected percentiles creatinine adjusted- urinary bisphenol A concentrations in 246 study participants (ug/g creatinine)

	N	% ≥ LOQ	Geometric Mean (95th CI)	50th Percentile (95th CI)	75th Percentile (95th CI)	90th Percentile (95th CI)
Total	246	89	1.9 1.6 - 2.3	2.3 1.9 – 2.6	4.3 3.6 – 5.2	8.7 7.0 – 12.3
20-44		90	2.0 1.6 - 2.4	2.3 1.8 – 2.7	4.3 3.6 – 5.4	8.2 6.4 – 13.7
45-73	83	88	1.8 1.3 - 2.4	2.0 1.4 – 3.1	4.4 3.3 – 7.1	9.4 7.0 – 14.9
Males	131	86	1.7 1.3 – 2.2	2.1 1.8 – 2.7	3.8 3.2 – 5.0	7.3 5.5 – 10.5
Females	115	92	2.2 1.7 – 2.8	2.4 1.7 – 3.1	5.0 3.5 – 6.8	11.7 7.2 – 20.9
Jewish	183	92	2.5 2.1 – 3.0	2.5 2.1 – 3.1	5.1 4.0 – 6.7	10.2 7.6 – 15.6
Arab	59	78	0.8 0.5 – 1.2	1.1 0.6-1.6	2.7 1.6 – 3.7	3.9 3.3 – 6.1

Median creatinine adjusted bisphenol A urinary concentrations in the study population (2.3 ug/g creatinine) were comparable to the median creatinine adjusted bisphenol A urinary concentrations reported for the general US population ages 20 and older (1.9 ug/g creatinine) in 2007 – 2008 (CDC, 20012). Median creatinine adjusted bisphenol A urinary concentrations in the study population (2.3 ug/g creatinine) were higher than median creatinine adjusted bisphenol A urinary concentrations reported for the general Canadian population ages 20 - 39 (1.5 ug/g creatinine) in 2007 – 2009 (Health Canada, 2010).

5.3 Organophosphate Pesticides

Organophosphorus (OP) insecticides are active against a broad spectrum of insects. OPs are used in Israel primarily for insect control on food and non-food crops. In 2011 (when the current study was conducted) approximately 20 OP insecticides, in a variety of formulations, were registered for use in Israel by the Ministry of Agriculture. Residential uses of two main OPs, chlorpyrifos and diazinon, were phased out in Israel beginning in 2008 and uses in gardens and public parks were banned in 2009. Prior to the ban, chlorpyrifos and diazinon were widely used as residential pesticides in Israel. Agricultural uses of ten OPs will be phased out in Israel in 2012 – 2014 (Israel Ministry of Health, 2012).

The primary routes of exposure for the public are through ingestion of food previously treated with organophosphate pesticides and from hand-to-mouth contact with surfaces containing organophosphorus insecticides; less common routes include inhalation and dermal contact. Despite their rapid degradation in the environment, small amounts can be detected in food and drinking water (CDC, 2009).

After entry into the body, organophosphate pesticides are rapidly metabolized and excreted in urine as dialkyl phosphate metabolites. Dialkyl phosphate metabolites are not considered toxic, but are considered to be biomarkers of exposure to the parent pesticides. The dialkyl phosphate metabolites are not pesticide-specific; rather, each is associated with several organophosphate pesticides, and many organophosphates can form more than one of these metabolites. There are six dialkyl phosphate metabolites: dimethylphosphate (DMP), dimethylthiophosphate (DMTP), dimethyldithiophosphate (DMDTP), diethyl phosphate (DEP), diethylthiophosphate (DETP), and diethyldithiophosphate (DEDTP). Measurement of these metabolites reflects recent exposure, predominantly in the previous few days. Dialkyl phosphates may also occur in the environment as a result of degradation of organophosphorus insecticides and therefore, the presence in a person's urine may reflect exposure to the metabolite itself (CDC, 2009).

The table shows the six urinary metabolites and the parent organophosphorus insecticides that can lead to the creation of these metabolites. Each of the six urinary dialkyl phosphate metabolites can be produced from the metabolism of more than one organophosphorus insecticide. Therefore, the presence of one or more dialkyl phosphate metabolites without additional information cannot be linked to exposure to a specific organophosphorus insecticide.

Table 7: Organophosphate pesticides and their dialkyl phosphate metabolites (Health Canada, 2010)

Organophosphate Pesticides[a]	Dialkyl Phosphate Metabolites					
	DMP	DMTP	DMDTP	DEP	DETP	DEDTP
Acephate	–	–	–	–	–	–
Azinphos-Methyl	■	■	■	–	–	–
Bensulide	–	–	–	–	–	–
Chlorpyrifos	–	–	–	■	■	–
Coumaphos	–	–	–	■	■	–
Diazinon	–	–	–	■	■	–
Dichlorvos (DDVP)	■	–	–	–	–	–
Dimethoate	■	■	■	–	–	–
Fenthion[b]	■	■	–	–	–	–
Malathion	■	■	■	–	–	–
Methamidophos	–	–	–	–	–	–
Naled	■	–	–	–	–	–
Phorate	–	–	–	■	■	■
Phosalone	–	–	–	■	■	■
Phosmet	■	■	■	–	–	–
Propetemphos	–	–	–	–	–	–
Terbufos	–	–	–	■	■	■
Tetrachlorvinphos	■	–	–	–	–	–

The acute high dose effects of OP insecticides from intentional and unintentional overdoses or from high-dose worker exposures are well known and include neurological dysfunction that results from the inhibition of the enzyme acetylcholinesterase leading to excess acetylcholine in the central and peripheral nervous systems. There is considerable variation in the toxicity of different OP insecticides.

Chronic exposures studied in farmers and insecticide applicators, who have neither past acute poisoning nor significant reduction in blood cholinesterase activity, have shown possible subtle or subclinical neurological effects (CDC, 2009). Over the past decade, three separate longitudinal birth cohort studies conducted in the US have indicated that very low levels of exposure to OPs during pregnancy can adversely impact growth and cognitive development in infants and children (Gray and Lawler 2011).

There are limited data on exposure of the general population in Israel to organophosphate pesticides. In a pilot study in 20 pregnant women in Jerusalem, conducted in 2006, DMP was detected in 74% of the urine samples whereas DMTP was detected in 90% of the urine samples.

Creatinine-adjusted total dimethyl metabolite concentrations were between 4 and 6 times higher in this population compared to other populations of pregnant women in the United States while total diethyl metabolite concentrations were lower (Berman et al 2011).

Finding a measurable amount of dialkyl phosphate metabolites in urine does not necessarily mean that the levels of dialkyl phosphate metabolites, or their parent compounds, cause an adverse health effect.

Table 8: Geometric mean and selected percentiles – diethyl phosphate (DEP) urinary concentrations in 247 study participants (ug/L)

	N	% ≥ LOQ	Geometric Mean (95^{th} CI)	50^{th} Percentile (95^{th} CI)	75th Percentile (95^{th} CI)	90th Percentile (95^{th} CI)
Total	247	98	1.9 1.7 – 2.2	2.0 1.7 – 2.3	3.8 3.2 – 4.3	6.2 5.1 – 7.6
20-44	164	99	1.9 1.7 – 2.2	1.9 1.6 – 2.2	3.8 2.9 – 4.3	6.3 4.8 – 8.0
45-73	83	96	2.0 1.6 – 2.5	2.1 1.7 – 3.0	4.2 3.2 – 5.1	6.1 5.1 – 9.9
Males	131	98	1.8 1.5 – 2.1	1.8 1.5 – 2.2	3.3 2.8 – 4.3	6.1 4.6 – 7.9
Females	116	98	2.1 1.8 – 2.5	2.2 1.8 – 2.9	4.3 3.4 – 5.0	6.4 5.1 – 9.1
Jewish	183	97	2.0 1.7 – 2.3	2.1 1.7 – 2.4	4.0 3.3 – 4.7	6.2 5.1 – 8.0
Arab	60	100	1.9 1.5 – 2.4	1.9 1.3 – 2.6	3.6 2.6 – 5.0	6.3 4.2 – 10.6

Table 9: Geometric mean and selected percentiles - creatinine adjusted urinary diethyl phosphate (DEP) concentrations in 247 study participants (ug/g creatinine)

	N	% ≥ LOQ	Geometric Mean (95^{th} CI)	50^{th} Percentile (95^{th} CI)	75th Percentile (95^{th} CI)	90th Percentile (95^{th} CI)
Total	247	98	1.5 1.4 – 1.7	1.5 1.2 – 1.7	3.0 2.5 – 3.5	4.6 4.0 – 6.3
20-44	164	99	1.5 1.3 – 1.7	1.5 1.2 – 1.7	2.7 2.2 – 3.3	4.0 3.6 – 4.9
45-73	83	96	1.8 1.4 – 2.2	1.6 1.2 – 2.3	3.8 2.9 – 5.0	6.7 4.8 – 10.4
Males	131	98	1.3 1.2 – 1.5	1.2 1.0 – 1.5	2.6 1.8 – 3.3	4.1 3.6 – 5.6
Females	116	98	1.8 1.5 – 2.2	1.8 1.6 – 2.2	3.5 2.8 – 4.0	6.2 4.2 – 8.6
Jewish	183	97	1.6 1.4 – 1.8	1.6 1.2 – 1.8	3.0 2.6 – 3.7	4.8 4.0 – 6.3
Arab	60	100	1.5 1.2 – 1.9	1.3 1.2 – 1.7	2.8 1.9 – 3.8	4.5 3.5 – 11.2

Table 10: Geometric mean and selected percentiles – diethylthiophosphate (DETP) urinary concentrations in 247 study participants (ug/L)

	N	% ≥ LOQ	Geometric Mean (95th CI)	50th Percentile (95th CI)	75th Percentile (95th CI)	90th Percentile (95th CI)
Total	247	76	0.6 0.5 - 0.7	0.6 0.5 – 0.7	1.3 1.2 – 1.5	2.6 1.9 – 3.4
20-44	164	75	0.6 0.5 – 0.7	0.5 0.5 – 0.7	1.4 1.2 – 1.6	2.6 1.9 – 3.4
45-73	83	77	0.6 0.4 – 0.7	0.6 0.5 – 0.8	1.3 0.9 – 1.5	3.1 1.5 – 5.5
Males	131	76	0.6 0.5 – 0.7	0.6 0.5 – 0.8	1.3 1.1 – 1.5	3.3 1.6 – 5.3
Females	116	76	0.5 0.4 – 0.7	0.5 0.5 – 0.7	1.4 1.0 – 1.6	2.6 1.8 – 3.5
Jewish	183	77	0.6 0.5 – 0.7	0.6 0.5 – 0.8	1.4 1.2 – 1.6	3.2 2.4 – 4.1
Arab	60	73	0.5 0.3 – 0.6	0.5 0.4 – 0.7	0.9 0.7 – 1.5	1.8 1.3 – 3.4

Table 11: Geometric mean and selected percentiles - creatinine adjusted diethyl thiophosphate (DETP) concentrations in 247 study participants (ug/g creatinine)

	N	% ≥ LOQ	Geometric Mean (95th CI)	50th Percentile (95th CI)	75th Percentile (95th CI)	90th Percentile (95th CI)
Total	247	76	0.4 0.4 – 0.5	0.5 0.3 – 0.5	1.0 0.8 – 1.3	2.2 1.8 – 3.1
20-44	164	75	0.4 0.4 – 0.5	0.4 0.3 – 0.5	0.9 0.7 – 1.2	2.1 1.3 – 2.8
45-73	83	77	0.5 0.4 – 0.7	0.5 0.3 – 0.7	1.3 0.9 – 1.8	2.9 1.7 – 5.2
Males	131	76	0.4 0.3 – 0.5	0.4 0.3 – 0.5	1.0 0.7 – 1.2	2.2 1.4 – 3.7
Females	116	76	0.5 0.4 – 0.6	0.5 0.3 – 0.6	1.2 0.8 – 1.4	2.4 1.5 – 3.4
Jewish	183	77	0.5 0.4 – 0.6	0.5 0.3 – 0.6	1.1 0.9 – 1.3	2.3 1.8 – 3.5
Arab	60	73	0.4 0.3 – 0.5	0.4 0.3 – 0.5	0.7 0.6 – 1.3	1.8 1.1 – 3.6

Table 12: Geometric mean and selected percentiles – diethyl dithiophosphate (DEDTP) urinary concentrations in 247 study participants (ug/L)

	N	% ≥ LOQ	Geometric Mean (95th CI)	50th Percentile (95th CI)	75th Percentile (95th CI)	90th Percentile (95th CI)
Total	247	44	*	*	*	*
20-44	164	39	*	*	*	*
45-73	83	53	*	*	*	*
Males	131	44	*	*	*	*
Females	116	44	*	*	*	*
Jewish	183	53	*	*	*	*
Arab	60	17	*	*	*	*

* *Proportion of results below limit of quantification was too high to provide a valid result.*

Table 13: Geometric mean and selected percentiles - creatinine adjusted diethyl dithiophosphate (DEDTP) concentrations in 247 study participants (ug/g creatinine)

	N	% ≥ LOQ	Geometric Mean (95th CI)	50th Percentile (95th CI)	75th Percentile (95th CI)	90th Percentile (95th CI)
Total	247	44	*	*	*	*
20-44	164	39	*	*	*	*
45-73	83	53	*	*	*	*
Males	131	44	*	*	*	*
Females	116	44	*	*	*	*
Jewish	183	53	*	*	*	*
Arab	60	17	*	*	*	*

* *Proportion of results below limit of quantification was too high to provide a valid result.*

Table 14: Geometric mean and selected percentiles – dimethyl phosphate (DMP) urinary concentrations in 247 study participants (ug/L)

	N	% ≥ LOQ	Geometric Mean (95th CI)	50th Percentile (95th CI)	75th Percentile (95th CI)	90th Percentile (95th CI)
Total	247	99	13.5 11.8 – 15.4	13.6 12.0 – 15.6	26.5 22.7 – 30.8	44.6 38.4 – 61.2
20-44	164	100	13.1 11.2 – 15.2	13.3 11.8 – 15.1	24.0 20.8 – 30.2	42.3 33.1 – 73.6
45-73	83	98	14.3 10. 9 – 18.6	16.5 11.6 – 21.3	30.6 23.1 – 39.1	48.0 38.0 – 86.7
Males	131	98	12.7 10.4 – 15.5	12.7 11.8 – 15.2	23.0 19.0 – 36.5	44.9 38.6 – 89.0
Females	116	100	14.4 12.1 – 17.2	14.9 11.7 – 20.4	28.4 23.3 – 31.5	44.5 33.1 – 70.5
Jewish	183	99	14.5 12.5 – 16.7	13.8 12.2 – 16.3	27.0 22.7 – 31.8	44.7 37.5 – 62.4
Arab	60	98	10.9 7.8 – 15.1	11.8 7.3 – 19.0	23.6 19.2 – 38.4	47.7 31.8 – 102.6

