Supplemental Material

"Polychlorinated Biphenyls, Lead, and Mercury Are Associated with Liver Disease In American Adults: NHANES 2003-2004"

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Supplementary Material, Table 1. Adult NHANES 2003-2004 Pollutant List by Environmental Pollutant Subclass

ANALYTE NAME	ABBREV[1]	LAB[2]	SUBCLASS[3]	SUBPOP[4]	LLOD[5]	PERCENT[6]
Cadmium (ug/L)	LBXBCD	ITNB	BMT	A	0.100	82.77*
Lead (ug/dL)	LBXBPB	ITNB	BMT	A	0.200	99.64*
Mercury, inorganic (ug/L)	LBXIHG	ITNB	BMT	A	0.300	25.94
Mercury, total (ug/L)	LBXTHG	ITNB	BMT	A	0.140	92.49*
Cotinine (ng/mL)	LBXCOT	ITNB	COT	A	0.011	81.33*
PCB28 Lipid Adj (ng/g)	LBX028LA	OATB	DFP / cPCB	D		100*
PCB66 Lipid Adj (ng/g)	LBX066LA	OATB	DFP / cPCB	D		98.87*
PCB74 Lipid Adj (ng/g)	LBX074LA	OATB	DFP / cPCB	D		100*
PCB105 Lipid Adj (ng/g)	LBX105LA	OATB	DFP / cPCB	D		98.01*
PCB118 Lipid Adj (ng/g)	LBX118LA	OATB	DFP / cPCB	D		100*
PCB156 Lipid Adj (ng/g)	LBX156LA	OATB	DFP / cPCB	D		91.71*
PCB157 Lipid Adj (ng/g)	LBX157LA	OATB	DFP / cPCB	D		74.88*
PCB167 Lipid Adj (ng/g)	LBX167LA	OATB	DFP / cPCB	D		68.02*
PCB189 Lipid Adj (ng/g)	LBX189LA	OATB	DFP / cPCB	D		28.31
1,2,3,7,8-pncdd Lipid Adj (pg/g)	LBXD01LA	OATB	DFP	D		62.25*
1,2,3,4,7,8-hxcdd Lipid Adj (pg/g)	LBXD02LA	OATB	DFP	D		32.43
1,2,3,6,7,8-hxcdd Lipid Adj (pg/g)	LBXD03LA	OATB	DFP	D		86.89*
1,2,3,7,8,9-hxcdd Lipid Adj (pg/g)	LBXD04LA	OATB	DFP	D		33.51
1,2,3,4,6,7,8-hpcdd Lipid Adj (pg/g)	LBXD05LA	OATB	DFP	D		97.85*
1,2,3,4,6,7,8,9-ocdd Lipid Adj (pg/g)	LBXD07LA	OATB	DFP	D		89.74*
2,3,7,8-tcdf Lipid Adj (pg/g)	LBXF01LA	OATB	DFP	D		3.31
1,2,3,7,8-pncdf Lipid Adj (pg/g)	LBXF02LA	OATB	DFP	D		1.77
2,3,4,7,8-pncdf Lipid Adj (pg/g)	LBXF03LA	OATB	DFP	D		74.48*
1,2,3,4,7,8-hxcdf Lipid Adj (pg/g)	LBXF04LA	OATB	DFP	D		68.46*
1,2,3,6,7,8-hxcdf Lipid Adj (pg/g)	LBXF05LA	OATB	DFP	D		57.77
1,2,3,7,8,9-hxcdf Lipid Adj (pg/g)	LBXF06LA	OATB	DFP	D		0.39
2,3,4,6,7,8-hxcdf Lipid Adj (pg/g)	LBXF07LA	OATB	DFP	D		6.24
1,2,3,4,6,7,8-hxcdf Lipid Adj (pg/g)	LBXF08LA	OATB	DFP	D		88.62*
1,2,3,4,7,8,9-hpcdf Lipid Adj (pg/g)	LBXF09LA	OATB	DFP	D		5.68
1,2,3,4,6,7,8,9-ocdf Lipid Adj (pg/g)	LBXF10LA	OATB	DFP	D		28.23
3,3',4,4',5,5'-hxcb Lipid Adj (pg/g)	LBXHXCLA	OATB	DFP / cPCB	D		70.33*
3,3',4,4',5-pcnb Lipid Adj (pg/g)	LBXPCBLA	OATB	DFP / cPCB	D		94.84*
3,4,4',5-tcb Lipid Adj (pg/g)	LBXTC2LA	OATB	DFP	D		37.5
2,3,7,8-tcdd Lipid Adj (pg/g)	LBXTCDLA	OATB	DFP	D		45.36
Urinary 4-tert-octyl phenol (ng/mL)	CRA4TO	OATB	EPH	D	0.170	54.24
Urinary Benzophenone-3 (ng/mL)	CRABP3	OATB	EPH	D	0.340	96.58*
Urinary Bisphenol A (ng/mL)	CRABPH	OATB	EPH	D	0.360	92.24*
Urinary Triclosan (ng/mL)	CRATRS	OATB	EPH	D	0.170	74.23*
Barium, urine (ng/mL)	CRAUBA	ITNB	HM	B	0.220	92.12*
Beryllium, urine (ng/mL)	CRAUBE	ITNB	HM	B	0.05, 0.08	0.74
Cadmium, urine (ng/mL)	CRAUCD	ITNB	HM	B	0.03, 0.04	95.41*
Cobalt, urine (ng/mL)	CRAUCO	ITNB	HM	B	0.060	95.44*
Cesium, urine (ng/mL)	CRAUCS	ITNB	HM	B		100*
Molybdenum, urine (ng/mL)	CRAUMO	ITNB	HM	B	1.060	99.94*

