

SUPPLEMENTAL MATERIAL

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Table S1. Geometric mean concentrations (ng/mL) and sample sizes for all metabolites by study visit and by year (20011-2017) in PROTECT and NHANES (2009-2016)

		PROTECT									NHANES				
Parent	Metabolite	By Prenatal Visit				By Year					By Year				
		Visits	N (sample)	GM	GSD	Year	N (sample)	%>LOD*	GM	GSD	Year	N (sample)	%>LOD	GM	GSD
DEHP	ΣDEHP	Overall	2013	30.1	2.7	Overall	2013	NA	30.1	2.7	Overall	1517	NA	27.4	3.0
		1	753	31.9	2.3	2011-2012	584	NA	40.5	2.3	2009-2012	775	NA	33.6	3.1
		2	717	33.4	2.2	2013-2014	683	NA	34.0	2.1	2013-2014	394	NA	23.9	3.0
		3	543	31.3	2.3	2015-2017	713	NA	25.5	2.2	2015-2016	348	NA	20.3	2.6
	MEHP	Overall	2024	2.7	2.6	Overall	2024	84.8	2.7	2.6	Overall	1517	72.4	1.7	3.0
		1	755	2.5	2.6	2011-2012	588	93.9	3.5	2.7	2009-2012	775	77.8	1.8	3.4
		2	722	2.9	2.6	2013-2014	688	87.3	2.6	2.4	2013-2014	394	65.0	1.6	2.8
		3	547	2.5	2.6	2015-2017	715	75.3	2.1	2.4	2015-2016	348	68.7	1.6	2.5
	MEHHP	Overall	2022	8.4	2.5	Overall	2022	99.6	8.4	2.5	Overall	1517	99.7	8.0	3.3
		1	757	8.4	2.5	2011-2012	588	100.0	10.6	2.5	2009-2012	775	99.9	10.0	3.4
		2	718	8.8	2.4	2013-2014	688	99.9	8.9	2.3	2013-2014	394	99.2	6.9	3.3
		3	547	7.9	2.5	2015-2017	713	98.9	6.5	2.4	2015-2016	348	100.0	6.0	2.8
	MEOHP	Overall	2023	7.2	2.4	Overall	2023	99.7	7.2	2.4	Overall	1517	99.5	5.5	3.2
		1	755	7.0	2.4	2011-2012	588	99.8	8.9	2.4	2009-2012	775	99.6	6.8	3.2
		2	719	7.5	2.3	2013-2014	688	99.7	7.6	2.2	2013-2014	394	99.2	4.7	3.2
		3	549	7.1	2.4	2015-2017	714	99.6	5.8	2.4	2015-2016	348	99.7	3.9	2.8
	MECPP	Overall	2026	15.5	2.2	overall	2026	100.0	15.5	2.2	overall	1517	99.9	13.3	3.0
		1	758	15.5	2.2	2011-2012	589	100.0	19.4	2.2	2009-2012	775	99.9	16.6	3.1