Table 15: Geometric mean and selected percentiles -creatinine adjusted urinary dimethyl phosphate (DMP) concentrations in 247 study participants (ug/g creatinine)

	N	% ≥ LOQ	Geometric Mean (95th CI)	50th Percentile (95th CI)	75th Percentile (95th CI)	90th Percentile (95th CI)
Total	247	99	10.8 9.5 – 12.2	10.0 8.8 – 11.2	20.1 17.4 – 26.1	37.7 32.6 – 51.8
20-44	164	100	9.9 8.6 – 11.4	9.5 7.8 – 10.7	17.2 12.7 – 23.5	35.8 27.4 – 48.9
45-73	83	98	12.7 9.7 – 16.6	13.1 9.0 – 17.6	26.5 19.4 – 34.3	45.7 33.0 – 144.6
Males	131	98	9.4 7.8 – 11.4	9.3 7.6 – 10.6	17.9 13.0 – 25.7	37.4 27.5 – 56.2
Females	116	100	12.5 10.5 – 14.8	11.5 8.9 – 13.6	23.2 17.5 – 31.1	39.6 31.8 – 64.4
Jewish	183	99	11.6 10.1 – 13.3	10.5 9.1 – 11.9	22.9 17.4 – 27.0	37.3 32.4 – 47.5
Arab	60	98	8.7 6.3 – 12.0	8.2 5.7 – 12.1	17.9 12.2 – 28.7	55.3 21.6 – 111.5

Table 16: Geometric mean and selected percentiles – dimthyl thiophosphate (DMTP) urinary concentrations in 247 study participants (ug/L)

	N	% ≥ LOQ	Geometric Mean (95th CI)	50th Percentile (95th CI)	75th Percentile (95th CI)	90th Percentile (95th CI)
Total	247	100	8.0 6.8 – 9.4	7.1 6.0 – 8.5	15.8 13.0 – 20.2	52.3 32.4 – 81.9
20-44	164	99	7.4 6.1 – 9.0	6.1 5.0 – 7.2	13.0 10.1 – 16.9	51.4 27.4 – 93.3
45-73	83	100	9.3 6.8 – 12.6	10.1 7.6 – 13.2	23.2 16.2 – 34.1	57.1 30.2 – 122.0
Males	131	99	6.8 5.5 – 8.5	5.9 4.6 – 7.2	13.6 9.9 – 24.8	50.3 27.7 – 65.9
Females	116	100	9.5 7.5 – 12.2	8.7 7.2 – 12.6	16.5 13.7 – 23.8	85.0 27.6 – 155.5
Jewish	183	99	7.6 6.4 – 9.1	7.0 5.9 – 8.3	14.6 12.0 – 18.4	38.3 26.8 – 77.5
Arab	60	100	9.0 6.0 – 13.6	8.1 5.0 – 12.7	22.1 12.8 – 59.4	116.0 46.8 – 218.2

Table 17: Geometric mean and selected percentiles - creatinine adjusted dimethyl thiophosphate (DMTP) concentrations in 247 study participants (ug/g creatinine)

	N	% ≥ LOQ	Geometric Mean (95th CI)	50th Percentile (95th CI)	75th Percentile (95th CI)	90th Percentile (95th CI)
Total	247	100	6.4 5.4 – 7.5	5.2 4.7 – 6.0	13.6 9.7 – 16.5	47.2 29.5 – 79.8
20-44	164	99	5.6 4.6 – 6.8	4.7 4.0 – 5.5	10.1 7.4 – 14.3	42.4 19.2 – 95.1
45-73	83	100	8.3 6.1 – 11.2	7.0 5.7 – 12.4	17.7 14.2 – 35.3	61.8 34.7 – 101.4
Males	131	99	5.1 4.1 – 6.3	4.4 3.5 – 5.1	8.9 5.9 – 16.2	39.9 19.6 – 57.6
Females	116	100	8.3 6.5 – 10.5	7.0 5.8 – 8.6	14.8 12.8 – 22.5	79.0 24.7 – 116.3
Jewish	183	99	6.1 5.1 – 7.3	5.1 4.6 – 5.9	12.7 8.6 – 16.2	43.0 23.1 – 57.6
Arab	60	100	7.3 4.8 – 10.9	6.1 4.0 – 9.7	18.1 10.4 – 44.6	92.0 29.0 – 205.1

Table 18: Geometric mean and selected percentiles – dimethyl dithiophosphate (DMDTP) urinary concentrations in 247 study participants (ug/L)

	N	% ≥ LOQ	Geometric Mean (95^{th} CI)	50^{th} Percentile (95^{th} CI)	75th Percentile (95^{th} CI)	90th Percentile (95^{th} CI)
Total	247	73	0.4 0.3 – 0.4	0.3 0.3 – 0.4	0.8 0.7 – 1.3	4.2 2.3 – 6.5
20-44	164	71	0.3 0.2 – 0.4	0.3 0.3 – 0.3	0.7 0.5 – 0.8	2.5 1.3 – 7.1
45-73	83	77	0.5 0.3 – 0.7	0.4 0.3 – 0.7	1.8 1.0 – 3.4	5.2 3.0 – 10.4
Males	131	71	0.3 0.2 – 0.4	0.3 0.2 – 0.4	0.7 0.5 – 1.1	2.5 1.6 – 8.7
Females	116	76	0.4 0.3 – 0.6	0.3 0.3 – 0.6	1.3 0.8 – 2.0	4.9 2.9 – 10.5
Jewish	183	74	0.4 0.3 – 0.5	0.3 0.3 – 0.4	0.8 0.6 – 1.4	4.2 2.0 – 8.6
Arab	60	72	0.4 0.2 – 0.6	0.3 0.2 – 0.5	0.8 0.6 – 3.2	4.9 2.0 – 11.3

Table 19: Geometric mean and selected percentiles - creatinine adjusted dimethyl dithiophosphate (DMDTP) concentrations in 247 study participants (ug/g creatinine)

	N	% ≥ LOQ	Geometric Mean (95^{th} CI)	50^{th} Percentile (95^{th} CI)	75th Percentile (95^{th} CI)	90th Percentile (95^{th} CI)
Total	247	73	0.3 0.2 – 0.4	0.2 0.2- 0.3	0.7 0.5 – 1.0	4.0 2.0 – 6.7
20-44	164	71	0.2 0.2 – 0.3	0.2 0.2 – 0.2	0.4 0.3 – 0.7	2.0 1.0 – 5.3
45-73	83	77	0.5 0.3 – 0.7	0.3 0.2 – 0.5	1.6 0.8 – 3.7	6.4 3.3 – 11.1
Males	131	71	0.2 0.2 – 0.3	0.2 0.1 – 0.2	0.4 0.3 – 0.8	2.8 1.0 – 7.0
Females	116	76	0.4 0.3 – 0.5	0.3 0.2 – 0.5	1.0 0.6 – 2.2	4.9 2.5 – 8.9
Jewish	183	74	0.3 0.2 – 0.4	0.2 0.2 – 0.3	0.7 0.5 – 1.1	3.8 1.8 – 6.7
Arab	60	72	0.3 0.2 – 0.5	0.2 0.2 – 0.3	0.8 0.4 – 2.1	5.5 1.6 – 8.3

For comparison, median creatinine adjusted urinary concentrations of the six dialkyl phosphate metabolites in the study population are shown, along with median creatinine adjusted urinary concentrations in NHANES 2003 – 2004 (4th Report) (CDC, 2009), the Canadian Health Measures Survey 2007 – 2009 (Health Canada, 2010), and the 2010 Study on Exposure of the French Population to Environmental Pollutants (Frery et al 2010).

Table 20: Median creatinine adjusted dialkyl phosphate urinary concentrations (ug/g) in the Israel study population, NHANES, Canada, and France

	Ages	N	DMP	DMTP	DMDTP	DEP	DETP	DEDTP
Israel	20 - 73	247	10	5.2	0.2	1.5	0.5	<LOD
US	20 - 59	937	<LOD	1.7	<LOD	<LOD	<LOD	<LOD
Canada	Canada, 20-39	1159	3.1	1.8	<LOD	2.4	<LOD	<LOD
	Canada, 40-59	1218	3.5	1.9	<LOD	2.8	<LOD	<LOD
	Canada, 60-79	1080	4.3	3.9	<LOD	3.6	<LOD	<LOD
France	18-74	392	8.04	5.95	0.54	3.66	1.12	0.015

5.4 Phthalates

Phthalates are a family of chemicals that are added to plastics to impart flexibility and resilience and are often referred to as plasticizers. Phthalates are also used as solubilizing and stabilizing agents in other applications. Phthalates can be found in a wide array of consumer products, including cosmetics, perfumes, building materials, food packaging, medications, paints, adhesives, and medical equipment made with polyvinyl chloride (PVC) plastics. Because they are not chemically bound to the plastics to which they are added, phthalates can be released into the environment during use or disposal of the product (CDC, 2009).

People are exposed to phthalates through ingestion, inhalation, and, to a lesser extent, dermal contact with products that contain phthalates. For the general population, dietary sources have been considered as the major exposure route, followed by inhaling indoor air (CDC, 2009).

Previous studies on population exposure to phthalates have generally measured urinary concentrations of phthalate metabolites (hydrolytic phthalate monoesters and oxidative phthalate metabolites). Measuring urinary phthalate metabolites minimizes problems of contamination from ubiquitous parent compounds, since phthalates are widely used both in medical and laboratory products (Hauser and Calafat, 2005). Eleven phthalate metabolites were measured in urine samples in this study.

Table 21: Urinary metabolites measured in this study and their parent compounds

Phthalate name	Abbreviation	Urinary metabolite name	Abbreviation
Benzylbutyl phthalate	BzBP	Mono-benzyl phthalate	MBzP
Diisobutyl phthalate	DiBP	Mono-isobutyl phthalate	MiBP
Di-n-butyl phthalate	DBP	Mono-n-butyl phthalate	MnBP
Di-2-ethylhexyl phthalate	DEHP	Mono-2-ethylhexyl phthalate	MEHP
		2-Ethyl-5-hydroxy-Hexylphthalate	5OH-MEHP
		2-Carboxymethylhexyl phthalate	2cx-MMHP
		2-Ethyl-5-carboxy pentylphthalate	5cx-MEPP
		2-Ethyl-5-oxy-Hexylphthalate	5oxo-MEHP
Diisononyl phthalate	DiNP	Mono(4-methyl-7-oxo-octyl)phthalate	7oxo-MiNP
		Mono(4-methyl-7-hydroxyoctyl)phthalate	7OH-MiNP
		Mono(4-methyl-7-carboxyheptyl)phthalate	7cx-MiNP

Widespread exposure to phthalates has been documented in international populations in the general population, and in subpopulations of infants, children, pregnant and nursing women. There are limited previous data on exposure of the population in Israel to phthalates. In a pilot study in 19 pregnant women in Jerusalem, in 2006, nine phthalate metabolites were detected in at least 95% of the urine samples from these women. Phthalate metabolite concentrations in these pregnant women were remarkably similar to those in the general United States female population (Berman et al 2009).

Available evidence indicates that phthalates vary widely in their potential toxicity, depending upon the specific side-chains linked by the phthalate ester bridge In rodents, some phthalates have well documented endocrine modulating effects. Studies involving pregnant women have suggested adverse health effects associated with exposure to some phthalates including reduced anogenital distance in male infants, shortened gestational length, and low maternal thyroid hormone levels. Human health effects from phthalates at low environmental doses or at biomonitored levels from low environmental exposures are currently unknown (CDC, 2009).

Finding a measurable amount of one or more phthalate metabolites in urine does not mean that the levels of the metabolites or the parent phthalate cause an adverse health effect.

Table 22: Geometric mean and selected percentiles - MnBP urinary concentrations in 248 study participants (ug/L)

	N	% ≥ LOQ	Geometric Mean (95^{th} CI)	50^{th} Percentile (95^{th} CI)	75th Percentile (95^{th} CI)	90th Percentile (95^{th} CI)
Total	248	99	28.9 25.8 – 32.4	27.9 24.8 – 31.8	50.8 44. – 62.9	90.8 78.3 – 97.8
20-44	164	99	27.6 24.0 – 31.8	25.9 23.1 – 30.6	49.4 43.3 – 64.2	91.6 74.6 – 99.8
45-73	84	99	31.5 25.7 – 38.7	33.2 26.2 – 40.4	53.7 43.6 – 74.4	85.7 74.2 – 105.1
Males	131	98	25.4 21.3 – 30.3	23.1 19.8 – 27.8	44.4 36.7 – 56.7	90.8 59.5 – 121.1
Females	117	100	33.4 29.0 – 38.4	35.0 28.2 – 41.2	64.9 47.8 – 74.6	91.0 76.6 – 99.4
Jewish	184	99	28.8 25.0 – 33.1	28.3 24.4 – 35.4	56.0 45.3 – 71.4	92.0 81.7 – 100.3
Arab	60	100	29.2 23.6 – 36.1	27.3 23.9 – 33.1	40.2 34.1 – 55.3	73.5 47.8 – 119.4

Table 23: Geometric mean and selected percentiles – creatinine adjusted MnBP urinary concentrations in 248 study participants (ug/g)

	N	% ≥ LOQ	Geometric Mean (95^{th} CI)	50^{th} Percentile (95^{th} CI)	75th Percentile (95^{th} CI)	90th Percentile (95^{th} CI)
Total	248	99	23.0 21.1 – 25.0	23.3 20.3 – 26.2	34.0 30.9 – 36.1	50.4 41.9 – 60.8
20-44	164	99	20.9 18.9 – 23.1	20.7 18.1 – 25.2	32.0 28.8 – 35.9	43.2 39.9 – 52.9
45-73	84	99	27.7 23.8 – 32.1	26.5 22.4 – 29.8	34.7 32.4 – 47.9	71.2 47.5 – 82.5
Males	131	98	18.8 16.6 – 21.4	16.4 14.6 – 20.0	28.7 22.5 – 33.0	41.3 34.6 – 66.9
Females	117	100	28.7 26.1 – 31.7	28.4 26.7 – 31.0	36.5 34.3 – 45.2	55.7 45.7 – 74.2
Jewish	184	99	23.0 20.8 – 25.5	24.9 20.3 – 27.5	34.6 31.5 – 39.7	54.8 43.4 – 68.6
Arab	60	100	23.0 19.5 – 27.2	21.7 18.1 – 25.2	31.3 25.5 – 35.8	46.8 34.6 – 99.1

Table 24: Geometric mean and selected percentiles – MiBP urinary concentrations in 248 study participants (ug/l)