Lead, urine (ng/mL)	CRAUPB	ITNB	HM	B	0.07, 0.23	83.44*
Platinum, urine (ng/mL)	CRAUPT	ITNB	HM	B	0.01, 0.05	0.31
Antimony, urine (ng/mL)	CRAUSB	ITNB	HM	B	0.02, 0.05	56.96
Thallium, urine (ng/mL)	CRAUTL	ITNB	HM	B	0.011	99.14*
Tungsten, urine (ng/mL)	CRAUTU	ITNB	HM	B	0.01, 0.02, 0.03	77.65*
Uranium, urine (ng/mL)	CRAUUR	ITNB	HM	B	0.001, 0.004	65.02*
PCB199 Lipid Adj (ng/g)	LBD199LA	OATB	NPB	D		92.81*
PCB44 Lipid Adj (ng/g)	LBX044LA	OATB	NPB	D		99.92*
PCB49 Lipid Adj (ng/g)	LBX049LA	OATB	NPB	D		99.39*
PCB52 Lipid Adj (ng/g)	LBX052LA	OATB	NPB	D		100*
PCB87 Lipid Adj (ng/g)	LBX087LA	OATB	NPB	D		83.54*
PCB99 Lipid Adj (ng/g)	LBX099LA	OATB	NPB	D		100*
PCB101 Lipid Adj (ng/g)	LBX101LA	OATB	NPB	D		96.6*
PCB110 Lipid Adj (ng/g)	LBX110LA	OATB	NPB	D		98.4*
PCB128 Lipid Adj (ng/g)	LBX128LA	OATB	NPB	D		25.78
PCB138 & 158 Lipid Adj (ng/g)	LBX138LA	OATB	NPB	D		100*
PCB146 Lipid Adj (ng/g)	LBX146LA	OATB	NPB	D		99.17*
PCB149 Lipid Adj (ng/g)	LBX149LA	OATB	NPB	D		95.8*
PCB151 Lipid Adj (ng/g)	LBX151LA	OATB	NPB	D		80.18*
PCB153 Lipid Adj (ng/g)	LBX153LA	OATB	NPB	D		100*
PCB170 Lipid Adj (ng/g)	LBX170LA	OATB	NPB	D		99.17*
PCB172 Lipid Adj (ng/g)	LBX172LA	OATB	NPB	D		77.09*
PCB177 Lipid Adj (ng/g)	LBX177LA	OATB	NPB	D		89.29*
PCB178 Lipid Adj (ng/g)	LBX178LA	OATB	NPB	D		85.89*
PCB180 Lipid Adj (ng/g)	LBX180LA	OATB	NPB	D		99.77*
PCB183 Lipid Adj (ng/g)	LBX183LA	OATB	NPB	D		93.62*
PCB187 Lipid Adj (ng/g)	LBX187LA	OATB	NPB	D		99.16*
PCB194 Lipid Adj (ng/g)	LBX194LA	OATB	NPB	D		87.78*
PCB195 Lipid Adj (ng/g)	LBX195LA	OATB	NPB	D		65.51*
PCB196 & 203 Lipid Adj (ng/g)	LBX196LA	OATB	NPB	D		93.61*
PCB206 Lipid Adj (ng/g)	LBX206LA	OATB	NPB	D		96.85*
PCB209 Lipid Adj (ng/g)	LBX209LA	OATB	NPB	D		96.37*
Aldrin Lipid Adj (ng/g)	LBXALDLA	OATB	OCP	C		0.15
B-hexachlorocyclohexane Lipid Adj (ng/g)	LBXBHCLA	OATB	OCP	C		75.4*
Dieldrin Lipid Adj (ng/g)	LBXDIELA	OATB	OCP	C		88.48*
Endrin Lipid Adj (ng/g)	LBXENDLA	OATB	OCP	C		0.15
G-hexachlorocyclohexane Lipid Adj (ng/g)	LBXGHCLA	OATB	OCP	C		0.72
Hexachlorobenzene Lipid Adj (ng/g)	LBXHCBLA	OATB	OCP	C		99.93*
Heptachlor Epoxide Lipid Adj (ng/g)	LBXHPELA	OATB	OCP	C		61.67*
Mirex Lipid Adj (ng/g)	LBXMIRLA	OATB	OCP	C		43.61
o,p'-DDT Lipid Adj (ng/g)	LBXODTLA	OATB	OCP	C		7.06
Oxychlordane Lipid Adj (ng/g)	LBXOXYLA	OATB	OCP	C		83.83*
p,p'-DDE Lipid Adj (ng/g)	LBXPDELA	OATB	OCP	C		99.71*
p,p'-DDT Lipid Adj (ng/g)	LBXPDTLA	OATB	OCP	C		78.96*
Trans-nonachlor Lipid Adj (ng/g)	LBXTNALA	OATB	OCP	C		93.92*
Dimethylphosphate(µg/L)	CRAOP1	TB	OPD	D	0.500	61.82*
Diethylphosphate(µg/L)	CRAOP2	TB	OPD	D	0.100	62.84*
Dimethylthiophosphate(µg/L)	CRAOP3	TB	OPD	D	0.500	81.91*
Diethylthiophosphate(µg/L)	CRAOP4	TB	OPD	D	0.200	66.99*