		2	720	15.7	2.2	2013-2014	689	100.0	16.4	2.1	2013-2014	394	99.7	11.6	3.0
		3	548	15.2	2.2	2015-2017	715	100.0	12.2	2.1	2015-2016	348	100.0	9.5	2.8
	BBzP	MBzP	Overall	2025	3.0	3.1	Overall	2025	95.5	3.0	3.1	Overall	1517	98.5	5.7
1			756	3.1	3.2	2011-2012	585	98.0	3.7	3.1	2009-2012	775	99.0	6.2	3.7
2			721	3.1	3.1	2013-2014	690	96.1	3.5	3.1	2013-2014	394	98.0	5.5	4.0
3			548	2.8	3.1	2015-2017	717	93.0	2.2	3.0	2015-2016	348	98.0	5.0	3.9
DNP	MCOP	Overall	2014	13.5	3.1	Overall	2014	100.0	13.5	3.1	Overall	1517	99.7	15.3	4.4
		1	754	13.8	3.2	2011-2012	584	100.0	15.4	3.0	2009-2012	775	99.9	15.7	4.3
		2	713	13.3	3.0	2013-2014	682	100.0	17.3	3.1	2013-2014	394	99.7	24.0	4.6
		3	547	13.4	3.2	2015-2017	715	100.0	9.8	3.1	2015-2016	348	99.4	8.6	3.8
	MNP	Overall	1201	1.0	2.8	Overall	1201	29.4	1.0	2.8	Overall	1517	45.2	1.2	3.4
		1	467	1.0	2.9	2011-2012	80	31.3	1.0	2.0	2009-2012	775	51.6	1.3	3.9
		2	417	1.0	2.8	2013-2014	386	41.0	1.3	2.8	2013-2014	394	48.0	1.5	3.4
		3	317	1.0	2.5	2015-2017	715	23.0	0.9	2.8	2015-2016	348	27.9	1.0	2.3
	MONP	Overall	314	1.9	2.8	Overall	314	89.8	1.9	2.8	Overall	348	92.8	2.3	3.4
		1	118	1.9	2.9	2011-2012	NA	NA	NA	NA	2009-2012	NA	NA	NA	NA
		2	108	2.0	2.9	2013-2014	5	100.0	3.3	5.1	2013-2014	NA	NA	NA	NA
		3	88	1.9	2.7	2015-2017	305	89.8	1.9	2.8	2015-2016	348	92.8	2.3	3.4
DDP	MCNP	Overall	2010	2.0	2.2	Overall	2010	98.7	2.0	2.2	Overall	1517	98.2	2.5	3.1
		1	750	2.1	2.3	2011-2012	583	99.5	2.2	2.3	2009-2012	775	98.8	2.6	3.0
		2	714	2.0	2.2	2013-2014	682	99.1	2.3	2.2	2013-2014	394	98.0	2.8	3.3
		3	546	2.0	2.2	2015-2017	712	97.6	1.7	2.1	2015-2016	348	97.1	1.8	3.1
DOP, DBP, others	MCP	Overall	2025	3.0	3.1	Overall	2017	91.1	1.7	2.8	Overall	1517	90.4	2.1	3.9
		1	756	3.1	3.2	2011-2012	585	98.3	2.3	2.8	2009-2012	775	97.5	2.8	3.8