	N	% ≥ LOQ	Geometric Mean (95th CI)	50th Percentile (95th CI)	75th Percentile (95th CI)	90th Percentile (95th CI)
Total	248	100	34.3 30.7 – 38.2	37.6 33. – 42.8	66.3 58.2 – 72.6	89.0 82.0 – 95.6
20-44	164	100	35.9 31.7 – 40.7	37.6 33.9 – 43.6	67.4 59.5 – 77.7	89.6 82.3 – 97.4
45-73	84	99	31.3 25.3 – 38.6	37.7 28.4 – 44.3	60.8 46.8 – 75.5	84.9 74.8 – 109.9
Males	131	99	31.1 26.6 – 36.2	34.4 27.4 – 39.0	61.4 46.8 – 73.6	86.1 77.4 – 95.4
Females	117	100	38.2 32.7 – 44.7	43.3 35.5 – 53.6	69.5 61.1 – 78.2	93.4 81.3 – 116.0
Jewish	184	99	33.3 29.1 – 38.1	37.0 29.9 – 42.8	67.1 59.1 – 76.7	89.1 81.8 – 96.4
Arab	60	100	36.9 30.6 – 44.3	39.1 31.7 – 46.3	63.0 48.3 – 77.2	89.9 72.5 – 112.7

Table 25: Geometric mean and selected percentiles – creatinine adjusted MiBP urinary concentrations in 248 study participants (ug/g)

	N	% ≥ LOQ	Geometric Mean (95th CI)	50th Percentile (95th CI)	75th Percentile (95th CI)	90th Percentile (95th CI)
Total	248	100	27.3 25.1 – 29.6	27.2 24.7 – 29.7	44.5 38.9 – 49.1	65.2 56.0 – 67.2
20-44	164	100	27.2 24.7 – 29.9	27.8 24.0 – 30.6	44.3 38.7 – 49.3	64.9 55.1 – 67.2
45-73	84	99	27.4 23.5 – 32.0	26.9 23.9 – 30.9	45.7 34.1 – 53.9	65.6 53.7 – 94.4
Males	131	99	23.0 20.6 – 25.8	23.4 18.8 – 28.6	36.7 32.5 – 43.7	54.5 46.5 – 66.6
Females	117	100	32.9 29.4 – 36.8	30.6 26.9 – 38.7	50.5 45.5 – 60.1	67.9 62.6 – 90.9
Jewish	184	99	26.7 24.1 – 29.5	27.4 24.0 – 30.3	44.5 38.5 – 49.1	65.4 54.4 – 70.9
Arab	60	100	29.1 25.1 – 33.6	27.0 23.4 – 33.2	45.9 34.1 – 59.2	64.9 54.1 – 84.5

Table 26: Geometric mean and selected percentiles – MBzP urinary concentrations in 248 study participants (ug/l)

	N	% ≥ LOQ	Geometric Mean (95th CI)	50th Percentile (95th CI)	75th Percentile (95th CI)	90th Percentile (95th CI)
Total	248	92	4.4 3.8 – 5.1	4.3 3.8 – 5.1	9.0 7.3 – 10.8	20.5 14.0 – 23.9
20-44	164	94	4.7 3.9 – 5.6	4.5 3.5 – 5.2	9.2 7.3 – 12.5	22.0 14.6 – 33.1
45-73	84	87	4.0 3.0 – 5.2	4.1 3.0 – 6.2	8.5 6.8 – 10.7	16.3 10.6 – 27.0
Males	131	90	4.5 3.6 – 5.7	4.0 3.4 – 5.1	9.2 6.4 – 13.3	23.3 16.5 – 57.6
Females	117	93	4.3 3.6 – 5.2	4.7 3.4 – 5.7	8.6 7.3 – 10.8	15.6 11.5- 21.9
Jewish	184	93	4.5 3.8 – 5.3	4.3 3.8 – 5.1	8.4 7.0 – 10.3	18.1 12.4 – 27.9
Arab	60	87	4.2 3.0 – 5.8	3.9 2.6 – 6.5	11.3 6.5 – 20.0	22.5 15.6 – 40.0

Table 27: Geometric mean and selected percentiles – creatinine adjusted MBzP urinary concentrations in 248 study participants (ug/g)

	N	% ≥ LOQ	Geometric Mean (95th CI)	50th Percentile (95th CI)	75th Percentile (95th CI)	90th Percentile (95th CI)
Total	248	92	3.5 3.1 – 4.0	3.1 2.8 – 3.6	6.1 4.9 – 7.4	12.1 9.2 – 17.5
20-44	164	94	3.5 3.0 – 4.1	3.1 2.7 – 3.7	5.5 4.7 – 7.4	14.0 9.1 – 24.5
45-73	84	87	3.5 2.8 – 4.3	3.4 2.6 – 4.0	7.1 4.8 – 8.5	11.7 8.1 – 19.0
Males	131	90	3.4 2.8 – 4.1	2.9 2.4 – 3.4	6.4 4.3 – 9.3	17.4 10.3 – 25.0
Females	117	93	3.7 3.2 – 4.3	3.6 2.8 – 4.4	6.0 5.0 – 7.5	9.4 7.5 – 13.5
Jewish	184	93	3.6 3.1 – 4.1	3.2 2.8 – 3.7	5.7 4.8 – 7.5	11.3 8.5 – 17.1
Arab	60	87	3.3 2.4 – 4.5	3.0 2.2 – 4.1	6.9 4.3 – 13.3	17.6 9.9 – 35.5

Table 28: Geometric mean and selected percentiles – MEHP urinary concentrations in 248 study participants (ug/l)

	N	% ≥ LOQ	Geometric Mean (95^{th} CI)	50^{th} Percentile (95^{th} CI)	75th Percentile (95^{th} CI)	90th Percentile (95^{th} CI)
Total	248	100	12.0 10.4 – 13.9	11.2 10.1 – 12.7	25.5 21.6 – 30.5	49.3 39.6 – 57.0
20-44	164	100	13.1 11.0 – 15.5	12.0 10.3 – 15.5	24.9 20.4 – 36.6	50.7 41.2 – 58.9
45-73	84	100	10.2 7.9 – 13.2	10.4 7.7 – 12.6	25.7 14.9 – 32.5	46.1 32.1 – 67.8
Males	131	100	12.4 10.1 – 15.3	10.6 8.6 – 15.2	25.7 19.1 – 38.0	52.5 42.1 – 85.4
Females	117	100	11.6 9.6 – 14.1	12.2 10.3 – 14.5	25.5 17.8 - 30.3	45.1 32.6 – 55.9
Jewish	184	100	12.0 10.1 – 14.3	11.1 9.8 – 13.5	25.7 22.3 – 31.7	50.7 38.5 – 58.3
Arab	60	100	12.1 9.3 – 15.8	11.7 8.5 – 15.7	23.5 16.3 – 43.5	49.1 35.2 – 65.6

Table 29: Geometric mean and selected percentiles – creatinine adjusted MEHP urinary concentrations in 248 study participants (ug/g)

	N	% ≥ LOQ	Geometric Mean (95^{th} CI)	50^{th} Percentile (95^{th} CI)	75th Percentile (95^{th} CI)	90th Percentile (95^{th} CI)
Total	248	100	9.6 8.5 – 10.8	8.3 7.6 – 9.6	18.0 15.0 – 22.2	34.7 28.8 – 40.3
20-44	164	100	9.9 8.6 – 11.4	8.4 7.6 – 10.3	18.0 14.8 – 22.3	31.5 27.2 – 41.3
45-73	84	100	9.0 7.3 – 11.1	7.9 6.7 – 10.0	18.7 12.8 – 25.7	36.4 25.0 – 54.8
Males	131	100	9.2 7.8 – 10.9	7.9 7.4 – 9.1	17.2 12.8 – 22.1	30.7 23.6 – 50.4
Females	117	100	10.0 8.5 – 11.8	9.1 7.5 – 11.2	19.1 15.3 – 25.7	36.0 26.0 – 40.5
Jewish	184	100	9.6 8.4 – 11.0	8.4 7.5 – 10.2	17.5 14.5 – 22.2	30.6 25.7 – 41.9
Arab	60	100	9.5 7.4 – 12.3	8.3 7.5 – 10.4	20.5 11.0 – 33.8	39.7 28.1 – 58.7

Table 30: Geometric mean and selected percentiles – 5OH-MEHP urinary concentrations in 248 study participants (ug/l)

	N	% ≥ LOQ	Geometric Mean (95^{th} CI)	50^{th} Percentile (95^{th} CI)	75th Percentile (95^{th} CI)	90th Percentile (95^{th} CI)
Total	248	100	29.8 26.6 – 33.4	30.4 26.5 – 36.4	55.4 47.6 – 61.0	91.1 74.6 – 104.5
20-44	164	100	29.3 25.6 – 33.5	29.1 25.8 – 34.8	51.3 45.7 – 61.3	87.5 70.1 – 102.8
45-73	84	100	30.8 24.9 – 38.0	36.0 24.2 – 44.1	59.1 48.7 – 74.6	104.0 69.1 -129.4
Males	131	100	27.7 23.5 – 32.5	28.3 22.6 – 35.6	51.5 43.7 – 60.6	96.4 63.2-105.1
Females	117	100	32.4 27.6 – 38.0	33.1 28.3 – 44.1	58.1 47.6 – 73.2	89.1 75.0-112.2
Jewish	184	100	26.5 23.2 – 30.3	26.5 22.8 – 31.2	49.0 43.8 – 61.1	86.8 65.8-101.8
Arab	60	100	42.2 34. 0 – 52.3	44.1 33.5 – 49.8	60.0 50.4 – 99.9	110.0 80.5 – 302.6

Table 31: Geometric mean and selected percentiles – creatinine adjusted 5OH-MEHP urinary concentrations in 248 study participants (ug/g)

	N	% ≥ LOQ	Geometric Mean (95^{th} CI)	50^{th} Percentile (95^{th} CI)	75th Percentile (95^{th} CI)	90th Percentile (95^{th} CI)
Total	248	100	23.7 21.7 – 26.0	23.5 20.7 – 27.5	38.7 34.1- 43.0	53.0 49.9 – 65.2
20-44	164	100	22.2 19.9 - 24.7	22.5 18.0 – 26.0	36.1 32.5 – 41.2	51.3 43.2 – 63.3
45-73	84	100	27.0 23.0 - 31.7	27.4 21.2 – 33.1	44.7 36.0 – 50.5	68.0 50.4 – 105.5
Males	131	100	20.5 18.2 - 23.2	18.6 15.2 – 23.1	34.1 30.3 – 39.1	50.0 42.2 – 63.4
Females	117	100	27.9 24.6 – 31.7	28.2 24.3 – 32.6	43.2 38.3 – 50.1	63.8 50.6 – 98.7
Jewish	184	100	21.2 19.3 - 23.4	20.5 17.2 – 23.9	34.1 31.2 – 39.0	50.2 43.0 – 52.7
Arab	60	100	33.2 27.1 – 40.8	33.3 28.3 – 41.3	51.9 43.3 – 69.9	72.7 63.5 – 213.8

Table 32: Geometric mean and selected percentiles – 5oxo-MEHP urinary concentrations in 248 study participants (ug/l)

	N	% ≥ LOQ	Geometric Mean (95^{th} CI)	50^{th} Percentile (95^{th} CI)	75th Percentile (95^{th} CI)	90th Percentile (95^{th} CI)
Total	248	100	17.3 15.4 – 19.4	17.1 15.5 – 19.9	32.9 28.6 – 37.5	55.5 48.5 – 61.0
20-44	164	100	16.6 14.4 – 19.1	16.2 14.3 – 19.4	32.6 24.2 – 39.8	53.7 42.8 – 60.9
45-73	84	100	18.7 15.2 – 22.9	19.5 15.9 – 23.7	33.4 28.7 – 49.2	57.6 44.7 – 72.8
Males	131	100	15.3 13.1 – 18.0	16.0 13.6 – 19.2	29.1 23.4 – 33.5	52.2 35.6 – 61.0
Females	117	100	19.7 16.7 – 23.2	18.7 15.7 – 23.5	39.5 29.3 – 48.8	57.1 50.5 – 70.9
Jewish	184	100	15.8 13.8 – 18.0	15.9 14.0 – 17.9	32.0 24.3 – 37.5	54.1 42.8 – 61.0
Arab	60	100	22.8 18.2 – 28.5	23.1 17.1 – 26.8	36.0 27.4 – 54.1	58.1 48.3 – 147.8

Table 33: Geometric mean and selected percentiles – creatinine adjusted 5oxo-MEHP urinary concentrations in 248 study participants (ug/g)

	N	% ≥ LOQ	Geometric Mean (95^{th} CI)	50^{th} Percentile (95^{th} CI)	75th Percentile (95^{th} CI)	90th Percentile (95^{th} CI)
Total	248	100	13.7 12.5 – 15.1	13.0 12.2 – 15.2	23.8 20.6 – 25.8	33.8 28.2 – 39.5
20-44	164	100	12.6 11.2 – 14.1	12.6 10.7 – 14.2	23.1 18.6 – 25.4	30.5 26.1 – 38.8
45-73	84	100	16.4 14.0 – 19.1	16.1 12.6 – 19.0	25.7 21.2 – 29.3	38.0 29.3 – 82.1
Males	131	100	11.4 10.1 – 12.9	10.7 8.1 – 12.6	20.5 14.7 – 23.9	28.8 25.4 – 37.6
Females	117	100	17.0 14.9 – 19.4	17.7 14.6 – 19.7	25.9 23.6 – 29.4	38.6 30.0 – 56.6
Jewish	184	100	12.6 11.4 – 14.0	12.2 10.9 – 13.9	21.7 18.5 – 25.4	29.3 25.9 – 37.1
Arab	60	100	18.0 14.5 – 22.2	17.4 14.1 – 23.7	29.2 24.1 – 38.3	54.4 36.5 – 120.9

Table 34: Geometric mean and selected percentiles urinary 5cx-MEPP concentrations in 248 study participants (ug/L)

	N	% ≥ LOQ	Geometric Mean (95^{th} CI)	50^{th} Percentile (95^{th} CI)	75th Percentile (95^{th} CI)	90th Percentile (95^{th} CI)
Total	248	100	33.1 29.6 – 37.0	34.2 31.1 – 36.5	59.7 49.7 – 69.0	106.1 86.6 – 130.0
20-44	164	100	32.1 27.9 – 36.9	32.8 29.0 – 36.0	54.7 45.3 – 69.8	111.7 79.6 – 141.7
45-73	84	100	35.2 28.9 – 42.7	37.4 29.6 – 45.6	64.4 56.0 – 87.7	104.9 86.9 – 125.4
Males	131	100	31.9 27.1 – 37.6	33.3 28.0 – 40.7	56.9 47.5 – 69.4	119.3 72.9 – 147.8
Females	117	100	34.4 29.4 – 40.3	34.4 31.2 – 37.4	64.1 46.6 – 83.8	102.4 86.6 – 122.3
Jewish	184	100	29.9 26.2 – 34.1	31.2 27.2 – 34.8	49.6 41.6 – 68.2	97.8 79.2 – 130.3
Arab	60	100	45.2 36.4 – 56.1	46.9 38.1 – 58.7	71.7 59.1 – 104.4	113.9 96.1 – 224.3