Dimethyldithiophosphate(µg/L)	CRAOP5	TB	OPD	D	0.100	56.58
Diethyldithiophosphate(µg/L)	CRAOP6	TB	OPD	D	0.100	30.97
1-napthol (ng/L)	CRAP01	OATB	PAH	C	46.700	99.94*
2-napthol (ng/L)	CRAP02	OATB	PAH	C	31.100	100*
3-fluorene (ng/L)	CRAP03	OATB	PAH	C	5.000	99.67*
2-fluorene (ng/L)	CRAP04	OATB	PAH	C	5.000	100*
3-phenanthrene (ng/L)	CRAP05	OATB	PAH	C	5.000	99.73*
1-phenanthrene (ng/L)	CRAP06	OATB	PAH	C	5.000	99.93*
2-phenanthrene (ng/L)	CRAP07	OATB	PAH	C	5.000	98.87*
1-benzo[c] phenanthrene (ng/L)	CRAP08	OATB	PAH	C	5.000	10.66
1-pyrene (ng/L)	CRAP10	OATB	PAH	C	5.000	98.94*
2-benzo[c] phenanthrene (ng/L)	CRAP11	OATB	PAH	C	4.000	7.16
1-benzo[a] anthracene (ng/L)	CRAP12	OATB	PAH	C	5.000	7.84
6-chrysene (ng/L)	CRAP13	OATB	PAH	C	5.000	13.08
3-benzo[c] phenanthrene (ng/L)	CRAP14	OATB	PAH	C	5.000	9.14
3-chrysene (ng/L)	CRAP15	OATB	PAH	C	5.500	6.79
3-benz[a] anthracene (ng/L)	CRAP16	OATB	PAH	C	10.500	7.66
9-fluorene (ng/L)	CRAP17	OATB	PAH	C	5.000	100*
4-phenanthrene (ng/L)	CRAP19	OATB	PAH	C	5.000	90.35*
1-chrysene (ng/L)	CRAP20	OATB	PAH	C	5.000	27.29
2-chrysene (ng/L)	CRAP21	OATB	PAH	C	5.000	3.09
4-chrysene (ng/L)	CRAP22	OATB	PAH	C	5.000	6.91
3-benzo(a) pyrene (ng/L)	CRAP24	OATB	PAH	C	5.000	12.14
2,2',4,4',5,5'-hexbrombiphenyl lipid adj	LBXBB1LA	OATB	PBE	C		83.52*
2,2',4-tribromodiphenyl ether lipid adj	LBXBR1LA	OATB	PBE	C		4.97
2,4,4'-tribromodiphenyl ether lipid adj	LBXBR2LA	OATB	PBE	C		79.3*
2,2',4,4'-tetrabromphenyl ether lipid ad	LBXBR3LA	OATB	PBE	C		97.4*
2,2',3,4,4'-pentabromphenyl lipid adj	LBXBR4LA	OATB	PBE	C		24.31
2,2',4,4',5-pentabromphenyl lipid adj	LBXBR5LA	OATB	PBE	C		66.83*
2,3',4,4'-tetrabromodiphenyl lipid adj	LBXBR66L	OATB	PBE	C		21.87
2,2',4,4',6-pentabromdphenyl lipid adj	LBXBR6LA	OATB	PBE	C		93.06*
2,2',4,4',5,5'-hexabromphenyl lipid adj	LBXBR7LA	OATB	PBE	C		92.64*
2,2',4,4',5,6'-hexabromphenyl lipid adj	LBXBR8LA	OATB	PBE	C		53.09
2,2',3,4,4',5',6-heptabrophenl lipid adj	LBXBR9LA	OATB	PBE	C		16.81
Perchlorate, urine (ng/mL)	CRAUP8	ERATB	PER	D		100*
2-(N-ethyl-PFOSA) acetate	LBXEPAH	OATB	PFC	B	0.400	4.58
2-(N-methyl-PFOSA) acetate	LBXMPAH	OATB	PFC	B	0.600	26.51
Perfluorobutane sulfonic acid	LBXPFBS	OATB	PFC	B	0.400	0.33
Perfluorodecanoic acid	LBXPFDE	OATB	PFC	B	0.300	29.58
Perfluorododecanoic acid	LBXPFDO	OATB	PFC	B	1.000	0.07
Perfluoroheptanoic acid	LBXPFHP	OATB	PFC	B	0.300	4.84
Perfluorohexane sulfonic acid	LBXPFHS	OATB	PFC	B	0.300	97.58*
Perfluorononanoic acid	LBXPFNA	OATB	PFC	B	0.100	98.1*
Perfluorooctanoic acid	LBXPFOA	OATB	PFC	B	0.100	99.61*
Perfluorooctane sulfonic acid	LBXPFOS	OATB	PFC	B	0.400	99.87*
Perfluorooctane sulfonamide	LBXPFSA	OATB	PFC	B	0.200	21.99
Perfluoroundecanoic acid	LBXPFUA	OATB	PFC	B	0.300	9.36
Mono-2-ethyl-5-carboxypentyl phthalate	CRAECP	OATB	PH	C	0.250	99.94*
Mono-n-butyl phthalate	CRAMBP	OATB	PH	C	0.400	99.37*
Mono-(3-carboxypropyl) phthalate	CRAMC1	OATB	PH	C	0.160	97.97*

Mono-cyclohexyl phthalate	CRAMCP	OATB	PH	C	0.200	8.63
Mono-ethyl phthalate	CRAMEP	OATB	PH	C	0.400	100*
Mono-(2-ethyl-5-hydroxyhexyl) phthalate	CRAMHH	OATB	PH	C	0.320	99.68*
Mono-(2-ethyl)-hexyl phthalate	CRAMHP	OATB	PH	C	0.900	66.16*
Mono-isobutyl phthalate	CRAMIB	OATB	PH	C	0.260	96.63*
Mono-n-methyl phthalate	CRAMNM	OATB	PH	C	1.000	54.41
Mono-isononyl phthalate	CRAMNP	OATB	PH	C	1.000	4.19
Mono-(2-ethyl-5-oxohexl) phthalate	CRAMOH	OATB	PH	C	0.450	98.86*
Mono-n-octyl phthalate	CRAMOP	OATB	PH	C	1.000	1.02
Mono-benzyl phthalate	CRAMZP	OATB	PH	C	0.110	99.56*
Urinary Arsenobetaine (µg/L)	CRAUAB	ITNB	UAS	B	0.400	71.71*
Urinary Arsenocholine (µg/L)	CRAUAC	ITNB	UAS	B	0.600	2.02
Urinary total Arsenic (µg/L)	CRAUAS	ITNB	UAS	B	0.600	98.77*
Urinary Arsenous acid (µg/L)	CRAUAS3	ITNB	UAS	B	1.200	5.27
Urinary Arsenic acid (µg/L)	CRAUAS5	ITNB	UAS	B	1.000	6.25
Urinary Dimethylarsonic acid (µg/L)	CRAUDMA	ITNB	UAS	B	1.700	86.34*
Urinary Monomethylacrsonic acid (µg/L)	CRAUMMA	ITNB	UAS	B	0.900	35.29
Urinary Trimethylarsine Oxide (µg/L)	CRAUTM	ITNB	UAS	B	1.000	0.24
Mercury, urine (ng/mL)	CRAUHG	ITNB	UHG	B	0.100	82.72*
Iodine, urine (ng/mL)	CRAUIO	ITNB	UIO	D	0.707	100*
Blood 2,5-Dimethylfuran (ng/mL)	LBX2DF	ERATB	VOC	B,D		23.39
Blood 1,1-Dichloroethane (ng/mL)	LBXV1A	ERATB	VOC	B,D		0
Blood 1,2-Dichlorobenzene (ng/mL)	LBXV1D	ERATB	VOC	B,D		0
Blood 1,1-Dichloroethene (ng/mL)	LBXV1E	ERATB	VOC	B,D		0
Blood 1,2-Dichloroethane (ng/mL)	LBXV2A	ERATB	VOC	B,D		0
Blood cis-1,2-Dichloroethene (ng/mL)	LBXV2C	ERATB	VOC	B,D		0
Blood 1,2-Dibromo-3-chloropropane(ng/mL)	LBXV2P	ERATB	VOC	B,D		0
Blood trans-1,2-Dichloroethene (ng/mL)	LBXV2T	ERATB	VOC	B,D		0
Blood 1,1,1-Trichloroethane (ng/mL)	LBXV3A	ERATB	VOC	B,D		0.17
Blood 1,3-Dichlorobenzene (ng/mL)	LBXV3B	ERATB	VOC	B,D		0
Blood 1,1,2-Trichloroethane (ng/mL)	LBXV4A	ERATB	VOC	B,D		0
Blood Tetrachloroethene (ng/mL)	LBXV4C	ERATB	VOC	B,D		16.53
Blood 1,1,2,2-Tetrachloroethane (ng/mL)	LBXV4T	ERATB	VOC	B,D		0.16
Blood Bromoform (pg/mL)	LBXVBF	ERATB	VOC	B,D		42.18
Blood Bromodichloromethane (pg/mL)	LBXVBM	ERATB	VOC	B,D		74.49*
Blood Benzene (ng/mL)	LBXVBZ	ERATB	VOC	B,D		56.89
Blood Chlorobenzene (ng/mL)	LBXVCB	ERATB	VOC	B,D		0
Blood Chloroform (pg/mL)	LBXVCF	ERATB	VOC	B,D		91.72*
Blood Dibromochloromethane (pg/mL)	LBXVCM	ERATB	VOC	B,D		47.47
Blood Carbon Tetrachloride (ng/mL)	LBXVCT	ERATB	VOC	B,D		0.58
Blood 1,4-Dichlorobenzene (ng/mL)	LBXVDB	ERATB	VOC	B,D		53.58
Blood Dibromomethane (ng/mL)	LBXVDM	ERATB	VOC	B,D		0.17
Blood 1,2-Dichloropropane (ng/mL)	LBXVDP	ERATB	VOC	B,D		0
Blood Ethylbenzene (ng/mL)	LBXVEB	ERATB	VOC	B,D		65.28*
Blood Hexachloroethane (ng/mL)	LBXVHE	ERATB	VOC	B,D		0
Blood Methylene Chloride (ng/mL)	LBXVMC	ERATB	VOC	B,D		0.66
Blood MTBE (pg/mL)	LBXVME	ERATB	VOC	B,D		81.4*
Blood Nitrobenezene (ng/mL)	LBXVNB	ERATB	VOC	B,D		0
Blood o-Xylene (ng/mL)	LBXVOX	ERATB	VOC	B,D		35.83