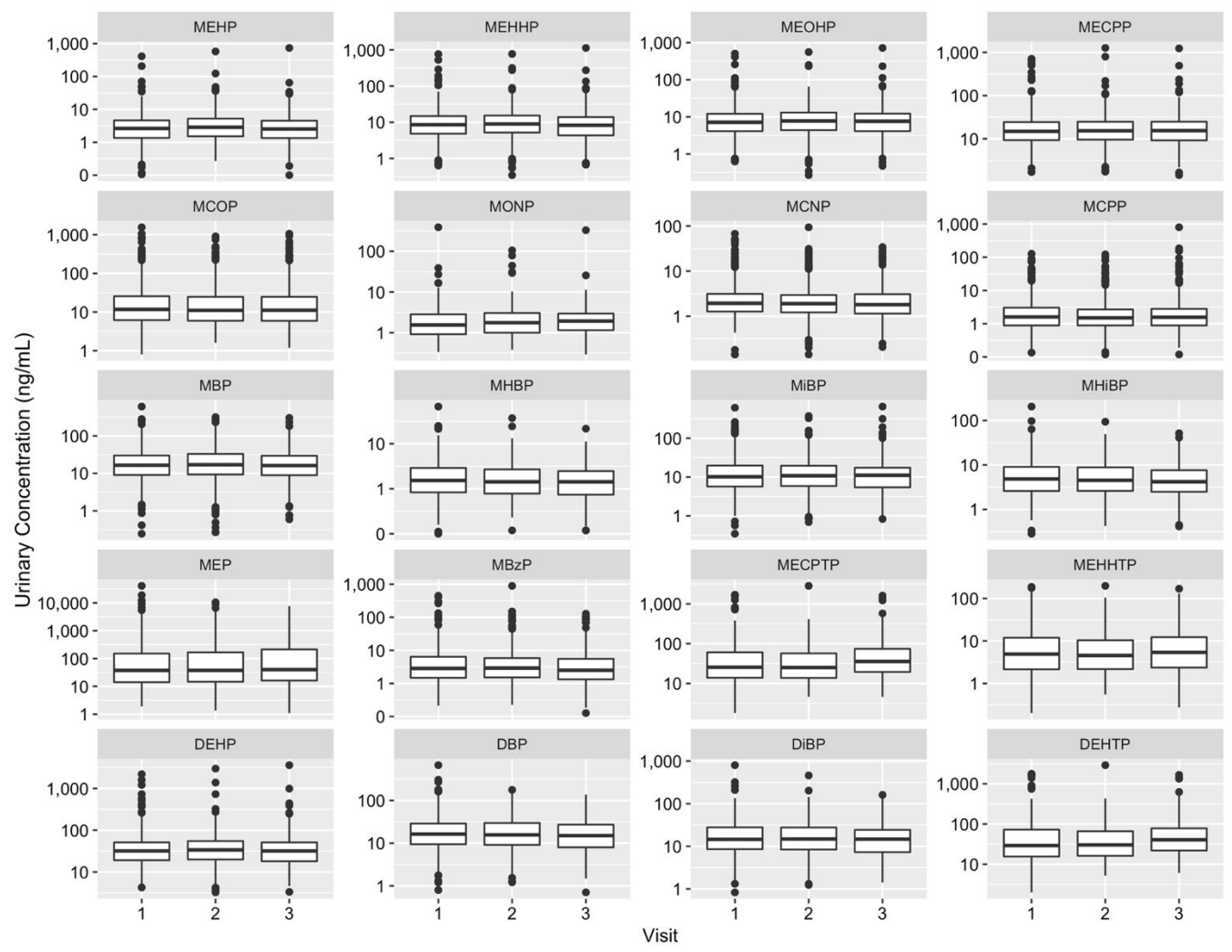
		2	721	3.1	3.1	2013-2014	684	95.7	2.0	2.7	2013-2014	394	87.8	2.2	4.2	
		3	548	2.8	3.1	2015-2017	716	80.6	1.2	2.6	2015-2016	348	77.3	1.1	3.0	
DEP	MEP	Overall	2017	52.9	5.2	Overall	2017	99.9	52.9	5.2	Overall	1517	99.9	52.4	4.7	
		1	752	50.5	5.1	2011-2012	578	100.0	79.4	5.2	2009-2012	775	100.0	61.9	5.0	
		2	721	53.1	5.2	2013-2014	693	99.9	53.7	5.4	2013-2014	394	100.0	43.8	4.5	
		3	544	56.0	5.3	2015-2017	713	99.9	37.3	4.6	2015-2016	348	99.4	44.3	4.1	
DBP	ΣDBP	Overall	1192	14.3	3.1	Overall	1192	NA	14.3	3.1	Overall	392	NA	11.2	3.2	
		1	462	16.6	2.6	2011-2012	75	NA	21.6	2.9	2009-2012	NA	NA	NA	NA	
		2	414	16.1	2.4	2013-2014	384	NA	18.4	2.5	2013-2014	392	NA	11.2	3.2	
		3	316	14.5	2.6	2015-2017	713	NA	14.2	2.5	2015-2016	NA	NA	NA	NA	
	MBP	Overall	2027	16.5	2.7	Overall	2027	99.4	16.5	2.7	Overall	1517	97.3	11.5	3.6	
		1	758	16.4	2.7	2011-2012	585	99.2	20.3	2.8	2009-2012	775	96.3	12.5	4.0	
		2	720	16.9	2.7	2013-2014	694	99.7	17.8	2.5	2013-2014	394	97.5	10.1	3.5	
		3	549	15.9	2.7	2015-2017	715	99.2	12.7	2.5	2015-2016	348	99.4	11.0	2.9	
	MHBP	Overall	1199	1.5	2.5	Overall	1199	83.8	1.5	2.5	Overall	392	72.7	0.9	2.6	
		1	466	1.6	2.6	2011-2012	80	86.3	1.7	3.0	2009-2012	NA	NA	NA	NA	
		2	416	1.5	2.4	2013-2014	386	87.2	1.6	2.5	2013-2014	392	72.7	0.9	2.6	
		3	317	1.4	2.5	2015-2017	713	81.7	1.4	2.4	2015-2016	NA	NA	NA	NA	
DIBP	ΣDiBP	Overall	1190	13.6	3.0	Overall	1190	NA	13.6	3.0	Overall	392	NA	12.2	3.1	
		1	461	15.6	2.6	2011-2012	73	NA	17.1	2.6	2009-2012	NA	NA	NA	NA	
		2	414	15.5	2.5	2013-2014	384	NA	18.1	2.4	2013-2014	392	NA	12.2	3.1	
		3	315	14.0	2.4	2015-2017	714	NA	13.6	2.5	2015-2016	NA	NA	NA	NA	
	MiBP	Overall	2026	10.7	2.6	Overall	2026	98.8	10.7	2.6	Overall	1517	98.7	8.8	3.1	
		1	756	10.6	2.6	2011-2012	585	100.0	10.5	2.6	2009-2012	775	99.4	8.2	3.3	