Table 35: Geometric mean and selected percentiles creatinine adjusted 5cx-MEPP urinary concentrations in 248 study participants (ug/g creatinine)

	N	% ≥ LOQ	Geometric Mean (95^{th} CI)	50^{th} Percentile (95^{th} CI)	75th Percentile (95^{th} CI)	90th Percentile (95^{th} CI)
Total	248	100	26.3 24.1 – 28.8	24.8 22.1 – 27.5	42.1 37.6 – 49.6	66.1 58.2 – 78.7
20-44	164	100	24.3 21.7 – 27.2	22.0 19.4 – 25.6	40.6 35.6 – 47.0	59.8 53.3 – 76.9
45-73	84	100	30.8 26.7 – 35.6	27.7 24.8 – 34.1	49.9 36.7 – 63.1	72.7 62.7 – 93.6
Males	131	100	23.7 21.0 – 26.7	21.5 18.2 – 24.8	41.1 32.2 – 46.8	60.3 53.9 – 81.2
Females	117	100	29.7 26.0 – 33.8	29.8 25.2 – 33.8	47.5 37.6 – 56.0	70.5 60.1 – 90.0
Jewish	184	100	23.9 21.7 – 26.3	22.6 20.5 – 25.5	38.3 33.1 – 42.2	57.1 50.4 – 62.3
Arab	60	100	35.6 29.0 – 43.7	36.6 27.5 – 46.0	68.1 46.7 – 74.2	94.2 71.4 – 157.9

Table 36: Geometric mean and selected percentiles urinary 2cx-MMHxP concentrations in 248 study participants (ug/L)

	N	% ≥ LOQ	Geometric Mean (95^{th} CI)	50^{th} Percentile (95^{th} CI)	75th Percentile (95^{th} CI)	90th Percentile (95^{th} CI)
Total	248	100	8.0 7.0 – 9.1	9.2 7.3 – 9.9	16.1 14.0 – 18.7	28.2 23.9 – 36.1
20-44	164	100	7.6 6.5 – 8.9	8.2 6.9 – 9.9	14.2 12.1 – 17.1	31.2 19.4 – 39.2
45-73	84	99	8.7 7.0 – 10.9	9.6 7.3 – 13.7	19.9 15.7 – 23.9	28.5 23.5 – 34.6
Males	131	99	7.1 5.9 – 8.5	7.9 6.5 – 10.0	14.1 11.9 – 17.5	20.7 18.9 – 40.0
Females	117	100	9.2 7.7 – 10.9	9.5 7.5 – 11.5	17.4 14.8 – 25.6	32.0 25.9 – 38.2
Jewish	184	99	7.0 6.0 – 8.1	7.3 6.4 – 9.6	15.2 11.9 – 17.1	24.2 19.3 – 36.2
Arab	60	100	12.2 9.8 – 15.1	11.5 9.2 – 14.2	25.1 14.5 – 29.3	35.1 26.3 – 64.6

Table 37: Geometric mean and selected percentiles creatinine adjusted 2cx-MMHxP urinary concentrations in 248 study participants (ug/g creatinine)

	N	% ≥ LOQ	Geometric Mean (95^{th} CI)	50^{th} Percentile (95^{th} CI)	75th Percentile (95^{th} CI)	90th Percentile (95^{th} CI)
Total	248	100	6.4 5.7 – 7.1	6.3 5.5 – 7.2	10.6 9.6 – 14.0	17.6 15.7 – 22.6
20-44	164	100	5.8 5.1 – 6.6	5.8 4.9 – 6.6	9.6 8.6 – 12.6	16.6 15.0 – 19.4
45-73	84	99	7.7 6.4 – 9.2	8.1 6.2 – 9.7	14.0 10.4 – 15.6	22.4 15.6 – 30.4
Males	131	99	5.3 4.6 – 6.1	5.0 4.3 – 6.0	9.5 7.8 – 10.4	16.1 10.8 – 18.0
Females	117	100	7.9 6.8 – 9.1	7.6 6.5 – 9.1	14.3 12.5 – 15.6	22.2 15.8 – 29.4
Jewish	184	99	5.6 4.9 – 6.3	5.5 4.8 – 6.5	9.6 8.8 – 12.5	15.7 14.2 – 17.6
Arab	60	100	9.6 7.9 – 11.6	9.0 7.0 – 11.9	16.0 12.0 – 23.2	29.6 20.8 – 38.8

Table 38: Geometric mean and selected percentiles urinary 7OH-MMOP concentrations in 248 study participants (ug/L)

	N	% ≥ LOQ	Geometric Mean (95^{th} CI)	50^{th} Percentile (95^{th} CI)	75th Percentile (95^{th} CI)	90th Percentile (95^{th} CI)
Total	248	98	13.0 11.3 – 14.9	13.9 12.0 – 15.7	22.9 19.9 – 29.3	53.6 40.0 – 63.3
20-44	164	99	13.8 11.6 – 16.3	14.9 12.0 – 17.1	27.1 21.1 – 37.7	54.8 42.8 – 69.9
45-73	84	96	11.5 8.9 – 14.8	13.6 9.6 – 15.2	19.8 15.8 – 27.4	35.2 23.9 – 68.9
Males	131	98	15.1 12.2 – 18.6	15.8 13.7 – 17.9	31.1 21.5 – 44.7	60.5 52.4 – 78.5
Females	117	98	11.0 9.2 – 13.1	11.7 9.4 – 13.9	19.8 16.3 – 23.5	32.1 25.8 – 52.4
Jewish	184	98	13.8 11.7 – 16.3	14.9 12.9 – 16.5	27.4 21.2 – 35.7	54.9 46.6 – 70.2
Arab	60	98	10.9 8.3 – 14.3	12.2 9.1- 15.5	18.1 15.5 – 24.1	32.4 21.4 – 57.8

Table 39: Geometric mean and selected percentiles creatinine adjusted 7OH-MMOP urinary concentrations in 248 study participants (ug/g creatinine)

	N	% ≥ LOQ	Geometric Mean (95^{th} CI)	50^{th} Percentile (95^{th} CI)	75th Percentile (95^{th} CI)	90th Percentile (95^{th} CI)
Total	248	98	10.3 9.2 – 11.5	10.1 9.3 – 11.3	17.0 14.4 – 21.2	33.1 26.8 – 39.6
20-44	164	99	10.4 9.0 – 12.0	10.0 9.0 – 11.6	17.8 14.5 – 21.2	36.3 27.7 – 41.4
45-73	84	96	10.1 8.4 – 12.2	10.7 9.1 – 11.4	16.4 11.8 – 19.3	26.4 18.9 – 59.8
Males	131	98	11.2 9.4 – 13.3	10.7 9.6 – 13.0	21.7 16.5 – 27.6	37.2 29.3 – 51.0
Females	117	98	9.4 8.2 – 10.8	9.7 8.3 – 11.2	13.4 11.7 – 17.7	25.2 18.7 – 39.2
Jewish	184	98	11.0 9.7 – 12.6	11.2 9.6 – 12.0	18.8 16.1 – 24.9	35.1 27.6 – 41.8
Arab	60	98	8.6 6.7 – 11.0	9.7 6.9 – 10.8	11.9 10.9 – 15.9	25.4 15.0 – 51.2

Table 40: Geometric mean and selected percentiles urinary 7oxo-MMOP concentrations in 248 study participants (ug/L)

	N	% ≥ LOQ	Geometric Mean (95th CI)	50th Percentile (95th CI)	75th Percentile (95th CI)	90th Percentile (95th CI)
Total	248	98	7.0 6.0 – 8.0	6.9 6.1 – 8.7	13.7 12.6 – 16.4	29.1 22.2 – 32.4
20-44	164	99	7.4 6.2 – 8.8	7.4 6.3 – 9.3	15.7 12.8 – 19.0	30.1 22.3 – 35.9
45-73	84	96	6.1 4.8 – 7.8	5.9 4.8 – 8.4	12.4 10.0 – 15.5	23.5 14.2 – 41.5
Males	131	98	7.9 6.4 – 9.7	7.7 6.4 – 10.5	17.0 13.5 – 23.8	32.5 29.2 – 37.9
Females	117	97	6.1 5.1 – 7.2	6.3 5.2 – 7.9	12.2 9.6 – 14.0	17.8 15.6 – 26.7
Jewish	184	98	7.8 6.6 – 9.2	8.5 7.0 – 10.0	15.6 13.3 – 21.1	30.4 26.1 – 36.5
Arab	60	98	4.9 3.8 – 6.3	4.6 3.8 – 6.3	8.8 6.4 – 12.9	16.7 10.8 – 20.8

Table 41: Geometric mean and selected percentiles creatinine adjusted 7oxo-MMOP urinary concentrations in 248 study participants (ug/g creatinine)

	N	% ≥ LOQ	Geometric Mean (95th CI)	50th Percentile (95th CI)	75th Percentile (95th CI)	90th Percentile (95th CI)
Total	248	98	5.5 4.9 – 6.2	5.2 4.5 – 5.9	10.4 8.5 – 11.6	16.4 14.5 – 25.6
20-44	164	99	5.6 4.8 – 6.5	5.4 4.6 – 6.3	10.7 8.4 – 12.1	17.5 14.6 – 26.2
45-73	84	96	5.4 4.5 – 6.5	4.7 3.9 – 6.1	10.3 6.8 – 13.9	15.8 13.2 – 30.5
Males	131	98	5.8 4.9 – 6.9	5.4 4.3 – 7.3	12.1 9.9 – 14.5	22.8 15.1 – 28.3
Females	117	97	5.2 4.5 – 6.0	5.2 4.2 – 6.0	8.4 6.7 – 10.4	14.7 10.6 – 17.4
Jewish	184	98	6.3 5.5 – 7.1	6.2 5.1 – 7.4	11.5 10.3 – 14.0	17.5 15.1 – 26.2
Arab	60	98	3.8 3.0 – 4.8	3.9 3.1 – 4.6	5.5 4.6 – 7.6	10.9 6.5 – 28.8

Table 42: Geometric mean and selected percentiles urinary 7cx-MMHpP concentrations in 248 study participants (ug/L)

	N	% ≥ LOQ	Geometric Mean (95th CI)	50th Percentile (95th CI)	75th Percentile (95th CI)	90th Percentile (95th CI)
Total	248	99	9.4 8.3 – 10.6	9.4 8.4 – 10.7	17.2 15.5 – 19.7	29.7 24.3 – 42.6
20-44	164	99	9.6 8.3 – 11.2	9.5 8.4 – 12.1	17.8 15.5 – 21.3	28.7 23.5 – 50.2
45-73	84	99	9.0 7.3 – 11.1	9.2 7.3 – 10.6	16.8 11.7 – 21.0	30.5 20.8 – 56.1
Males	131	98	10.1 8.4 – 12.1	11.1 9.3 – 13.1	18.6 16.0 – 23.5	37.4 24.6 – 62.3
Females	117	100	8.7 7.5 – 10.1	8.4 7.4 – 9.5	15.6 12.2 – 19.2	27.7 19.4 – 31.4
Jewish	184	99	9.9 8.6 – 11.5	9.6 8.4 – 12.2	18.5 16.2 – 21.5	30.6 25.1 – 56.6
Arab	60	100	8.2 6.5 – 10.4	8.8 6.5 – 10.4	13.7 10.6 – 19.2	22.5 17.5 – 42.9

Table 43: Geometric mean and selected percentiles creatinine adjusted 7cx-MMHpP urinary concentrations in 248 study participants (ug/g creatinine)

	N	% ≥ LOQ	Geometric Mean (95th CI)	50th Percentile (95th CI)	75th Percentile (95th CI)	90th Percentile (95th CI)
Total	248	99	7.5 6.8 – 8.3	7.3 6.6 – 8.4	11.9 10.7 – 13.5	18.0 15.3 – 23.9
20-44	164	99	7.3 6.4 – 8.3	7.3 6.6 – 8.7	11.7 10.4 – 13.4	19.4 15.0 – 26.4
45-73	84	99	7.9 6.8 – 9.2	7.3 6.4 – 9.1	13.0 9.9 – 15.0	17.4 14.7 – 30.7
Males	131	98	7.5 6.4 – 8.7	8.1 6.6 – 9.3	13.6 11.8 – 15.0	19.0 15.7 – 33.1
Females	117	100	7.5 6.7 – 8.4	6.8 6.3 – 8.0	10.6 9.2 – 12.0	17.3 12.0 – 25.2
Jewish	184	99	7.9 7.1 – 8.9	7.9 7.1 – 9.3	12.9 11.7 – 14.7	18.6 15.8 – 27.1
Arab	60	100	6.5 5.3 – 8.0	6.4 5.0 – 8.0	9.1 8.3 – 13.1	16.4 11.4 – 33.8

For comparison, median creatinine adjusted urinary concentrations of phthalate metabolites in the study population are shown, along with median creatinine adjusted urinary concentrations in NHANES 2007 – 2008 (4th Report) (CDC, 2012).

Table 44: Median creatinine adjusted phthalate metabolite urinary concentrations (ug/g) in the Israel study population and NHANES

	Ages	N	MBzP	MiBP	MnBP	MEHP	5OH-MEHP (MEHHP)	5oxo-MEHP (MEOHP)	5cx-MEPP (MECPP)
Israel	20 - 73	248	3.1	27.2	23.3	8.3	23.5	13	24.8
NHANES 2007-2008 (4th Report update)	20 +	1814	6.4	6.7	17.2	2.36	18.5	10.7	27.8

* 2cx-MMHP, 7OH-MMOP, 7oxo-MMOP, 7cx-MMHpP were not measured in NHANES

5.5 Polycyclic Aromatic Hydrocarbons

Polycyclic aromatic hydrocarbons (PAHs) are a group of over 100 chemicals formed during incomplete burning of organic substances such as coal, oil, gas, wood, garbage, and tobacco. PAHs are widely distributed in the ambient air, in food, in soil, and in many occupational environments. These substances generally are found in the environment as complex mixtures rather than as single compounds. PAHs are formed by pyrolysis during high temperature charbroiling or grilling and have been found at high concentrations in grilled and flame broiled foods (CDC, 2009).

PAHs are lipid soluble and can be absorbed through the skin, respiratory tract, and gastrointestinal tract. For most individuals, the major source of exposure to PAHs in the environment is inhalation of volatilized PAHs or of PAHs attached to airborne particulate matter. Sources include cigarette smoke, vehicle exhausts, asphalt roads, coal, coal tar, wildfires, agricultural burning, residential wood burning, municipal and industrial waste incineration, and hazardous waste sites (CDC, 2009).