Blood Styrene (ng/mL)	LBXVST	ERATB	VOC	B,D	36.08
Blood Trichloroethene (ng/mL)	LBXVTC	ERATB	VOC	B,D	1.46
Blood Toluene (ng/mL)	LBXVTO	ERATB	VOC	B,D	94.62*
Blood m-/p-Xylene (ng/mL)	LBXVXY	ERATB	VOC	B,D	98.24*

[1] Analytes ending in -LA are lipid adjusted; Analytes beginning with CRA- are creatinine adjusted.

[2] Laboratory at the Center for Disease Control, National Center for Environmental Health, Division of Laboratory Sciences where the analyte data was collected: ITNB = Inorganic Toxicology and Nutrition Branch, OATB = Organic Analytical Toxicology Branch, TB = Toxicology Branch, ERATB = Emergency Response & Air Toxicants Branch.

[3] Subclass Key: BMT = Lead, cadmium, mercury; COT = Cotinine; DFP = Dioxins, furans, coplanar PCBs; cPCB = Coplanar PCBs; EPH = Environmental phenols; HM = Heavy metals; NPB = Non-dioxin-like PCBs; OCP = Organochlorine pesticides; OPD = Organophosphate Insecticides; PAH = Polyaromatic hydrocarbons; PBE = Polybrominated diphenyl ethers; PER = Perchlorate; PFC = Polyfluorinated compounds; PH = Phthalates; UAS = Total & speciated arsenics; UIO = Iodine; VOC = Volatile organic compounds. NOTE: Total PCBs (PCB) were cPCB and NPB groups combined.

[4] SUBPOP: Subpopulation of patients on which the particular analyte data was collected. See Table 1 for details.

[5] LLOD: Lower limit of detection. The limit below which the analyte was undetectable within the sample.

[6] Percent of subjects passing the LLOD for each pollutant. Values with astericks indicate that the pollutant was present in a sufficient percentage of subjects (60%) to warrant further analysis. Pollutants not passing this threshold were omitted from further analysis.

Supplementary Material, Table 2. Number, Min, Max, and Quartiles for Analytes Passing the Percent Detection Threshold.