		2	722	10.8	2.6	2013-2014	695	99.4	12.3	2.5	2013-2014	394	97.2	9.0	3.1	
		3	548	10.5	2.6	2015-2017	714	97.4	9.5	2.6	2015-2016	348	98.9	10.2	2.8	
	MHiBP	Overall	1203	4.7	2.5	Overall	1203	97.9	4.7	2.5	Overall	392	94.6	3.2	3.1	
		1	468	4.9	2.5	2011-2012	79	100.0	5.5	2.7	2009-2012	NA	NA	NA	NA	
		2	417	4.7	2.5	2013-2014	388	99.2	5.5	2.4	2013-2014	392	94.6	3.2	3.1	
		3	318	4.3	2.5	2015-2017	716	97.1	4.2	2.5	2015-2016	NA	NA	NA	NA	
DINCH	MHiNCH	Overall	1698	0.5	2.2	Overall	1698	34.8	0.5	2.2	Overall	1102	40.1	0.5	2.5	
		1	644	0.4	2.2	2011-2012	260	29.9	0.4	1.8	2009-2012	360	21.7	0.4	1.9	
		2	604	0.4	2.1	2013-2014	693	25.8	0.4	1.9	2013-2014	394	31.5	0.4	2.0	
		3	450	0.5	2.2	2015-2017	715	45.3	0.5	2.5	2015-2016	348	69.0	0.9	3.1	
	MCOCH	Overall	1204	0.5	1.9	Overall	1204	17.5	0.5	1.9	Overall	348	60.1	0.7	2.4	
		1	469	0.5	1.9	2011-2012	80	7.5	<LOD	1.6	2009-2012	NA	NA	NA	NA	
		2	418	0.5	1.9	2013-2014	389	7.7	<LOD	1.6	2013-2014	NA	NA	NA	NA	
		3	317	0.5	2.0	2015-2017	715	23.8	0.5	2.1	2015-2016	348	60.1	0.7	2.4	
DEHTP	ΣDEHTP	Overall	314	34.1	3.9	Overall	314	NA	34.1	3.9	Overall	348	NA	30.2	4.8	
		1	118	37.7	3.8	2011-2012	NA	NA	NA	NA	2009-2012	NA	NA	NA	NA	
		2	108	34.2	3.0	2013-2014	5	NA	14.1	4.2	2013-2014	NA	NA	NA	NA	
		3	88	45.8	3.4	2015-2017	305	NA	39.1	3.4	2015-2016	348	NA	30.2	4.8	
	MECPTP	Overall	314	33.7	3.5	Overall	314	100.0	33.7	3.5	Overall	348	100.0	24.3	5.0	
		1	118	32.7	3.9	2011-2012	NA	NA	NA	NA	2009-2012	NA	NA	NA	NA	
		2	108	29.9	3.0	2013-2014	5	100.0	13.3	4.3	2013-2014	NA	NA	NA	NA	
		3	88	40.4	3.5	2015-2017	305	100.0	34.1	3.5	2015-2016	348	100.0	24.3	5.0	
	MEHHTP	Overall	314	5.3	3.6	Overall	314	96.5	5.3	3.6	Overall	348	97.4	5.9	4.6	
		1	118	5.5	3.8	2011-2012	NA	NA	NA	NA	2009-2012	NA	NA	NA	NA	
			2	108	4.8	3.1	2013-2014	5	83.3	1.2	5.2	2013-2014	NA	NA	NA	NA