The general population is also exposed to PAHs through dietary intake of grilled meats, smoked fish, and foods contaminated by airborne particle deposition or growth in contaminated soil. In non-smoking, non-occupationally exposed individuals living in the U.S., it was calculated that dietary pyrene intake accounts for between 87.5 and 99.8% of total exposure (Li et al. 2008). Research has identified diet as the most important factor determining levels of 1-hydroxypyrene-glucuronide (1-OHPG) levels in children. A study of PAH exposure in South Korean children showed that increased grilled fish and/or shellfish consumption was positively associated with urinary1–OHPG levels (Lee et al. 2008). Consumption of grilled food at least once a week was a

predictor of increased PAH exposures in German children, and chocolate consumption contributed to PAH exposure in these children (Becker et al. 2007). For some individuals, the primary source of exposure to PAHs is inhalation and/or dermal exposure in the workplace.

Current evidence indicates that exposure to PAHs may result in reproductive, developmental, hematologic, cardiovascular, neurologic, and immunologic toxicities (ATSDR 1995). PAH exposure has been associated with incidence of a number of different types of cancer (Clapp et al. 2008). A number of PAHs have been classified as probable human carcinogens.

The current study used urinary pyrene and phenanthrene metabolite concentrations (1-hydroxypyrene, 1-hydroxyphenanthrene, 2-hydroxyphenanthrene, 3-hydroxyphenanthrene, and 4-hydroxyphenanthrene) as markers of PAH exposure.

Finding a measurable amount of one or more metabolites in the urine does not mean that the levels of the PAH metabolites or the parent PAH cause an adverse health effect.

Table 45: Geometric mean and selected percentiles – urinary 1-hydroxypyrene concentrations in 243 study participants (ng/L)

	N	% ≥ LOQ	Geometric Mean (95^{th} CI)	50^{th} Percentile (95^{th} CI)	75th Percentile (95^{th} CI)	90th Percentile (95^{th} CI)
Total	243	91	171.6 147.9 – 199.1	204.2 175.7 – 234.0	370.2 308.2 – 441.4	640.7 531.2 – 816.9
20-44	160	94	198.2 167.1 – 235.0	216.6 184.9 – 246.7	390.9 310.8 – 481.9	664.5 521.4 – 1002.2
45-73	83	86	130.1 98.2 – 172.2	163.6 108.3 – 218.6	323.5 256.0 – 448.6	633.5 436.8 – 819.9
Males	129	93	186.4 153.0 – 227.1	216.4 175.3 – 247.7	383.0 303.0 – 485.2	666.8 506.5 – 968.0
Females	114	89	156.4 124.7 – 196.1	196.7 149.2 – 239.2	342.8 290.1 – 448.7	627.4 482.8 – 830.8
Jewish	183	91	170.9 143.3 – 203.8	206.8 172.7 – 242.9	370.2 310.6 – 450.1	652.0 497.0 – 845.2
Arab	56	93	169.8 126.6 – 227.8	186.0 156.5 – 237.0	298.7 237.2 – 544.5	664.0 509.7 – 935.4

Table 46: Geometric mean and selected percentiles –creatinine adjusted urinary 1-hydroxypyrene concentrations in 243 study participants (ng/g creatinine)

	N	% ≥ LOQ	Geometric Mean (95^{th} CI)	50^{th} Percentile (95^{th} CI)	75th Percentile (95^{th} CI)	90th Percentile (95^{th} CI)
Total	243	91	137.1 122.1 – 153.9	144.5 119.4 – 166.6	256.6 224.2 – 300.0	397.5 353.0 – 458.6
20-44	160	94	150.1 131.0 – 171.9	151.0 128.8 – 176.6	270.2 229.4 – 324.9	399.2 351.9 – 560.3
45-73	83	86	115.1 92.9 – 142.7	119.4 99.9 – 165.3	229.6 194.5 – 294.5	398.5 288.2 – 494.2
Males	129	93	139.1 119.4 – 162.2	139.2 114.5 – 166.6	269.3 208.9 – 313.0	399.8 341.0 – 531.8
Females	114	89	134.8 112.8 – 161.0	151.9 119.3 – 177.6	249.2 216.5 – 328.4	400.9 344.8 – 487.4
Jewish	183	91	137.6 120.5 – 157.0	148.9 118.2 – 169.8	256.6 224.8 – 302.8	397.5 345.4 – 453.4
Arab	56	93	133.2 102.6 – 172.9	141.3 106.0 – 173.4	270.9 173.5 – 382.5	435.4 356.4 – 606.5

Table 47: Geometric mean and selected percentiles – urinary 1-hydroxyphenanthrene concentrations in 243 study participants (ng/L)

	N	% ≥ LOQ	Geometric Mean (95^{th} CI)	50^{th} Percentile (95^{th} CI)	75th Percentile (95^{th} CI)	90th Percentile (95^{th} CI)
Total	243	90	190.4 164.7 – 220.1	218.8 193.8 – 235.2	397.8 327.1 – 469.2	775.0 628.1 – 891.8
20-44	160	93	210.4 177.8 – 249.0	220.8 194.9 – 257.9	409.8 335.1 – 503.2	869.0 669.9 – 981.2
45-73	83	83	156.9 119.3 – 206.4	202.6 135.4 – 235.2	338.5 257.9 – 509.1	639.6 491.2 – 908.4
Males	129	90	185.8 153.4 – 225.0	224.6 188.3 – 258.3	385.2 309.4 – 446.3	670.7 474.5 – 870.8
Females	114	89	195.7 156.5 – 244.7	210.8 159.7 – 239.3	447.0 320.1 – 616.3	868.4 664.3 – 1110.0
Jewish	183	87	168.1 141.6 – 199.6	199.1 159.6 – 223.3	338.5 273.3 – 444.8	669.8 536.3 – 870.5
Arab	56	96	277.4 213.8 - 360.0	304.0 232.5 – 376.1	495.1 378.0 – 755.1	903.1 728.4 – 1791.9

Table 48: Geometric mean and selected percentiles – creatinine adjusted 1-hydroxyphenanthrene urinary concentrations in 243 study participants (ng/g creatinine)

	N	% ≥ LOQ	Geometric Mean (95th CI)	50th Percentile (95th CI)	75th Percentile (95th CI)	90th Percentile (95th CI)
Total	243	90	152.0 135.2 – 170.9	149.0 124.6 – 166.8	275.5 238.5 – 342.2	491.8 439.1 – 586.4
20-44	160	93	159.3 138.3 – 183.4	149.4 124.6 – 167.0	303.9 236.2 – 399.2	533.2 442.1 – 702.1
45-73	83	83	138.9 112.4 – 171.6	135.3 114.4 – 192.9	263.1 217.6 – 338.7	443.5 314.3 – 658.7
Males	129	90	138.7 118.8 – 161.9	135.3 113.4 – 157.9	247.0 186.2 – 335.9	463.9 378.5 - 664.4
Females	114	89	168.7 141.1 – 201.7	169.9 126.2 – 220.1	305.5 241.3 – 439.4	549.2 443.9 – 825.5
Jewish	183	87	135.3 118.3 – 154.8	126.2 109.0 – 151.3	237.8 198.3 – 296.8	476.8 392.8 – 553.4
Arab	56	96	217.6 172.0 – 275.4	236.7 161.6 – 289.0	395.6 290.3 – 479.8	671.6 464.7 – 1289.3

Table 49: Geometric mean and selected percentiles – urinary 2-hydroxyphenanthrene concentrations in 243 study participants (ng/L)

	N	% ≥ LOQ	Geometric Mean (95th CI)	50th Percentile (95th CI)	75th Percentile (95th CI)	90th Percentile (95th CI)
Total	243	99	92.9 82.4 – 104.7	94.8 82.8 – 107.4	172.9 147.5 – 212.7	305.3 254.3 – 356.8
20-44	160	99	99.9 86.5 – 115.4	106.0 83.8 – 126.3	199.9 152.3 – 230.8	323.6 258.5 – 388.2
45-73	83	99	80.8 65.2 – 100.0	88.9 66.7 – 102.4	136.5 105.6 – 208.8	267.5 206.1 – 443.4
Males	129	99	97.6 82.7 – 115.1	104.3 86.9 – 124.7	201.4 148.0 – 232.3	312.0 253.9 – 438.5
Females	114	99	87.9 73.7 – 104.8	88.6 70.9 – 107.9	150.8 127.4 – 214.0	276.1 227.7 – 395.2
Jewish	183	99	84.2 73.1 – 97.0	90.5 76.4 – 105.1	155.0 132.5 – 199.0	289.3 224.2 – 353.5
Arab	56	100	126.8 102.2 – 157.4	124.1 91.7 – 158.7	229.2 159.9 – 306.2	392.8 250.4 – 612.5

Table 50: Geometric mean and selected percentiles –creatinine adjusted urinary 2-hydroxyphenanthrene concentrations in 243 study participants (ng/g creatinine)

	N	% ≥ LOQ	Geometric Mean (95^{th} CI)	50^{th} Percentile (95^{th} CI)	75th Percentile (95^{th} CI)	90th Percentile (95^{th} CI)
Total	243	99	74.2 67.2 – 81.9	69.8 60.5 – 78.4	128.1 106.4 – 153.7	232.0 185.7 – 265.1
20-44	160	99	75.6 66.9 – 85.6	69.1 60.2 – 82.5	135.2 107.6 – 164.5	241.4 196.0 – 291.0
45-73	83	99	71.5 60.5 – 84.5	69.8 57.6 – 78.3	114.4 86.8 – 153.9	190.3 147.2 – 350.8
Males	129	99	72.8 63.4 – 83.7	62.9 53.9 – 78.4	129.8 104.2 – 164.1	230.4 183.1 – 291.8
Females	114	99	75.8 65.7 – 87.3	73.9 62.8 – 83.7	127.0 97.5 – 158.1	234.0 163.3 – 294.9
Jewish	183	99	67.8 60.7 – 75.7	62.7 56.9 – 74.6	107.8 86.9 – 135.6	187.5 158.7 – 239.5
Arab	56	100	99.5 80.2 – 123.5	97.4 70.6 – 127.4	200.2 127.8 – 262.2	293.3 232.5 – 435.6

Table 51: Geometric mean and selected percentiles – urinary 3-hydroxyphenanthrene concentrations in 243 study participants (ng/L)

	N	% ≥ LOQ	Geometric Mean (95^{th} CI)	50^{th} Percentile (95^{th} CI)	75th Percentile (95^{th} CI)	90th Percentile (95^{th} CI)
Total	243	97	130.6 113.1 – 150.7	140.7 119.9 – 158.3	260.4 219.5 – 343.5	520.6 435.3 – 615.9
20-44	160	97	142.5 119.5 – 170.0	150.7 122.3 – 176.6	288.7 239.2 – 379.5	576.4 457.9 – 708.0
45-73	83	96	110.2 86.0 – 141.3	125.7 93.5 – 145.2	218.5 162.6 – 338.9	459.6 302.8 – 573.7
Males	129	97	143.4 117.5 – 174.9	155.5 122.8 – 205.5	278.0 238.9 – 395.6	577.7 470.0 – 718.1
Females	114	96	117.4 95.3 – 144.7	124.2 99.1 – 145.4	220.9 178.8 – 336.1	469.6 349.1 – 572.1
Jewish	183	96	123.6 104.5 – 146.2	131.5 113.6 – 157.9	252.9 214.4 – 336.9	512.0 398.3 – 577.1
Arab	56	98	152.6 113.9 – 204.4	142.9 113.2 – 206.2	284.7 206.9 – 521.5	655.9 391.0 – 1173.9

Table 52: Geometric mean and selected percentiles – creatinine adjusted urinary 3-hydroxyphenanthrene concentrations in 243 study participants (ng/g creatinine)

	N	% ≥ LOQ	Geometric Mean (95^{th} CI)	50^{th} Percentile (95^{th} CI)	75th Percentile (95^{th} CI)	90th Percentile (95^{th} CI)
Total	243	97	104.3 92.8 – 117.1	92.7 82.0 – 107.1	191.8 151.3 – 245.7	352.3 300.9 – 489.7
20-44	160	97	107.9 93.4 – 124.7	92.2 78.2 – 119.3	205.2 164.5 – 267.7	383.8 304.5 – 537.6
45-73	83	96	97.6 79.8 – 119.3	93.6 80.0 – 122.3	150.4 131.2 – 243.5	340.5 227.4 – 631.9
Males	129	97	107.0 91.2 – 125.6	93.6 78.1 – 126.0	204.7 158.6 – 269.7	353.9 289.6 – 509.6
Females	114	96	101.2 85.2 – 120.3	92.5 81.0 – 115.2	169.0 141.3 – 241.8	355.9 248.2 – 625.3
Jewish	183	96	99.5 87.4 – 113.3	89.5 80.3 – 105.4	174.7 142.3 – 214.2	340.8 266.0 – 461.7
Arab	56	98	119.7 91.1 – 157.2	105.8 77.9 – 146.6	248.1 146.7 – 352.9	524.1 304.7 – 855.7

Table 53: Geometric mean and selected percentiles – urinary 4-hydroxyphenanthrene concentrations in 241 study participants (ng/L)

	N	% ≥ LOQ	Geometric Mean (95^{th} CI)	50^{th} Percentile (95^{th} CI)	75th Percentile (95^{th} CI)	90th Percentile (95^{th} CI)
Total	241	63	28.9 25.1 – 33.4	31.9 27.5 – 38.4	69.2 52.9 – 82.7	146.4 121.8 – 165.2
20-44	158	65	30.0 25.2 – 35.7	33.6 27.7 – 39.6	73.2 51.4 – 89.5	141.6 119.4 – 163.1
45-73	83	59	27.0 20.9 – 34.7	29.3 8.0 – 42.0	54.8 46.0 – 106.4	149.3 93.7 – 219.9
Males	127	62	28.3 23.2 – 34.6	32.7 27.2 – 39.1	66.2 44.5 – 101.3	147.6 110.1 – 183.7
Females	114	64	29.6 24.0 – 36.5	31.8 26.3 – 42.8	75.1 53.6 – 92.1	145.8 106.2 – 180.0
Jewish	183	59	25.7 21.9 – 30.1	29.0 25.1 – 35.4	54.8 46.4 – 73.8	130.0 82.5 – 162.1
Arab	54	78	42.6 31.4 – 57.6	42.5 30.7 – 73.0	120.3 70.4 – 140.6	163.5 127.1 – 242.4

Table 54: Geometric mean and selected percentiles – creatinine adjusted urinary 4-hydroxyphenanthrene concentrations in 241 study participants (ng/g creatinine)

	N	% ≥ LOQ	Geometric Mean (95th CI)	50th Percentile (95th CI)	75th Percentile (95th CI)	90th Percentile (95th CI)
Total	241	63	23.1 20.2 – 26.5	23.5 17.7 – 27.3	52.4 42.1 – 66.7	103.4 86.0 – 123.7
20-44	158	65	22.8 19.3 – 26.9	23.1 16.9 – 27.7	52.7 38.6 – 67.2	100.7 81.8 – 121.2
45-73	83	59	23.9 18.8 – 30.3	24.2 16.3 – 34.8	52.7 39.4 – 79.6	115.2 76.1 – 163.4
Males	127	62	21.2 17.5 – 25.7	17.7 13.9 – 25.0	55.0 39.8 – 72.0	103.4 81.1 – 131.3
Females	114	64	25.5 21.1 – 30.9	26.4 22.8 – 32.8	50.4 37.9 – 70.9	108.7 76.0 – 136.7
Jewish	183	59	20.7 17.8 – 24.0	18.5 15.4 – 24.4	42.1 35.0 – 55.6	96.0 66.8 – 118.5
Arab	54	78	33.6 25.1 – 45.0	36.8 24.4 – 60.3	81.0 59.0 – 100.2	126.2 86.8 – 168.5

For comparison, median creatinine adjusted urinary concentrations of PAHs in the study population are shown, along with median creatinine adjusted urinary concentrations in NHANES 2003 – 2004 (4th Report).