ANALYTE NAME[1]	N*	MIN	0.25	0.50	0.75	MAX
Cadmium (ug/L)	3858	0.20	0.30	0.40	0.70	7.20
Lead (ug/dL)	4644	0.30	1.00	1.50	2.40	23.90
Mercury, total (ug/L)	4311	0.20	0.50	1.00	1.80	32.20
Cotinine (ng/mL)	3747	0.02	0.04	0.18	46.80	1639.00
PCB28 Lipid Adj (ng/g)	1299	0.80	3.50	4.97	6.80	147.00
PCB66 Lipid Adj (ng/g)	1307	0.27	0.98	1.38	2.10	40.10
PCB74 Lipid Adj (ng/g)	1322	0.55	2.46	4.72	10.80	180.00
PCB105 Lipid Adj (ng/g)	1282	0.21	0.70	1.17	2.36	76.82
PCB118 Lipid Adj (ng/g)	1314	0.70	3.16	5.61	12.40	354.00
PCB156 Lipid Adj (ng/g)	1206	0.20	1.64	4.22	8.50	367.00
PCB157 Lipid Adj (ng/g)	975	0.12	0.70	1.30	2.30	84.00
PCB167 Lipid Adj (ng/g)	885	0.10	0.78	1.40	2.60	50.90
1,2,3,7,8-pncdd Lipid Adj (pg/g)	813	1.10	4.30	6.30	8.90	36.20
1,2,3,6,7,8-hxcdd Lipid Adj (pg/g)	1133	1.40	14.10	27.00	45.00	206.00
1,2,3,4,6,7,8-hpcdd Lipid Adj (pg/g)	1276	3.60	17.15	28.70	50.45	456.00
1,2,3,4,6,7,8,9-ocdd Lipid Adj (pg/g)	1155	34.50	143.00	241.00	411.00	3280.00
2,3,4,7,8-pncdf Lipid Adj (pg/g)	969	1.30	3.90	5.70	8.60	38.80
1,2,3,4,7,8-hxcdf Lipid Adj (pg/g)	890	1.00	3.40	4.60	6.50	28.40
1,2,3,4,6,7,8-hxcdf Lipid Adj (pg/g)	1145	1.90	5.80	7.90	10.90	367.00
3,3',4,4',5,5'-hxcb Lipid Adj (pg/g)	915	2.50	9.90	16.70	28.50	196.00
3,3',4,4',5-pcnb Lipid Adj (pg/g)	1232	3.40	11.00	17.60	30.65	721.00
Urinary Benzophenone-3 (ng/mL)	1468	0.00	0.05	0.13	0.68	91.58
Urinary Bisphenol A (ng/mL)	1402	0.00	0.02	0.02	0.04	1.19
Urinary Triclosan (ng/mL)	1128	0.01	0.06	0.20	0.95	26.44
Barium, urine (ng/mL)	1496	0.00	0.01	0.01	0.02	0.89
Cadmium, urine (ng/mL)	1539	0.00	0.00	0.00	0.01	0.04
Cobalt, urine (ng/mL)	1550	0.00	0.00	0.00	0.00	1.44
Cesium, urine (ng/mL)	1624	0.01	0.03	0.04	0.06	5.81
Molybdenum, urine (ng/mL)	1623	0.02	0.26	0.38	0.55	3.70
Lead, urine (ng/mL)	1355	0.00	0.00	0.01	0.01	0.15
Thallium, urine (ng/mL)	1610	0.00	0.00	0.00	0.00	0.02
Tungsten, urine (ng/mL)	1261	0.00	0.00	0.00	0.00	0.03
Uranium, urine (ng/mL)	1056	0.00	0.00	0.00	0.00	0.01
PCB199 Lipid Adj (ng/g)	1214	0.20	1.56	4.80	10.70	298.00
PCB44 Lipid Adj (ng/g)	1314	0.33	1.31	2.01	3.00	85.40
PCB49 Lipid Adj (ng/g)	1300	0.19	0.84	1.33	1.90	54.50
PCB52 Lipid Adj (ng/g)	1321	0.38	1.70	2.70	4.10	133.00
PCB87 Lipid Adj (ng/g)	1101	0.17	0.70	1.05	1.52	39.00
PCB99 Lipid Adj (ng/g)	1312	0.49	2.36	4.00	7.25	304.00
PCB101 Lipid Adj (ng/g)	1277	0.20	1.10	1.73	2.81	79.30
PCB110 Lipid Adj (ng/g)	1293	0.16	0.76	1.24	2.00	59.20
PCB138 & 158 Lipid Adj (ng/g)	1321	1.30	7.30	16.76	36.30	773.00
PCB146 Lipid Adj (ng/g)	1310	0.18	1.03	2.60	5.85	86.75
PCB149 Lipid Adj (ng/g)	1253	0.11	0.41	0.63	0.99	23.90

PCB151 Lipid Adj (ng/g)	1048	0.07	0.21	0.34	0.52	8.20
PCB153 Lipid Adj (ng/g)	1321	1.05	9.10	22.50	49.30	986.00
PCB170 Lipid Adj (ng/g)	1307	0.36	2.45	7.40	15.30	299.00
PCB172 Lipid Adj (ng/g)	1013	0.12	0.73	1.44	2.50	26.30
PCB177 Lipid Adj (ng/g)	1175	0.12	0.84	1.90	3.80	51.87
PCB178 Lipid Adj (ng/g)	1132	0.10	0.76	1.70	3.30	29.76
PCB180 Lipid Adj (ng/g)	1318	0.50	6.20	19.84	43.37	627.00
PCB183 Lipid Adj (ng/g)	1233	0.20	0.93	2.00	4.05	50.74
PCB187 Lipid Adj (ng/g)	1306	0.27	1.90	5.49	12.01	158.00
PCB194 Lipid Adj (ng/g)	1128	0.26	1.98	5.51	11.27	149.00
PCB195 Lipid Adj (ng/g)	834	0.17	1.00	1.80	3.01	17.20
PCB196 & 203 Lipid Adj (ng/g)	1231	0.20	1.46	4.11	8.29	148.00
PCB206 Lipid Adj (ng/g)	1262	0.20	0.90	2.70	6.70	176.00
PCB209 Lipid Adj (ng/g)	1248	0.18	0.60	1.51	4.90	100.00
B-hexachlorocyclohexane Lipid Adj (ng/g)	1045	0.90	6.00	12.90	28.40	2850.00
Dieldrin Lipid Adj (ng/g)	1221	1.20	4.80	6.70	10.20	448.00
Hexachlorobenzene Lipid Adj (ng/g)	1384	4.30	11.80	15.70	20.40	174.00
Heptachlor Epoxide Lipid Adj (ng/g)	856	1.10	4.50	7.00	11.10	154.00
Oxychlordane Lipid Adj (ng/g)	1172	1.80	7.20	14.40	25.40	125.00
p,p'-DDE Lipid Adj (ng/g)	1378	7.60	126.00	292.00	775.00	22900.00
p,p'-DDT Lipid Adj (ng/g)	1096	0.90	4.20	6.15	10.75	1040.00
Trans-nonachlor Lipid Adj (ng/g)	1298	2.10	8.90	18.75	36.80	312.00
Dimethylphosphate(µg/L)	926	0.00	0.01	0.03	0.07	0.57
Diethylphosphate(µg/L)	925	0.00	0.02	0.04	0.07	1.89
Dimethylthiophosphate(µg/L)	1226	0.00	0.01	0.03	0.08	6.19
Diethylthiophosphate(µg/L)	980	0.00	0.00	0.01	0.01	0.34
1-napthol (ng/L)	1567	1.18	9.33	20.42	64.54	6545.68
2-napthol (ng/L)	1554	2.28	13.91	26.31	62.76	1208.79
3-fluorene (ng/L)	1494	0.04	0.43	0.76	2.32	34.69
2-fluorene (ng/L)	1515	0.15	1.33	2.09	4.94	80.31
3-phenanthrene (ng/L)	1456	0.05	0.58	0.91	1.66	81.67
1-phenanthrene (ng/L)	1507	0.13	0.86	1.36	2.16	41.95
2-phenanthrene (ng/L)	1489	0.04	0.34	0.53	0.88	22.69
1-pyrene (ng/L)	1499	0.06	0.39	0.71	1.37	47.41
9-fluorene (ng/L)	1507	0.16	1.46	2.34	4.09	217.63
4-phenanthrene (ng/L)	1329	0.03	0.14	0.25	0.43	6.80
2,2',4,4',5,5'-hexbrombiphenyl lipid adj	1201	0.30	1.60	2.80	5.50	225.00
2,4,4'-tribromodiphenyl ether lipid adj	1111	0.20	0.90	1.50	2.80	65.20
2,2',4,4'-tetrabromphenyl ether lipid ad	1386	1.80	10.20	20.65	43.30	2350.00
2,2',4,4',5-pentabromphenyl lipid adj	937	1.70	4.10	6.80	13.40	692.00
2,2',4,4',6-pentabromdphenyl lipid adj	1340	0.50	2.00	4.00	8.30	365.00
2,2',4,4',5,5'-hexabromphenyl lipid adj	1334	0.70	2.70	5.10	11.30	821.00
Perchlorate, urine (ng/mL)	1508	0.28	1.80	2.90	4.80	180.00
Perfluorohexane sulfonic acid	1491	0.30	1.10	1.80	3.10	82.00
Perfluorononanoic acid	1499	0.10	0.60	0.90	1.40	11.50
Perfluorooctanoic acid	1522	0.10	2.60	3.80	5.40	77.20
Perfluorooctane sulfonic acid	1526	0.60	13.50	20.40	29.70	435.00
Mono-2-ethyl-5-carboxypentyl phthalate	1574	0.01	0.15	0.26	0.49	18.59
Mono-n-butyl phthalate	1565	0.00	0.11	0.18	0.31	35.96
Mono-(3-carboxypropyl) phthalate	1543	0.00	0.02	0.02	0.04	4.26