	3	88	5.7	3.9	2015-2017	305	97.0	5.5	3.5	2015-2016	348	97.4	5.9	4.6
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Abbreviations: NHANES, National Health and Nutrition Examination Survey; PROTECT, Puerto Rico Testsite for Environmental Contamination Threats; DDP, Diisodecyl phthalate; DOP, di-n-octyl phthalate; GM, geometric mean; GSD, geometric standard deviation; NA, not available.

*LODs (ranges indicate changes in LOD by batch): MEHP: 0.5-0.8; MEHHP: 0.2-0.4; MEOHP: 0.5; MECPP: 0.2-0.4; MBzP: 0.4; MCOP: 0.2-0.3; MNP:0.9; MONP: 0.4; MCNP: 0.2; MCPP: 0.2-0.4; MEP: 0.6-1.2; MBP: 0.4; MHBP: 0.4; MiBP: 0.2-0.8; MHiBP: 0.4; MHINCH: 0.4; MCOCH: 0.5; MECPTP: 0.2; MEHHTP: 0.4.

Figure S1. SG-corrected phthalate and phthalate replacement metabolite concentrations by prenatal study visit (n=994).



Note: MBzP and Σ DBP concentrations were significantly different by study visit ($p < 0.05$).

Table S2. Intraclass correlation coefficients (ICCs) for SG-corrected log-transformed urinary phthalate and phthalate replacement metabolite concentrations across study visits during pregnancy.

Parent	Metabolite	N (participants)	N (samples)	ICC	Lower 95% CI	Upper 95% CI
	Σ DEHP	937	2013	0.30	0.25	0.36
DEHP	MEHP	940	2024	0.34	0.29	0.39
	MEHHP	939	2022	0.28	0.23	0.34
	MEOHP	938	2023	0.29	0.24	0.34
	MECPP	939	2026	0.34	0.29	0.39
	BBzP	MBzP	941	2025	0.49	0.45
DNP	MCOP	938	2014	0.30	0.25	0.36
	MONP	150	314	0.18	0.08	0.36
DDP	MCNP	937	2010	0.16	0.11	0.22
DOP, DBP, others	MCPP	938	2017	0.30	0.24	0.35
MEP	MEP	939	2017	0.46	0.42	0.51
DBP	Σ DBP	632	1192	0.42	0.35	0.49
	MBP	942	2027	0.39	0.34	0.44
	MHBP	632	1199	0.44	0.37	0.51
	Σ DiBP	628	1190	0.56	0.50	0.62
	DiBP	MiBP	938	2026	0.49	0.45
DEHTP	MHiBP	635	1203	0.57	0.51	0.62
	Σ DEHTP	150	314	0.22	0.11	0.40
	MECPTP	150	314	0.26	0.14	0.43
	MEHHTP	150	314	0.26	0.14	0.44

Abbreviations: ICC, intraclass correlation coefficients; CI, confidence interval.

Table S3. Odds of detection¹ (<LOD vs >LOD) for urinary MNP and DINCH metabolites according to maternal characteristics.

Variables ²	MNP				MCOCH				MHINCH			
	n	OR	95% CI	<i>p-value</i>	n	OR	95% CI	<i>p-value</i>	n	OR	95% CI	<i>p-value</i>
Maternal age	1 196	1.05	(0.87,1.28)	0.61	1 199	1.24	(0.96,1.6)	0.10	1 692	0.95	(0.81,1.12)	0.54
Maternal education	1 166	1.35	(1.01,1.81)	0.04	1 169	1.38	(0.92,2.07)	0.12	1 645	1.00	(0.81,1.25)	0.97
Marital status	1 168	1.24	(0.82,1.88)	0.31	1 171	1.49	(0.85,2.61)	0.17	1 647	1.19	(0.87,1.63)	0.28
Employment status	1 159	0.84	(0.6,1.17)	0.29	1 162	1.14	(0.73,1.77)	0.57	1 635	1.11	(0.85,1.44)	0.43
Income status	1 001	1.17	(0.95,1.45)	0.15	1 004	1.04	(0.78,1.38)	0.79	1 386	0.90	(0.76,1.08)	0.26
Pre-pregnancy BMI	1 124	1.04	(0.84,1.3)	0.70	1 127	1.45	(1.1,1.91)	0.01	1 598	1.17	(0.99,1.39)	0.06

¹ Estimated from generalized linear mixed effects models with logistic link function; ² Reference groups for age, employment, marital and income status and pre-pregnancy BMI are <25 years, unemployed, <high school education, single, income <\$20,000, and ≤25 kg/m², respectively. Abbreviations: OR, odds ratio; CI, confidence interval.

Table S4. Odds of detection¹ of urinary MNP and DINCH metabolites according to household and personal care product use.