Table 55. Median creatinine adjusted PAH urinary concentrations (ug/g) in the Israel study population and NHANES

			1-OH-pyrene	1-OH-phen	2-OH-phen	3-OH-phen	4-OH-phen
	Ages	**N**					
Israel	20 - 73	243	144.5	149.0	69.8	92.7	23.5
US	20+	1477	73.5	147.0	54.8	99.1	23.3

5.6 Phytoestrogens

Phytoestrogens are naturally occurring polycyclic phenols that may have weak estrogenic effects when ingested and metabolized. The phytoestrogens considered in the present study, daidzein and genistein, are isoflavones found primarily in soybeans and in food products made from soybeans.

Daidzein and genistein are found in soy products as beta-glycosides. The ingested beta-glycosidic forms are hydrolyzed to aglycones in the intestine. The absorbed aglycones can weakly bind to estrogen-beta receptors in arteries and in smooth muscle, potentially inducing various estrogenic and anti-estrogenic responses in target tissues. The estrogenic activity of daidzein is largely determined by the extent to which it is metabolized to equol by intestinal

bacteria (CDC, 2009). Although phytoestrogens are far less potent than endogenously produced estrogens, plasma concentrations of phytoestrogens may be 100 - 1000 times greater than the endogenous forms (CDC, 2009).

In vitro studies have shown that the capacity for phytoestrogens to bind to estrogen receptors is greater than the estrogen receptor binding capacity of bisphenol A and other xenoestrogens (Kuiper et al. 1998; Han et al. 2002; Thomas and Dong 2006); however, ER binding alone is a poor predictor of in vivo activity, and estrogenic effects are observed inconsistently in clinical studies of the effects of phytoestrogens (Messina et al. 2006). Results of in vitro studies of phytoestrogens have shown a variety of genotoxic effects, but it has been noted that the concentrations at which such effects occurred were often much higher than the physiologically relevant doses achievable by dietary or pharmacologic intake of soy foods or supplements (Klein and King, 2007).

The Israel Ministry of Health Committee on Soya and Soy Products concluded in 2005 that there is widespread use of soy in the Israeli food industry but limited data on dietary intake in the Israeli population (Israel Ministry of Health, 2005). The Committee recommended that soy formula be given to infants only when there is a clinical indication, as long-term effects of ingesting soy formula are unknown.

Table 56: Geometric mean and selected percentiles - urinary daidzein concentrations in 247 study participants (ug/L)

	N	% ≥ LOQ	Geometric Mean (95^{th} CI)	50^{th} Percentile (95^{th} CI)	75th Percentile (95^{th} CI)	90th Percentile (95^{th} CI)
Total	247	98	66.8 54.9 – 81.4	76.0 62.8 – 90.5	186.0 153.3 – 210.8	380.8 281.4 – 477.4
20-44	163	98	61.6 48.7 – 77.9	74.1 56.8 – 98.2	171.4 138.7 – 204.3	318.1 233.1 – 416.0
45-73	84	98	78.3 54.5 – 112.5	79.2 62.4 – 125.5	237.8 147.6 – 335.7	626.9 326.2 – 912.2
Males	131	98	69.2 53.3 – 89.8	90.1 68.1 – 116.9	176.5 152.8 – 206.1	320.0 236.2 – 442.1
Females	116	97	64.3 47.5 – 87.0	64.7 48.4 – 85.1	191.8 129.8 – 278.3	450.9 305.1 – 777.0
Jewish	184	99	77.1 62.0 – 95.8	77.8 62.8 – 107.6	199.5 156.8 – 248.7	418.1 309.6 – 688.2
Arab	59	93	42.1 26.6 – 66.5	64.0 32.3 – 86.3	153.9 86.4 – 203.1	247.5 190.4 – 407.3

Table 57: Geometric mean and selected percentiles - creatinine adjusted urinary daidzein concentrations in 247 study participants (ug/g creatinine)

	N	% ≥ LOQ	Geometric Mean (95th CI)	50th Percentile (95th CI)	75th Percentile (95th CI)	90th Percentile (95th CI)
Total	247	98	53.1 43.8 – 64.5	57.8 45.5 – 75.8	152.2 128.2 – 190.1	270.8 231.1 – 389.6
20-44	163	98	46.6 37.2 – 58.3	51.5 40.6 – 68.8	129.8 98.8 – 163.1	231.4 194.2 – 283.5
45-73	84	98	68.7 47.6 – 99.3	78.4 52.9 – 107.5	194.5 143.7 – 271.1	453.1 268.0 – 1131.2
Males	131	98	51.3 39.8 – 66.2	56.5 43.7 – 78.8	129.8 100.9 – 162.6	230.4 176.7 – 301.3
Females	116	97	55.3 40.9 – 74.7	60.8 40.6 – 85.9	188.9 132.3 – 237.2	349.4 244.7 – 606.1
Jewish	184	99	61.7 49.8 – 76.4	61.2 51.3 – 81.9	158.7 127.1 – 198.1	298.7 232.6 – 590.4
Arab	59	93	33.0 21.0 – 51.9	39.0 23.7 – 77.2	143.3 78.6 – 219.7	233.5 185.3 – 298.4

Table 58: Geometric mean and selected percentiles – urinary genistein concentrations in 247 study participants (ug/L)

	N	% ≥ LOQ	Geometric Mean (95th CI)	50th Percentile (95th CI)	75th Percentile (95th CI)	90th Percentile (95th CI)
Total	247	91	26.9 21.7 – 33.2	31.8 25.6 – 37.8	84.1 59.1 – 108.3	190.0 136.2 – 264.8
20-44	163	92	25.4 19.7 – 32.5	29.1 22.6 – 36.2	76.5 53.2 – 103.0	166.1 122.4 – 261.3
45-73	84	89	30.1 20.2 – 44.9	38.3 26.9 – 50.9	107.3 66.1 – 146.6	249.7 142.6 – 367.3
Males	131	89	24.3 17.9 – 33.0	31.8 24.8 – 39.2	66.3 53.7 – 105.8	148.8 108.5 – 252.7
Females	116	94	30.1 22.4 – 40.5	31.1 22.1 – 40.6	99.2 57.3 – 132.4	244.5 147.3 – 338.4
Jewish	184	93	30.6 24.0 – 38.9	32.5 26.8 – 39.2	96.5 59.6 – 123.3	234.4 138.8 – 327.3
Arab	59	85	17.6 11.0 – 28.2	22.2 13.5 – 42.0	79.7 43.3 – 107.8	178.7 84.0 – 229.1

Table 59: Geometric mean and selected percentiles - creatinine adjusted urinary genistein concentrations in 247 study participants (ug/g creatinine)

	N	% ≥ LOQ	Geometric Mean (95th CI)	50th Percentile (95th CI)	75th Percentile (95th CI)	90th Percentile (95th CI)
Total	247	91	21.4 17.5 – 26.1	22.6 18.3 – 31.8	66.6 50.3 – 79.1	138.1 108.4 – 173.9
20-44	163	92	19.2 15.2 – 24.1	20.6 15.2 – 28.4	55.1 36.7 – 74.4	111.1 83.8 – 150.6
45-73	84	89	26.4 18.0 – 38.9	33.0 19.3 – 48.4	77.8 56.9 – 128.6	231.2 128.1 – 320.7
Males	131	89	18.0 13.6 – 23.9	22.6 15.8 – 32.6	51.7 36.8 – 68.1	103.4 74.3 – 140.1
Females	116	94	25.9 19.5 – 34.3	22.9 17.7 – 35.1	80.9 60.5 – 125.7	165.7 129.9 – 270.9
Jewish	184	93	24.5 19.6 – 30.5	25.7 19.9 – 32.5	71.5 48.1 – 92.1	144.3 110.0 – 221.2
Arab	59	85	13.8 8.6 – 22.1	17.7 10.2 – 33.6	63.6 33.8 – 82.6	137.8 69.7 – 154.4

For comparison, median creatinine adjusted urinary concentrations of daidzein and genistein in the study population are shown, along with median creatinine adjusted urinary concentrations in NHANES 2003 – 2004 (4th Report).

Table 60. Median creatinine adjusted daizein and genistein urinary concentrations (ug/g) in the Israel study population and NHANES

Population	Ages	N	Daidzein	Genistein
Israel	20 - 73	241	57.8	22.6
US	20+	1484	50.6	23.0

6. Conclusions

This report includes data on urinary concentrations of selected environmental contaminants in a study population of 249 Israeli adults.

The Ministry of Health, in cooperation with academic institutions, is currently analyzing the data on reported dietary intakes in the study population. Further analysis of the data collected in the study will include examining demographic, environmental, and dietary predictors of exposure to the environmental contaminants. These findings will be presented in future publications.

7. References

Agency for Toxic Substances and Disease Registry (ATSDR). Toxicological profile for polycyclic aromatic hydrocarbons [online] 1995. Available at http://www.atsdr.cdc.gov/toxprofiles/tp69.html. 19 June 2012.

Becker K, Conrad A, Kirsch N, Gehring-Kolossa M, Schulz C et al. German Environmental Survey (GerES): Human biomonitoring as a tool to identify exposure pathways. Int J Hyg Environ Health 2007; 210: 267-269.

Berman T., Hochner-Celnikier D., Calafat AM., Needham LL., Amitai Y., Wormser U., Richter E., 2009. Phthalate exposure among pregnant women in Jerusalem, Israel: results of a pilot study. Environ. Int. 35(2), 353-7.

Berman T., Hochner-Celnikier D., Barr DB., Needham LL., Amitai Y., Wormser U., Richter E., 2011. Pesticide exposure among pregnant women in Jerusalem, Israel: results of a pilot study. Environ. Int. 37(1), 198-203.

CDC (Centers for Disease Control and Prevention). (2009). Fourth National Report on Human Exposure to Environmental Chemicals. Atlanta (GA).

CDC (Centers for Disease Control and Prevention). (2012). Fourth National Report on Human Exposure to Environmental Chemicals. Updated Tables. Atlanta (GA).

Central Bureau of Statistics. Statistical Abstract of Israel 2011-No.62 . Table 2.11. Available at http://www1.cbs.gov.il/reader/, accessed 26 June 2012.

Clapp RW, Jacobs MM, Loechler EL. Environmental and Occupational Causes of Cancer New Evidence, 2005–2007. Rev Environ Health. 2008; 23(1): 1–37.

ECB (European Chemicals Bureau). (2003). Bisphenol A: European Union Risk Assessment Report (CAS No. 80-05-7), Vol 37. EINECS No. 201-245-8. Luxembourg: European Chemicals Bureau.

Fréry N, Saoudi A, Garnier R, Zeghnoun A, Falq G, Guldner L. Exposure of the French population to environmental pollutants –Environmental components of the French National Survey on Nutrition and Health – Initial results. Saint-Maurice (Fra): French Institute for Public Health Surveillance, september 2010, 12 p. Available on: www.invs.sante.fr

Gray K and Lawler C. 2011. Strength in numbers: three separate studies link in utero organophosphate pesticide exposure and cognitive development. Env Health Perp 119(8) A328 – A329.

Geens T, Goeyens L, Covaci A. Are potential sources for human exposure to bisphenol-A overlooked? Int J Hyg Environ Health. 2011 Sep;214(5):339-47.

Han DH, Denison MS, Tachibana H, Yamada K. Relationship between estrogen receptor-binding and estrogenic activities of environmental estrogens and suppression by flavonoids.Biosci Biotechnol Biochem. 2002;66(7):1479-87.

Hauser R and Calafat A. 2005. Phthalates and Human Health. Occup Environ Med 2005;**62**:806-818.

Health Canada. (2008a). Screening Assessment for Phenol, 4,4'-(1-methylethylidene)bis- (80-05-7). Retrieved March 4, 2010, from www.ec.gc.ca/ substances/ese/eng/challenge/batch2/batch2_ 80-05-7_en.pdf

Hwang YW, Kim SY, Jee SH, Kim YN, Nam CM. Soy food consumption and risk of prostate cancer: a meta-analysis of observational studies. Nutr Cancer. 2009;61(5):598-606.

International Agency for Research on Cancer. IARC Working Group on the Evaluation of Carcinogenic Risks to Humans. Tobacco Smoke and Involuntary Smoking. IARC Monogr Eval Carcinog Risks Hum. Vol 83. Summary of Data Reported and Evaluation [online] 2004. Available at URL: http://monographs. iarc.fr/ENG/Monographs/allmonos90.php; accessed 19 June 2012.

Israel Ministry of Health. 2012. http://www.health.gov.il/NewsAndEvents/SpokemanMesseges/Pages/09052012_3.aspx

Israel Ministry of Health. 2005. Committee on Soya and Soy products. Recommendations

Klein CB, King AA. Genistein genotoxicity: critical considerations of in vitro exposure dose. Toxicol Appl Pharmacol. 2007; 224(1):1-11.

Kuiper GG, Shughrue PJ, Merchenthaler I, Gustafsson JA. The estrogen receptor beta subtype: a novel mediator of estrogen action in neuroendocrine systems. Front Neuroendocrinol. 1998;19(4):253-86.

Lee KH, Vermeulen R, Lenters V, Cho SH, Strickland PT, et al. Determinants of urinary 1-hydroxypyrene glucuronide in South Korean children. Int Arch Occup Environ Health. 2008 Nov 20.

Li Z, Sandau C, Romanoff L, Caudill S, Sjodin A et al. Concentration and profile of 22 urinary polycyclic aromatic hydrocarbon metabolites in the US population. Environ Res 2008;107:320-331.

Messina M, McCaskill-Stevens W, Lampe JW. Addressing the soy and breast cancer relationship: review, commentary, and workshop proceedings. J Natl Cancer Inst. 2006; 98(18):1275-84.

Minister of Health Report on Smoking in Israel. 2011. http://www.health.gov.il/PublicationsFiles/smoke2011_30052012.pdf

Report on Human Biomonitoring of Environmental Chemicals in Canada. 2010. Results of the Canadian Health Measures Survey Cycle 1 (2007–2009).

Siegmund B, Leyden DE, Zikulnig E, Leitner E, Murkovic M, Pfannhauser W, Reif H. The contribution of dietary nicotine and dietary cotinine to salivary cotinine levels as a nicotine biomarker. Food Chemistry 2001; 74(3):259-265.

Thomas P, Dong J. Binding and activation of the seven-transmembrane estrogen receptor GPR30 by environmental estrogens: a potential novel mechanism of endocrine disruption. J Steroid Biochem Mol Biol. 2006;102(1-5):175-9.

U.S Department of Health and Human Services (U.S. DHHS). The Health Consequences of Smoking: The Surgeon General's Report—Executive Summary. U.S. Department of Heath and Human Services, Centers for Disease Control and Prevention, Coordinating Center for Health Promotion, National Center for 18 Fourth National Report on Human Exposure to Environmental Chemicals Cotinine Chronic Disease Prevention and Health Promotion, Office on Smoking and Health. [online]. 2004. Available at URL: http:// www.cdc.gov/tobacco/data_statistics/sgr/sgr_2004/index. htm#full; accessed 19 June 2012.

Appendix A: Study Questionnaire

Date _____ INT _____ Questionnaire no _____
Sex: 1. Male 2. Female Recall day (circle) – S M T W T F S

Ministry of Health
Public Health Services

Environmental Health Department Nutrition Department

Evaluation survey for certain environmental pollutants – Self administered questionnaire

Instructions:
All questions are written in the masculine form, but they equally refer to females as well. Please mark only one answer per question, unless it is specifically indicated that there is a multiple answer option. Wherever it is written "please specify" you may write in your own words.

1. Do you define yourself as vegetarian or vegan?
1. Yes, I'm vegetarian.
2. Yes, I'm vegan.
3. No, neither.

2. Which types of food do you <u>refrain</u> from eating? You may mark more than one answer
1. Meat (beef, lamb, etc)
2. Chicken, turkey
3. Fish
4. Milk products
5. Eggs
6. Other, please specify: _____ _____

3. How frequently do you eat food that was cooked on a grill or over open fire?
1. More than once a week
2. Once a week
3. 2-3 times a month
4. Once a month
5. Less than once a month or not at all

4. How frequently do you eat smoked products, e.g. sausage, fish, or smoked cheese?
1. More than once a week
2. Once a week
3. 2-3 times a month
4. Once a month
5. Less than once a month or not at all

5. Do you regularly drink water from e.g. 'Mey Eden' or 'Neviot' water-jugs (of 10 liters or more, not single-use bottles) at your workplace or at home?
1. Yes
2. No

6. Do you regularly drink water from sports bottles made of a transparent and rigid plastic material (e.g. 'Nalgeen' bottles)?

1. Yes
2. No

7. How frequently do you use the microwave to heat food in a plastic container?

1. Several times a day
2. Every day
3. Once a week
4. Once a month
5. Less than once a month or not at all

8. When you use a microwave to heat food in a plastic container – do you use a microwave-adjusted container?

1. Yes 2. No 3. I don't know

9. What is your height (without shoes) in cm? _____ (333) I don't know / remember (222) I decline to answer

10. What is your weight (without shoes, with light clothes) in kg? _____ (333) I don't know /remember (222) I decline to answer

11. What is your general health condition?

1. Very good
2. Good
3. Not so good
4. Not good at all

12. Where you ever diagnosed by a doctor for:

	1. Yes	**2. No**	**3. Decline**
1. Iron deficiency anemia	1	2	3
2. Osteoporosis	1	2	3
3. High cholesterol	1	2	3
4. High level of Triglycerides	1	2	3
5. Insulin dependant diabetes (not pregnancy diabetes)	1	2	3
6. Non-insulin dependant diabetes (not pregnancy diabetes)	1	2	3
7. Coronary heart disease	1	2	3
8. Stroke	1	2	3
9. Cancer	1	2	3
10. Arthritis	1	2	3
11. Fatty liver	1	2	3
12. Celiac disease	1	2	3

13. Did you receive a dialysis or an infusion treatment during the last week?

1. Yes
2. No

For women only –

14. Are you:

1. Currently pregnant?
2. Not sure if you're pregnant or not?
3. After birth and breastfeeding?
4. None of the above

15. Do you currently smoke, including a Narghile?

1. Yes → Go to question no. 16
2. Currently no, but I used to smoke before → Pass the question no. 18
3. No, I have never smoked → Pass to question no. 18

16. What do you currently smoke, or what did you smoke before? You may mark more than one answer

1. Cigarettes
2. Cigars → Go to question no. 18
3. Pipe → Go to question no. 18
4. Narghile → Go to question no. 18
5. Other, please specify: _____

17. How many cigarettes do you / were you used to smoke per day or per week? _____ cigarettes per day / week

18. How old are you? _____ years

19. In what country were you born?

1. Israel → Go to question no. 21
2. Other country, please specify _____

20. In what year did you immigrate to Israel? _____

21. What's your marital status?

1. Single
2. Married or living with a spouse
3. Divorced or living separately
4. Widowed
5. Other, please specify _____

22. Are you:

1. Jewish?
2. Non-Arab Christian?
3. Muslim Arab?
4. Christian Arab?
5. Druze?
6. Other, please specify _____

23. How do you define yourself?

1. Secular
2. Traditional
3. Religious

4.Ultra- orthodox
5. Other, please specify _____

24. <u>In total</u>, how many years of study do you have, starting from elementary school, including university and vocational studies (do not include years that you didn't complete)? _____

27. What's the highest certificate of education that you have?

1. Matriculation certificate **(**secondary school)
2. Vocational certificate, without matriculation
3. Vocational certificate, with matriculation
4. First academic degree
5. Second academic degree
6. Third academic degree
7. Rabbinical certificate or Yeshiva studies
8. Other certificate, please specify _____
9. No certificate

25. How many rooms does your apartment have, not including kitchen, toilet and rooms that are used for business purposes or that are leased? _____

26. How old is the building you live in?

1. Less than one year
2. 1-9 years
3. 10-19 years
4. 20-39 years
5. 40 years or more
6. I don't know

27. How would you chiefly describe yourself?

1. Hired worker
2. Self employed
3. Unemployed
4. Student
5. Pensioner
6. Housewife
7. Yeshiva student
8. Not working due to disability
9. Other, please specify _____ (222) decline to answer

28. What is your profession? _____

29. What is your main line of work at your current workplace? _____

30. In which of the following fields of work are you employed? Choose one only.

1. **Chemistry and chemical products:** Chemistry, medications, cleaning materials and disinfectants, oil refining, fuels, rubber and plastic products
2. **Construction, wood and paper:** Construction and construction products, wood industry, carpentry, paper, print
3. **Food and food services:** Food and beverage industry, catering
4. **Agriculture:** Agriculture, forestry and fishery

5. **Steel:** Basic steel industry (melting, casting, soldering, plating)
6. **Steel products:** Steel products, machines, mechanics, work tools, aircrafts, haulage tools
7. **Electricity and electrical and electronic products**
8. **Hi-Tech industry:** Machinery industry for offices, accounting and computers electronic components and electronic equipment for communications, industrial control equipment, and scientific-medical equipment
9. **Health:** Medicine and nursing, health professions
10. **Art, entertainment and sports**
11. **Office work:** Clerical work, trade, programming, free-lance professions
12. **Services:** Cleaning, maintenance, transportation and port services, barber's shops and beauty parlors, laundry services, hospitality, computer services, research and development services, engineering services
13. **Education, research and teaching institutes**
14. **Textile, fabrics, leather products, shoes**
15. Other, please specify: _____
16. Currently unemployed → Pass the question no. 32

31. What is the actual role you are performing in your field of work?
1. Management
2. Research
3. Service and administration
4. Teaching, education
5. Production
6. Counseling
7. Marketing and sales
8. Other _____

32. What is the net monthly income for your work? Q32

1. Up to 2,000 NIS
2. 2,001-3,000 NIS
3. 3,001-4,000 NIS
4. 4,001-5,000 NIS
5. 5,001-6,000 NIS
6. 6,001-7,500 NIS
7. 7,501-10,000 NIS
8. 10,001-14,000 NIS
9. Over 14,001 NIS
10. (Irrelevant – e.g. Kibbutz, non-working student, cooperative settlement)
(222) decline to answer

33. What is the <u>monthly average</u> net income from all sources of the entire household?
1. Up to 2,500 NIS
2. 2,501-4,000 NIS
3. 4,001-5,000 NIS
4. 5,001-6,500 NIS
5. 6,501-8,000 NIS
6. 8,001-10,000 NIS
7. 10,001-13,000 NIS
8. 13,001-17,000 NIS
9. 17,001-24,000 NIS

9. Over 24,001 NIS
10. (Irrelevant – e.g. Kibbutz, non-working student, cooperative settlement)
(222) decline to answer

34. Have you (yourself) applied a pesticide product in your house during the last week (i.e. using spray or powder)?
1. No / Irrelevant 2. If yes, with what preparation / substance _____

35. Did a professional apply a pesticide product in your house during the last week?
1. No / Irrelevant 2. If yes, with what preparation / substance _____

36. Have you (yourself)applied a pesticide product in your garden during the last week?
1. No / Irrelevant 2. If yes, with what preparation / substance _____

37. Did a professional apply a pesticide product in your house during the last week?
1. No/ Irrelevant 2. If yes, with what preparation / substance _____

38. Did you use an anti-flea shampoo or any other anti-flea preparation on your pet during the last week?
1. No / Irrelevant 2. Yes, with _____

39. Did you put a new anti-flea collar on your pet during the last week?
1. No / Irrelevant 2. Yes, with _____

40. Have you used a perfume / eau de Cologne during the last 48 hours?
1. Yes 2. No

41. Have you used a deodorant during the last 48 hours?
1. Yes 2. No

42. Have you used a hair gel or spray during the last 48 hours?
1. Yes 2. No

43. Have you used a hand / face cream during the last 48 hours? 1. Yes 2. No

<u>For women only</u>:
44. Have you used nail polish during the last 48 hours?
1. Yes 2. No

45. Have you used a lipstick during the last 48 hours? 1. Yes 2. No

<u>For men only</u>:
46. Have you used an aftershave during the last 48 hours?
1. Yes 2. No

Questionnaire - Consumption Frequency of Food Items

In this questionnaire you are requested to indicate in columns C **or** D **or** E your consumption frequency (**daily, weekly or monthly) of each food item,** according to **its specified quantity during the previous year**. If you do not consume a certain food item at all, or if you consume it less than once a month, you should mark X in column F. The questioning refers to **general** food consumption, according to the consumption frequency and the quantity consumed. Be sure to mark only one square per line – there's no need to calculate your consumption during all the indicated periods.

If there is any food item that you consume **at a high frequency and that is not** listed below, you may indicate it at the end of the questionnaire along with its related portion.

	A. The food	**B. Defined portion**	**C. No. of portions per day**	**D. No. of portions per week**	**E. No. of portions per month**	**F. Less than once a month or never**
1	Milk 0-1% fat (including in coffee), **excluding soy**	1 glass				
2	Milk, more than 1% fat (including in coffee), **excluding soy**	1 glass				
3	Chocolate milk or any other type of milk-drink,	1 glass				
4	Soy drink / soy milk	1 glass				
5	Soft white cheese or cream cheese or cottage cheese, more than 5% fat, **excluding soy**	1 spoon				
6	Soft white cheese or cream cheese or cottage cheese, 5% fat, **excluding soy**	1 spoon				
7	Soy based cheese	1 spoon				
8	Cultured milk ('Leben') or yogurt, 0-1.5% fat, additive-free and/or sugar-free, **excluding soy**	1 cup				
9	Cultured milk ('Leben') or yogurt, 3% fat or more, additive-free and/or sugar-free, **excluding soy**	1 cup				
10	Cultured milk ('Leben') or yogurt, 0-1.5% fat, with additives and/or with sugar, **excluding soy**	1 cup				
11	Cultured milk ('Leben') or yogurt, 3% fat or more, with additives and/or with sugar, **excluding soy**	1 cup				
12	**Diet** Yogurt, milk pudding or	1 cup				

	cheese, 0% fat, sugar-free, **excluding soy**					
13	Soy based pudding ("Yogurt")	1 cup				
14	Hard cheese, 9% fat or less	1 slice				
15	Any type of hard cheese, over 9% fat	1 slice				
16	Any type of salted cheese e.g. Safad cheese or Bulgarian cheese, 5% fat or less	1 slice or spoon				
17	Any type of salted cheese e.g. Safad cheese or Bulgarian cheese, over 5% fat	2 slices or spoons				
18	Egg recipes (omelets, scrambled eggs, 'sunny side up' recipe, Shakshuka)	1 egg				
19	Cooked eggs – soft or hard	1 egg				
20	Chicken and Turkey (excluding Schnitzels)	¼ chicken or portion				
21	Real chicken or turkey schnitzel – bought or home-made	Medium portion				
22	Mini-Schnitzels and Schnitzels, processed, bought, including Nuggets	1 portion				
23	Beef, veal, including steaks and Gulash	Medium portion				
24	Shawarma, Shish kebab in pita bread or Lafa	1 portion				
25	Chicken, turkey and beef cutlets, including Hamburgers and kebabs	2 medium portions				
26	Lamb	1 portion				
27	Meat, chicken or turkey assorted stews, e.g. Kube, stuffed and cholent	1 medium portion				
28	Internal organs of chicken or meat: liver, intestines, gizzards, heart, tongue	1 medium portion				
29	Smoked turkey Pastrami or breast	1 slice				
30	Any type of sausage	1 unit or 2 slices				
31	Vegetal products – Schnitzels, hamburgers, sausages, Soy kebab, soy cutlet or other soy and tofu products	1 unit				
32	Vegetable Schnitzel or vegetable cutlet	1 unit				
33	Falafel in pita bread	1 portion				
34	Baked or grilled or fried fish or baked in gravy	1 medium portion				
35	Canned tuna fish, including tuna salad	1 full spoon				
36	Dry, salty, sour, smoked or	1 slice				

	canned pickled fish, not including tuna fish					
37	Bun or pita bread or regular white bread or twist bread ('Hallah')	1 slice or **half** a bun / pita bread				
38	Bun or pita bread or whole wheat bread, including rye and corn flour	1 slice or **half** a bun / pita bread				
39	Low-calorie bread, low-calorie twist bread or low-calorie buns	1 unit				
40	Pizza	1 medium slice				
41	Pie or Quiche with vegetables or cheese, Blintzes	1 slice or medium unit				
42	Burekas, Malawach, Jachnun	1 Bureka or **half** Malawach / Jachnun				
43	Cooked or bakes potatoes, including puree or potato salad	1 medium portion or 1 glass				
44	Fried potatoes – chips (not processed snack), cutlet, pancake	1 medium portion				
45	Pasta, noodles, Ptitim	1 glass				
46	Cooked wheat, Burghul, Kuskus, quinoa, buckwheat, gritz	1 medium portion or 1 glass				
47	Cooked rice with or without additives (gravy)	1 glass				
48	Cooked cereals, e.g. oats and semolina	1 bowl				
49	Non-sweetened cereals	1 medium bowl				
50	Sweetened cereals, including granola	1 medium bowl				
51	Dry cooked legume, including soup and assorted stews (beans, fava beans, etc), not including soy beans	Half a glass or portion				
52	Cooked soy beans, including green soy beans	Half a glass				
53	Miso, Tampa	Half a spoon				
54	Tofu	Half a glass				
55	Fresh or cooked tomatoes or cherry tomatoes	1 tomato or 13 cherry tomatoes				
56	Tomato sauce or ketchup	1 spoon				

57	Fresh cucumber, including cucumber salad	1 cucumber				
58	Fresh or cooked pepper (all colors)	1 pepper				
59	Cooked or baked or grilled Zucchini, eggplant	1 medium portion				
60	Broccoli, cauliflower, or assorted cooked vegetables	1 medium portion				
61	Green and red cabbage, including in fresh salad	1 medium portion				
62	Fresh lettuce or lamellae or other leaf vegetables, including in salads	Glass of lettuce				
63	Maluchia, Hubeiza	Half a glass				
64	Non-cooked Chicory	Half a glass				
65	Fresh or cooked carrot, including carrot juice	1 carrot or 1/4 carrot juice				
66	Peas, green or yellow beans, okra (including frozen or canned)	1 glass				
67	Sweet potato, pumpkin, Butternut squash	1 medium portion				
68	Cooked spinach	1 portion				
69	Fresh vegetable salads	1 medium portion or glass				
70	Avocado (including avocado salad)	1 full spoon				
71	Soup with chicken or turkey or beef	1 bowl				
72	Vegetable soup	1 bowl				
73	Legume, gritz or other soups	1 bowl				
74	Humus and Tahini salads	1 full spoon				
75	Cooked vegetable salads, e.g. Turkish, Matbuha, eggplant – with or without mayonaise	1 full spoon				
76	Pickled vegetables, pickles, except for olives	1 unit				
77	Olives	10 olives				
78	Fresh or baked or cooked apple (excluding dry apples)	1 medium				
79	Fresh or baked or cooked pears (excluding dry pears)	1 unit				
80	Orange, pomegranate, mandarin or tangerine, or any other citrus fruit	1 medium or half a pomegranate				
81	Banana	1 medium				
82	Peach, nectarine, plum, apricot	1 medium				

	(not dried)					
83	Grapes	12 units				
84	Melon	1 slice				
85	Watermelon	1 big slice or 2 small slices				
86	Other fruits or fruit salad or cooked fruit	Half a glass or medium unit				
87	Natural or frozen juice from citrus fruits or other fruits	1 glass				
88	Dry fruits	4 units				
89	Salty snacks, e.g.: Bisli, chips, pretzels, popcorn, soup almonds, croutons	Small bag or 30gr or a handful				
90	Salty crackers	1 unit				
91	Ice cream – any milk-based type, excluding dietary and sorbet	One ice cream bar / 2 scoops				
92	Ice cream – 'Parve', excluding dietary and sorbet	2 scoops				
93	Dietary ice cream, yogurt ice cream	One ice cream bar / 2 scoops				
94	Ice pop or sorbet bar, or sorbet ice cream	One ice cream bar / 2 scoops				
95	Milk chocolate or bittersweet chocolate or any type of chocolate snack (e.g. chocolate coated snacks, 'Pesek Zman') or chocolate spread	1/2 big snack; or 1 mini snack or 1 line or spoon				
96	Honey or marmalade or syrup	1 spoon				
97	"simple" cookies, including biscuits and non-coated cookies	1 unit				
98	Filled or coated waffles and cookies	1 unit				
99	**Yeast cake or cookies, e.g.:** Rugelach, doughnuts	1 unit				
100	Mixed cake, marble cake, fruit cake, chocolate cake	1 slice				
101	Cheese cake or cream cake	1 slice				
102	Nuts, almonds, pistachios, peanuts	Handful / 25gr				
103	Sunflower, pumpkin, watermelon seeds	1/2 a cup				
104	Butter and low-calorie butter	1 spoon				
105	All types of margarine	1 spoon				
106	Olive oil, canola oil	1 spoon				
107	Soy oil, corn oil, safflower and	1 spoon				

	other types of oil					
108	All types of mayonnaise, including salad dressings	1 spoon				
109	Non-dietary sparkling drinks, including non-alcoholic beers	1 glass				
110	Dietary drinks, including sparkling drinks	1 glass				
111	Chaser or fruit nectar, or low-calorie drink, or water in tastes	1 glass				
112	All types of coffee, including decaffeinated	1 cup				
113	Tea, including herbal tea	1 cup				
114	Sugar, including in tea or coffee, or candies	1 spoon or 1 unit				
115	All types of beer, excluding non-alcoholic beer	1 can / one glass and a half				
116	Wine	1 small glass				
117	Alcoholic beverages	1 small glass				
118	Water	1 glass				
Other						
Other						
Other						
Other						
Other						

Thanks for your cooperation!

24 hour recall on (circle the day) S M T W TH F S:
Date: _____INT _____ Questionnaire no _____

Ministry of Health- Public Health Services
Environmental Health Department Nutrition Department
Evaluation survey for certain environmental pollutants

Interviewer ,read: **"**Hello, my name is _____ and I am an interviewer from Dialogue, on behalf of the Ministry of Health. The Ministry is currently carrying out a survey which examines eating and health habits and the link between them and exposure to certain environmental contaminants. Thank you for your willingness to take part in the survey. If, at any stage during the interview, any of the questions are not clear, please stop me and I will explain again.
Interviewer ,read: In the following questions, I will ask you for details regarding everything you ate and drank yesterday.

	What did you eat from 4 a.m. yesterday _____until 4 a.m. today____? *If necessary, read* "Previous studies have shown that at 4:00 am. it is possible to distinguish between one day of 24 hours and the next."Specify everything you ate and drank, in the house and outside of the house, at mealtimes and in between, including sweets and snacks, coffee, tea soft drinks, alcoholic drinks etc.		**What time did you begin to eat /drink the item?**
	The quick list	√	
A			
B			
C			
D			
E			
F			
G			
H			
I			
J			
K			
L			
M			
N			
O			
P			
Q			
R			
S			
T			

Interviewer - read: " There are foods which people forget they ate or drank, or they ate them without being aware. Try to remember if you forgot to mention one of these foods: hot drinks, cold drinks

(including water), alcoholic drinks, sweets, salty snacks, fruits, vegetables, bread".

To the interviewer - read: "I would now like to ask you for additional details regarding the food and drinks you mentioned. I will ask where you ate and if this item was part of a meal. If you remember something else, tell me. When I ask you about the quantity you ate or drank, you can use the examples I suggest, the dishes in your house or the information on the wrapper/packet".

Food/Drink description.

To the interviewer – Transfer, from the Quick List the item letter and hour to columns 1 and 2, and item name to column 5. Mark √on the Quick List in the column next to the item you've copied and go on to complete columns 3 and 4 using Card 1, and afterwards, complete columns 6 and 7 using the questions in the "Food and Food Quantities Guide".

Item Letter	*Hour*	**Where did you eat/drink this item?**	**Which meal was it?**	**Item name**	**Food/drink description**	**What quantity did you eat/drink?**
1	**2**	**3**	**4**	**5**	**6**	**7**
					1	
					2	
					3	
					4	
					5	
					6	
					7	
					8	
					9	
					10	
					11	
					12	
					13	
					14	
					15	
					16	
					17	

Item Letter	*Hour*	**Where did you eat/drink this item?**	**Which meal was it?**	**Item name**	**Food/drink description**	**What quantity did you eat/drink?**
					18	
					19	
					20	
					21	
					22	
					23	
					24	
					25	
					26	
					27	
					28	
					29	
					30	
					31	
					32	
					33	
					34	
					35	
					36	
					37	
					38	
					39	
					40	

Item Letter	*Hour*	**Where did you eat/drink this item?**	**Which meal was it?**	**Item name**	**Food/drink description**	**What quantity did you eat/drink?**
					41	
					42	
					43	
					44	
					45	

Interviewer: ***After completion of the 24 hour recall, please briefly review all items listed, so as to ensure that the interviewee had not forgotten anything. Then move to question 47. . ,***

Q47: Is the amount you ate yesterday similar to the amount you usually eat?

1. Yes, similar
2. No, yesterday I ate less than usual
3. No, yesterday I ate more than usual

333. Don't know

Q48. Do you take medications and/or nutrition supplements on a regular basis?

1. Yes
2. No (***Interviewer- read*** " I will now give you the questionnaire to be filled in by yourself. If you have questions, please ask me".
3.

Q49. Could you please bring the medications and/or nutrition supplements you take on a regular basis, including by mouth, suppositories and injections?

1. Yes
2. No, it is taken care of by someone else
3. No, I am not prepared to bring them.

50. Name of the drug/supplement	51.Amount (mg)	52. reason for talking drug/supplement	53. Dosage			
			Daily		On a weekly basis	
			No. of times	No. of units	No. of times	No. of units
1.		1. _____ 2. Don' t know				
2.		1. _____ 2. Don' t know				
3.		. _____ 2. Don' t know				
4.		. _____ 2. Don' t know				
5.		. _____ 2. Don' t know				

Appendix B: Analytical Methods for Measuring Environmental Chemicals in the Study

Laboratory analyses of environmental chemicals and creatinine were performed at the Institute and Outpatient Clinic for Occupational, Social and Environmental Medicine, University Erlangen-Nuremberg in Germany using the following methods:

For the determination of cotinine in urine a gas chromatography-mass spectrometry (GC-MS) procedure was applied (Müller et al. 2003). For separation of the analyte from the biological matrix the urine was extracted with dichloromethane. Deuterated cotinine was used as an internal standard. Calibration was performed using calibration standards which were prepared in pooled non-smoker urine and which were treated in the same manner as the samples to be analyzed.

The determination of bisphenol A, genistein and daidzein in urine were carried out using a gas chromatographic-tandem mass spectrometric (GC-MS/MS) method (Schmidt et al. 2012). The method comprised an enzymatic cleavage of the conjugated phenolic substances, a solid phase extraction of the analytes and a derivatization with N-tert-butyldimethylsilyl-N-methyltrifluoro-acetamide (MTBSTFA). For each analyte an isotope-labeled equivalent was used as internal standard. Calibration was performed using standard solutions in pooled human urine.

The determination of hydroxylated polycyclic hydrocarbons (1-hydroxypyrene, 1-hydroxyphenanthrene, sum of 2- and 9-hydroxyphenanthrene, 3-hydroxyphenanthrene, 4-hydroxyphenanthrene) was performed using a high-performance liquid chromatography with fluorescence detection (HPLC-FD) (Hemat et al. 2012). Clean-up took place using an online-extraction procedure with a copper phthalocyanine-modified silica gel phase (preconcentration column). Calibrations standards were prepared by spiking of pooled non-smoker urine with the hydroxylated PAHs.

The metabolites of organophosphorus pesticides (DMP, DEP, DMTP, DETP, DMDTP, DEDTP) in urine were determined using a GC-MS/MS procedure (Barr et al. 2010). Isotope-labeled analogues of the analytes were added to the urine, which was then freeze-dried. The lyophilized urine was extracted with diethyl ether and acetonitrile. Then the analytes were derivatized with pentafluorobenzyl bromide. After addition of water, liquid-liquid extraction was carried out twice with hexane to separate the derivatives from matrix components and excess of derivatization agent. Thereafter GC-MS/MS analysis took place. Calibration was performed with standard solutions prepared in pool urine.

The determination of the eleven metabolites of phthalates was performed by a liquid chromatography-tandem mass spectrometry (LC-MS/MS) procedure (Göen et al. 2011). After enzymatic hydrolysis the analytes were extracted by an online-extraction procedure using

restricted access material (RAM) of RP8 silica gel. Isotope-labeled analogues were used as internal standards. Calibration was performed using standard solution prepared in pooled urine.

Limits of detection (LODs) and limits of quantification (LOQs) for these procedures are listed in Appendix C.

References:

D. Barr, M. Wittassek, T. Schettgen, H.W. Hoppe, J. Angerer: Dialkyl phsphates. Determination in urine. In: Deutsche Forschungsgemeinschaft: The MAK-Collection for Occupational Health and Safety. Part IV: Biomonitoring Methods. Vol. 12. Wiley-VCH, Weinheim 2010, 185-209

Th. Göen, L. Dobler, J. Koschorreck, J. Müller, G.A. Wiesmüller, H. Drexler, M. Kolossa-Gehring: Trends of the internal phthalate exposure of young adults in Germany – Follow-up of a retrospective human biomonitoring study. Int. J. Hyg. Environ. Health 215 (2011), 36-45

H. Hemat, J. Wittsiepe, M. Wilhelm, J. Müller, Th. Göen: High levels of 1-hydroxypyrene and hydroxyphenanthrenes in urine of children and adults from Afghanistan. Journal of Exposure Science And Environmental Epidemiology 22 (2012), 46-51

M. Müller: Cotinine. Determination in urine to ascertain passive exposure to smoking. In: Deutsche Forschungsgemeinschaft: Analyses of Hazardous Substances in Biological Materials. Vol. 8. Wiley-VCH, Weinheim 2003, 53-65

L. Schmidt, J. Müller, Th. Göen: Simultaneous monitoring of exposure to seven potentially endorcrine disrupting compounds in human urine using gas chromatography – tandem mass spectrometry (GC-MS/MS). Anal. Bioanal. Chem. (2012) in preparation

Appendix C: Limits of Detection and Quantification

		Limit of Detection	Limit of Quantification
Cotinine	(in µg/l)	0.5	1.0
Bisphenol A	(in µg/l)	0.1	0.3
Genistein	(in µg/l)	0.6	2.0
Daidzein	(in µg/l)	0.3	1.0
1-Hydroxypyrene	(in ng/l)	12	36
1-Hydroxyphen.	(in ng/l)	16	48
2-Hydroxyphen.	(in ng/l)	4	12
3-Hydroxyphen.	(in ng/l)	5	15
4-Hydroxyphen.	(in ng/l)	8	24
DMP	(in µg/l)	0.1	0.3
DMTP	(in µg/l)	0.1	0.3
DMDTP	(in µg/l)	0.05	0.15
DEP	(in µg/l)	0.1	0.3
DETP	(in µg/l)	0.1	0.3
DEDTP	(in µg/l)	0.01	0.03
MnBP	(in µg/l)	1	2
MiBP	(in µg/l)	1	2
MBzP	(in µg/l)	0.5	1
MEHP	(in µg/l)	0.25	0.5
5OH-MEHP	(in µg/l)	0.25	0.5
5oxo-MEHP	(in µg/l)	0.25	0.5
5cx-MEPP	(in µg/l)	0.25	0.5
2cx-MMHxP	(in µg/l)	0.25	0.5
7OH-MMOP	(in µg/l)	0.25	0.5
7oxo-MMOP	(in µg/l)	0.25	0.5
7cx-MMHpP	(in µg/l)	0.25	0.5