Mono-ethyl phthalate	1575	0.02	0.78	1.89	5.18	307.82
Mono-(2-ethyl-5-hydroxyhexyl) phthalate	1570	0.00	0.09	0.17	0.32	15.79
Mono-(2-ethyl)-hexyl phthalate	1042	0.00	0.01	0.03	0.06	7.26
Mono-isobutyl phthalate	1522	0.00	0.02	0.04	0.06	1.10
Mono-(2-ethyl-5-oxohexl) phthalate	1557	0.01	0.06	0.11	0.21	10.28
Mono-benzyl phthalate	1568	0.00	0.06	0.11	0.20	4.26
Urinary Arsenobetaine (µg/L)	1171	0.00	0.01	0.03	0.09	9.27
Urinary total Arsenic (µg/L)	1603	0.01	0.05	0.08	0.15	9.88
Urinary Dimethylarsonic acid (µg/L)	1410	0.01	0.02	0.04	0.06	0.55
Mercury, urine (ng/mL)	1331	0.00	0.00	0.00	0.01	0.36
Iodine, urine (ng/mL)	1523	0.06	0.82	1.36	2.36	320.20
Blood Bromodichloromethane (pg/mL)	876	0.24	1.20	2.10	4.10	30.00
Blood Chloroform (pg/mL)	1008	2.20	6.45	11.00	20.00	3100.00
Blood Ethylbenzene (ng/mL)	769	0.02	0.03	0.04	0.06	0.49
Blood MTBE (pg/mL)	945	0.21	5.60	16.00	53.00	680.00
Blood Toluene (ng/mL)	1126	0.03	0.06	0.09	0.19	6.70
Blood m-/p-Xylene (ng/mL)	1175	0.03	0.09	0.13	0.19	2.00

[1] All analytes which are detectable in at least 60% of the subjects (i.e., at least 60% of subjects above the LLOD, see Supplementary Table 1).

***** The maximum sample available was used in the calculation of quartiles and median concentrations for each quartile. Analytes with missing values (MVs) include Perchlorate (11 MVs) and Urinary Benzophenone-3, Urinary Bisphenol A, Urinary Triclosan, and Dimethylthiophosphate (1 MV each).

Supplemental Material, Table 3. Adjusted Odds Ratios (ORs) and 95% CIs for ALT Elevation by Exposure Quartiles for 17 Pollutant Subclasses in Adult NHANES 2003-2004. ORs were adjusted for age, sex, race, poverty income ratio, and HOMA-IR.

Pollutant Subclass	Pollutants Screened / Analyzed[a]	Quartile				P_{trend}	$P_{trend\text{-}adj}$[†]
		1st	2nd	3rd	4th		
Lead, cadmium, mercury (blood)	4/3	57/520[b]	45/505	49/518	54/508	0.038	0.215
		Referent	0.9 (0.6-1.4)[c]	1.0 (0.7-1.5)	1.4 (1.0-2.0)		
Cotinine (serum)	1/1	54/527	49/515	58/504	43/504	0.736	0.834
		Referent	1.0 (0.6-1.4)	1.3 (0.9-1.9)	1.0 (0.6-1.7)		
Dioxins, furans, coplanar PCBs (serum)	29/17	13/138	12/136	17/135	13/126	0.003	0.033
		Referent	1.5 (0.6-3.9)	3.9 (1.6-9.5)	6.2 (1.6-24.7)		
Environmental phenols (urine)	4/3	19/145	22/162	11/165	17/171	0.152	0.644
		Referent	1.1 (0.5-2.4)	0.4 (0.1-1.3)	0.7 (0.3-1.6)		
Heavy metals (urine)	12/9	15/184	17/197	11/179	16/149	0.602	0.787
		Referent	0.8 (0.4-1.8)	0.5 (0.2-1.2)	0.9 (0.4-2.1)		
Non-dioxin-like PCBs (serum)	26/25	18/125	9/145	15/131	17/131	0.004	0.033
		Referent	0.6 (0.2-1.3)	1.7 (1.0-3.1)	2.7 (1.4-5.4)		
Organochlorine pesticides (serum)	13/8	15/136	15/140	21/155	12/156	0.597	0.787
		Referent	1.0 (0.6-1.7)	1.8 (0.7-4.8)	1.2 (0.3-4.4)		
Organophosphate Insecticides (urine)	6/4	25/162	12/159	13/159	19/151	0.382	0.787
		Referent	0.4 (0.2-0.9)	0.5 (0.2-1.0)	0.7 (0.4-1.3)		
Polyaromatic hydrocarbons (urine)	21/10	14/147	10/139	15/142	17/135	0.292	0.787
		Referent	0.8 (0.3-2.7)	1.1 (0.4-2.9)	1.7 (0.6-4.9)		
Polybrominated diphenyl ethers (serum)	11/6	20/169	19/149	18/149	13/147	0.316	0.787
		Referent	1.0 (0.5-1.8)	0.8 (0.3-1.9)	0.7 (0.3-1.5)		
Perchlorate (urine)	1/1	13/161	17/163	21/166	18/148	0.515	0.787
		Referent	1.1 (0.6-2.0)	1.3 (0.7-2.5)	1.3 (0.5-2.9)		
Perfluorinated compounds (serum)	12/4	18/189	13/169	12/167	15/169	0.572	0.787
		Referent	0.9 (0.3-2.4)	1.0 (0.4-2.6)	1.4 (0.4-4.6)		
Phthalates (urine)	13/9	23/177	17/158	13/150	19/170	0.661	0.803
		Referent	0.9 (0.3-2.3)	0.7 (0.3-1.7)	0.9 (0.5-1.6)		
Total & speciated arsenics (urine)	8/3	15/188	14/187	17/170	13/165	0.888	0.901
		Referent	0.8 (0.3-2.1)	1.1 (0.6-2.0)	0.8 (0.4-1.9)		
Total mercury (urine)	1/1	11/180	20/167	11/169	16/191	0.901	0.901
		Referent	2.0 (0.7-5.6)	1.0 (0.4-2.8)	1.3 (0.4-3.6)		
Iodine (urine)	1/1	18/158	16/160	18/180	16/147	0.421	0.787
		Referent	0.8 (0.4-1.5)	0.7 (0.4-1.2)	0.8 (0.4-1.5)		
Volatile organic compounds (blood)	33/6	10/108	16/97	13/111	14/117	0.569	0.787
		Referent	1.9 (0.8-4.4)	1.3 (0.6-2.8)	1.4 (0.7-2.9)		