Product ²	MNP				MCOCH				MHINCH			
	n	OR	95% CI	p-value	n	OR	95% CI	p-value	n	OR	95% CI	p-value
Cleaning and laundry products												
Liquid soap	907	0.96	(0.58,1.59)	0.88	910	1.11	(0.56,2.18)	0.77	1334	1.09	(0.74,1.59)	0.67
Bar soap	905	1.17	(0.64,2.14)	0.60	908	1.67	(0.65-4.32)	0.29	1332	1.11	(0.70,1.77)	0.65
Detergent	907	0.93	(0.68,1.27)	0.64	910	0.82	(0.56,1.209)	0.31	1334	0.92	(0.72,1.18)	0.52
Fabric Softener	907	0.88	(0.65,1.20)	0.42	910	1.20	(0.82-1.75)	0.34	1334	0.95	(0.74,1.21)	0.66
Cleaner	907	0.84	(0.62,1.14)	0.26	910	1.09	(0.74-1.60)	0.67	1334	1.18	(0.92,1.51)	0.19
Personal care products												
Lotion	905	1.02	(0.70,1.47)	0.93	908	0.78	(0.49-1.26)	0.31	1331	0.87	(0.65,1.17)	0.37
Shaving cream	907	0.54	(0.30,0.98)	0.04	910	1.13	(0.59,2.16)	0.72	1334	1.02	(0.65,1.60)	0.92
Perfume	906	0.97	(0.62,1.50)	0.88	909	0.58	(0.32,1.03)	0.06	1333	0.94	(0.67,1.34)	0.74
Cosmetics	906	1.30	(0.90,1.89)	0.16	909	1.32	(0.83,2.10)	0.24	1333	0.91	(0.68,1.21)	0.50
Hairspray	907	1.20	(0.86,1.69)	0.29	910	1.24	(0.80,1.92)	0.34	1333	0.92	(0.70,1.21)	0.53
Shampoo	906	0.80	(0.57,1.12)	0.20	909	1.53	(1.00,2.34)	0.049	1333	1.01	(0.77,1.33)	0.93
Conditioner	906	0.81	(0.59,1.13)	0.22	909	1.66	(1.09,2.52)	0.02	1333	1.00	(0.76,1.30)	0.98
Other hair products	363	0.77	(0.42,1.41)	0.41	365	0.02	(0.007,0.09)	<0.001	513	0.45	(0.20,0.99)	0.08
Nail polish	906	0.78	(0.55,1.11)	0.17	909	0.95	(0.62,1.45)	0.81	1333	1.01	(0.77,1.34)	0.92

¹ Estimated from generalized linear mixed effects models with logistic link function; ² Reference groups are reports of no use of each consumer product. Other household products were not assessed due to small samples in some cells.

Abbreviations: OR, odds ratio; CI, confidence interval.

Table S5. Odds of detection¹ of urinary MNP and DINCH metabolites according to food and water consumption.

Variables ²	MNP				MCOCH				MHINCH			
	n	OR	95% CI	p-value	n	OR	95% CI	p-value	n	OR	95% CI	p-value
Dairy products												
Milk	1 059	1.12	(0.75,1.68)	0.57	1 062	0.94	(0.59,1.50)	0.80	1 487	0.64	(0.46,0.87)	0.005
Cheese	1 059	1.15	(0.77,1.73)	0.49	1 062	1.19	(0.72,1.96)	0.51	1 487	0.80	(0.57,1.12)	0.19
Ice cream	1 059	1.31	(0.97,1.78)	0.08	1 062	0.77	(0.55,1.10)	0.15	1 487	0.94	(0.74,1.20)	0.63
Meat												
Meat (beef, veal, lamb, pork)	1 059	0.95	(0.71,1.27)	0.75	1 062	0.99	(0.71,1.39)	0.96	1 487	0.98	(0.773,1.24)	0.86
Chicken	1 059	1.07	(0.75,1.53)	0.70	1 062	1.15	(0.77,1.73)	0.50	1 487	0.92	(0.70,1.21)	0.55
Fish	1 059	0.83	(0.57,1.20)	0.32	1 062	1.27	(0.83,1.94)	0.27	1 487	0.82	(0.61,1.10)	0.18
Water characteristic												
Drinking water source (AAA vs bottled)	1 107	0.73	(0.53,1.018)	0.06	1 110	2.01	(1.29,3.15)	0.002	1 575	1.34	(1.03,1.75)	0.03
Store in cistern (no vs yes)	1 133	0.87	(0.60,1.27)	0.47	1 136	0.88	(0.53,1.47)	0.63	1 609	0.74	(0.56,0.98)	0.04
Treat drinking water (no vs yes) ³	595	1.51	(0.91,2.52)	0.11	596	0.76	(0.33,1.73)	0.51	894	0.87	(0.60,1.27)	0.47

¹ Estimated from generalized linear mixed effects models with logistic link function; ² Reference groups are reports of no consumption of each food item. The reference group for drinking and cooking water source is AAA, and a no response for the other water use characteristics. ³ Among women who reported AAA as primary drinking water source. Abbreviations: OR, odds ratio; CI, confidence interval.