[†] Additionally adjusted for multiple comparisons.
[a] In any given pollutant subclass, only chemicals present with at least a 60% detection rate were included in the analysis.

[b] Number of cases / total number.
[c] Adjusted odds ratios with 95% confidence intervals.

Detectable values of each pollutant were individually ranked, and the rank orders of the individual pollutants in each subclass were summed to arrive at the subclass value. All non-detectable values were ranked as one. The summary values were categorized by cutoff points of 25th, 50th, and 75th values of the sum of ranks.

Abbreviations: CI, confidence interval; PCB, polychlorinated biphenyl.

Supplementary Material, Table 4. Adjusted Odds Ratios (ORs) and 95% CIs for ALT Elevation by Exposure Quartiles for 17 Pollutant Subclasses in Adult NHANES 2003-2004. ORs were adjusted for age, sex, race, poverty income ratio, and BMI.

Pollutant Subclass	Pollutants Screened / Analyzed[a]	Quartile				P_{trend}	$P_{trend\text{-}adj}$[†]
		1st	2nd	3rd	4th		
Lead, cadmium, mercury (blood)	4/3	103/1061[b] Referent	100/1064 1.1 (0.8-1.6)[c]	104/1055 1.4 (1.0-1.9)	100/1058 1.7 (1.2-2.3)	<.001	0.006
Cotinine (serum)	1/1	108/1096 Referent	103/1039 1.0 (0.8-1.4)	109/1056 1.1 (0.8-1.6)	86/1049 0.9 (0.6-1.5)	0.821	0.948
Dioxins, furans, coplanar PCBs (serum)	29/17	31/279 Referent	25/282 1.4 (0.7-2.5)	28/281 2.6 (1.2-5.6)	23/277 4.9 (1.7-14.1)	0.004	0.033
Environmental phenols (urine)	4/3	30/329 Referent	40/326 1.6 (0.8-3.3)	24/333 0.8 (0.4-1.6)	33/351 1.2 (0.5-2.8)	0.875	0.948
Heavy metals (urine)	12/9	37/364 Referent	34/365 0.8 (0.4-1.5)	24/346 0.5 (0.4-0.8)	36/360 0.9 (0.5-1.4)	0.330	0.701
Non-dioxin-like PCBs (serum)	26/25	38/282 Referent	20/274 0.9 (0.4-1.7)	29/284 2.0 (1.0-3.7)	22/273 2.5 (0.9-7.0)	0.043	0.147
Organochlorine pesticides (serum)	13/8	35/317 Referent	30/309 0.9 (0.6-1.5)	38/311 1.4 (0.8-2.7)	23/309 1.1 (0.5-2.5)	0.498	0.871
Organophosphate Insecticides (urine)	6/4	43/327 Referent	24/330 0.5 (0.3-1.0)	25/324 0.6 (0.3-1.0)	35/340 0.9 (0.6-1.5)	0.755	0.948
Polyaromatic hydrocarbons (urine)	21/10	23/298 Referent	27/299 1.3 (0.5-2.9)	29/289 1.3 (0.7-2.3)	36/293 1.9 (1.0-3.6)	0.019	0.109
Polybrominated diphenyl ethers (serum)	11/6	39/318 Referent	41/318 0.9 (0.6-1.4)	27/315 0.6 (0.4-0.9)	26/320 0.6 (0.3-1.1)	0.042	0.147
Perchlorate (urine)	1/1	34/351 Referent	24/329 0.7 (0.4-1.1)	39/328 1.1 (0.7-1.7)	30/321 0.9 (0.4-1.9)	0.902	0.948
Perfluorinated compounds (serum)	12/4	30/353 Referent	36/352 1.4 (0.7-2.5)	31/351 1.5 (0.7-3.1)	34/361 1.8 (0.9-3.5)	0.078	0.221
Phthalates (urine)	13/9	38/364 Referent	36/351 0.9 (0.5-1.7)	37/331 1.0 (0.6-1.6)	30/323 0.8 (0.5-1.4)	0.512	0.871
Total & speciated arsenics (urine)	8/3	28/367 Referent	31/363 1.0 (0.5-1.8)	37/359 1.4 (0.9-2.3)	35/355 1.4 (0.7-2.6)	0.164	0.398
Total mercury (urine)	1/1	31/364 Referent	39/354 1.5 (1.0-2.3)	25/360 0.8 (0.5-1.2)	35/356 1.2 (0.7-1.9)	0.948	0.948
Iodine (urine)	1/1	36/342 Referent	28/328 0.7 (0.4-1.1)	30/340 0.7 (0.4-1.1)	32/332 0.9 (0.5-1.5)	0.744	0.948
Volatile organic compounds (blood)	33/6	25/236 Referent	33/238 1.4 (0.8-2.5)	32/232 1.4 (0.8-2.4)	23/232 1.0 (0.6-1.9)	0.862	0.948

[†] Additionally adjusted for multiple comparisons.
[a] In any given pollutant subclass, only chemicals present with at least a 60% detection rate were included in the analysis.
[b] Number of cases / total number.
[c] Adjusted odds ratios with 95% confidence intervals.

Detectable values of each pollutant were individually ranked, and the rank orders of the individual pollutants in each subclass were summed to arrive at the subclass value. All non-detectable values were ranked as one. The summary values were categorized by cutoff points of 25th, 50th, and 75th values of the sum of ranks.

Abbreviations: CI, confidence interval; PCB, polychlorinated biphenyl.

Supplementary Material, Table 5. Adjusted* Odds Ratios and 95% CIs for ALT Elevation by Exposure Quartile for the Polychlorinated Dibenzo-p-Dioxins (PCDDs) and Polychlorinated Dibenzofurans (PCDFs) in Adult NHANES 2003-2004.

Pollutant	Detection Rate (%)	Not Detectable	Detectable				P_{trend}	$P_{trend\text{-}adj}$ †
			1st	2nd	3rd	4th		
1,2,3,7,8-pncdd	62.3	--	3.40[a]	5.30	7.50	11.20	0.086	0.133
Lipid Adj (pg/g)		19/224	13/94[b]	12/90	7/73	11/88		
		Referent	1.8 (0.8-4.0)[c]	2.3 (0.9-6.4)	1.5 (0.5-5.0)	3.4 (0.8-13.6)		
1,2,3,6,7,8-hxcdd	86.9	--	9.50	19.30	35.50	60.40	0.856	0.856
Lipid Adj (pg/g)		11/74	13/132	12/126	15/125	10/111		
		Referent	0.5 (0.2-1.3)	0.5 (0.2-1.7)	0.9 (0.4-2.4)	0.8 (0.2-3.5)		
1,2,3,4,6,7,8-hpcdd	97.9	--	12.60	21.80	37.20	71.90	0.064	0.110
Lipid Adj (pg/g)		3/14	8/136	14/153	18/135	18/129		
		Referent	0.2 (0.1-0.7)	0.4 (0.1-1.2)	0.5 (0.2-1.3)	0.7 (0.3-1.4)		
1,2,3,4,6,7,8,9-ocdd	89.7	--	108.00	192.00	308.00	628.50	0.433	0.546
Lipid Adj (pg/g)		8/58	9/144	15/129	14/111	12/121		
		Referent	0.4 (0.2-0.9)	0.8 (0.2-2.8)	1.1 (0.3-3.5)	0.9 (0.2-3.9)		
2,3,4,7,8-pncdf	74.5	--	3.05	4.80	7.00	11.20	0.449	0.546
Lipid Adj (pg/g)		14/148	12/112	13/105	15/109	7/93		
		Referent	1.0 (0.4-2.8)	1.4 (0.4-4.5)	2.1 (0.5-8.3)	1.3 (0.3-5.5)		
1,2,3,4,7,8-hxcdf	68.5	--	2.80	4.00	5.40	8.10	0.793	0.843
Lipid Adj (pg/g)		17/183	15/105	11/96	12/93	6/89		
		Referent	1.4 (0.7-3.0)	1.5 (0.6-3.8)	1.9 (1.0-3.4)	0.8 (0.2-2.4)		
1,2,3,4,6,7,8-hpcdf	88.6	--	4.80	6.70	9.20	13.60	0.196	0.277
Lipid Adj (pg/g)		12/67	8/122	19/130	11/122	10/124		
		Referent	0.3 (0.1-0.9)	0.9 (0.4-2.4)	0.4 (0.2-1.2)	0.4 (0.2-1.1)		

* ORs were adjusted for age, sex, race, poverty income ratio, HOMA-IR, and BMI.
[a] Median concentration levels.
[b] Number of cases / total number.
[c] Adjusted odds ratios with 95% confidence intervals.
† Additionally adjusted for multiple comparisons.

Abbreviations:
CI; confidence interval

Dioxins and furans were measured in serum and are reported as lipid-adjusted values. For each pollutant, the reference group consisted of those individuals with values below the limit of detection for that pollutant, unless otherwise noted.

Supplementary Material, Statistical Methods. Details of the logistic regression models for investigating the association between elevated ALT levels and chemical exposure levels.

Pollutant exposure levels were scored using integer scores for each quartile, e.g. pollutant level p = 1 to 4 for the first through fourth quartiles. For the subclass models, exposure levels consisted of the cumulative rank scores (see 'Outcome Variables and Statistical Methods' section for details). The covariates HOMA-IR, PIR, and age were included in the logistic regression models as continuous covariates, while sex, race, and BMI were all included as categorical covariates. HOMA-IR had values ranging between 0.12 and 115.20, and PIR had possible values between 0 and 5. Categories for race were Mexican American, Other Hispanic, Non-Hispanic White, Non-Hispanic Black, and Other Race, while BMI was categorized as Underweight (< 18.5 kg/m^2), Normal weight (18.5-24.9 kg/m^2), Overweight (25.0-29.9 kg/m^2), Obesity Class 1 (30.0-34.9 kg/m^2), Obesity Class 2 (35.0-39.9 kg/m^2), and Extreme Obesity (>= 40.0 kg/m^2). For estimating the odds ratios for each pollutant quartile relative to the baseline level, the following logistic regression model was used to model the conditional probability of elevated ALT given age *i*, PIR score *j*, HOMA-IR score *k*, race *r*, gender *g*, and BMI *b*, and pollutant quartile *p*:

where P(Y=1 | age=*i*, PIR=*j*, HOMA-IR=*k*, race=*r*, gender=*g*, BMI=*b*, pollutant level=*p*) = is the conditional probability of elevated ALT given the values of the covariates, and logit(π) = log(π/(1- π)).

For obtaining trend statistics for each pollutant, the pollutant quartiles were treated as ordinal and the following model was used:

For the pollutant subclass Model 2, no adjustment was mode for BMI, resulting in the following model:

while for Model 3 no adjustment was made for HOMA-IR, resulting the following model: