Preplanned Studies

Exposure to Bisphenolic Analogues in the Sixth Total Diet Study — China, 2016–2019

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Summary

What is already known about this topic?

Bisphenol A (BPA) and other bisphenolic compounds (BPs) are proved to pose potential endocrine disrupting properties. The primary source of BP exposure is the diet. European Food Safety Authority (EFSA) established a temporary tolerable daily intake (t-TDI) of BPA 4 μg/kg body weight per day.

What is added by this report?

BPs were detected in composite food samples from the Sixth China Total Diet Study (TDS) at percentages of 27.1%–78.5%. The estimated dietary exposure of BPA and bisphenol S (BPS) for an average adult were 18.1 ng/kg body weight per day and 22.2 ng/kg body weight per day, respectively. The main dietary contributors for BPs were cereals, water and beverage, meat as well as vegetables.

What are the implications for public health practices?

BP dietary intake poses low risks on the Chinese general population based on the t-TDI set by EFSA. BPS presented a higher exposure level than BPA, which highlights the need to strengthen the surveillance of BP alternatives in foodstuffs.

Bisphenol A (BPA) is used in the synthesis of commercial plastics, including polycarbonates and epoxy resins, which are incorporated into a wide variety of consumer goods. Exposure to BPA was suspected to result in a variety of toxicities in the neurological, reproductive, metabolic, and immune system (*1*). Considering these potential undesirable effects, European Food Safety Authority (EFSA) established a temporary tolerable daily intake (t-TDI) of 4 μg/kg body weight per day (*2*).

Abiding by the regulations on the production and restricted use of BPA in European Union, United States, China, and other countries, BPA in commercial products was gradually replaced by its analogues, such as bisphenol S (BPS), bisphenol F (BPF), bisphenol B (BPB), and bisphenol AF (BPAF). After being put into use, these bisphenolic compounds (BPs) were released into the environment and entered the food chain. A variety of foods (cereals, fruits, meats etc.) were found to contain BPS and other analogues. Studies have shown that the genotoxicity and estrogenic activity of these alternatives are like that of BPA (*3*–*4*).

The primary source of exposure to BPA for most people is through the diet from contaminated foodstuffs (*5*). Dietary exposure of BPA from the Canadian Total Diet Study (TDS) was evaluated in view of BPs in composite food samples (*6*). In China, BPA from the Fourth China TDS (2007) samples as well as BPA and several analogues from the Fifth China TDS (2010–2012) were analyzed and the estimated daily intakes (EDI) of these BPs were safe for general people (*7*–*8*). However, in past decades, China's sustained development and progress have affected the lives of every resident. Under this circumstance, food consumption and contamination levels might have changed remarkably since China's restriction of BPA in baby products and food contact materials implemented since 2011. The purpose of this study was to evaluate the Chinese daily exposure to BPs from the Sixth TDS (2016–2019) (*9*).

Levels of BPs in the Sixth China TDS were provided in Supplementary Tables S1–S4 (available in https://weekly.chinacdc.cn/) and summarized in Table 1, where BPA was detected in 216 out of total 288 samples, with a concentration range of non-detected value (ND) to 20.0 μg/kg, among which the highest level occurred in cereals from Jiangsu Province. The mean concentrations of BPA from food categories ranged from 0.129 μg/kg (milk)–1.02 μg/kg (meat). BPS presented a rate of detection of 78.5%, accounting for 226 samples. The maximum level 67.1 μg/kg was attributed to a sample of meats from Fujian Province. While the second largest value is 16.6 μg/kg from a meat sample in Henan Province. BPF and BPAF were found in 8.33% and 27.1% of samples, with the maximum concentrations of 1.06 μg/kg and 1.75 μg/kg, respectively.

The EDIs of BPA, BPS, BPF, and BPAF for an

TABLE 1. Occurrence of BPA and its analogues in different composite Total Diet Study samples.

Category	Parameter	BPA	BPS	BPF	BPAF
Cereals	Mean (μg/kg)	0.466	0.545	0.007	0.012
	Medium (μg/kg)	0.256	0.128	ND	ND
	Range (μg/kg)	ND to 1.44	ND to 6.40	ND to 0.169	ND to 0.129
	Detective rate (%)	91.7	83.3	4.2	29.2
Legumes and nuts	Mean (μg/kg)	0.484	0.984	0.146	ND
	Medium (μg/kg)	0.255	0.707	ND	ND
	Range (μg/kg)	ND to 3.39	ND to 4.23	ND to1.06	ND
	Detective rate (%)	87.5	91.7	37.5	0
Potatoes	Mean (μg/kg)	0.340	0.163	0.008	0.006
	Medium (μg/kg)	0.271	0.147	ND	ND
	Range (μg/kg)	ND to 1.35	ND to 0.648	ND to 0.186	ND to 0.029
	Detective rate (%)	95.8	91.7	4.2	29.2
Meats	Mean (μg/kg)	1.024	5.827	0.106	0.026
	Medium (μg/kg)	0.476	2.010	ND	ND
	Range (μg/kg)	ND to 5.82	ND to 67.1	ND to 0.279	ND to 0.530
	Detective rate (%)	95.8	91.7	20.8	25
Eggs	Mean (μg/kg)	0.180	0.130	ND	0.021
	Medium (μg/kg)	0.169	0.042	ND	0.013
	Range (μg/kg)	ND to 0.544	ND to 0.636	ND	ND to 0.061
	Detective rate (%)	54.2	87.5	0	50
Aquatic foods	Mean (μg/kg)	0.927	1.25	0.015	0.125
	Medium (μg/kg)	0.689	0.621	ND	0.024
	Range (μg/kg)	0.199 to 3.31	ND to 6.34	ND to 0.192	ND to 1.75
	Detective rate (%)	100	95.8	8.3	79.2
Milk	Mean (μg/kg)	0.129	0.022	ND	0.002
	Medium (μg/kg)	ND	0.008	ND	ND
	Range (μg/kg)	ND to <0.385	ND to 0.148	ND	ND to 0.026
	Detective rate (%)	41.7	29.2	0	12.5
Vegetables	Mean (μg/kg)	0.347	0.343	0.015	0.010
	Medium (μg/kg)	0.293	0.127	ND	ND
	Range (μg/kg)	ND to 1.09	0.020 to 1.81	ND to 0.190	ND to 0.041
	Detective rate (%)	95.8	100	8.3	37.5
Fruits	Mean (μg/kg)	1.68	0.315	0.032	0.023
	Medium (μg/kg)	0.418	0.111	ND	ND
	Range (μg/kg)	ND to 20.0	0.026 to 1.71	ND to 0.449	ND to 0.175
	Detective rate (%)	91.7	100	12.5	41.7
Sugar	Mean (μg/kg)	0.909	0.034	0.011	0.006
	Medium (μg/kg)	0.602	0.021	ND	ND
	Range (μg/kg)	0.197 to 3.26	ND to 0.114	ND to 0.260	ND to 0.043
	Detective rate (%)	91.7	70.8	4.2	20.8
Beverages and water	Mean (μg/kg)	0.234	0.058	ND	ND
	Medium (μg/kg)	ND	0.013	ND	ND
	Range (μg/kg)	ND to 1.57	ND to 0.612	ND	ND
	Detective rate (%)	20.8	50.0	0	0
Alcoholic beverages	Mean (μg/kg)	0.161	0.081	ND	ND
	Medium (μg/kg)	ND	0.012	ND	ND
	Range (μg/kg)	ND to 0.610	ND to 1.54	ND	ND
	Detective rate (%)	37.5	50	0	0
Total	Mean (μg/kg)	0.546	1.17	0.023	0.019
	Medium (μg/kg)	0.251	0.055	ND	ND
	Detective rate (%)	75.3	78.5	8.33	27.1

Abbreviations: BPA=bisphenol A; BPS=bisphenol S; BPF=bisphenol F; BPAF=bisphenol AF; LOD=limits of detection; ND=non-detected value.

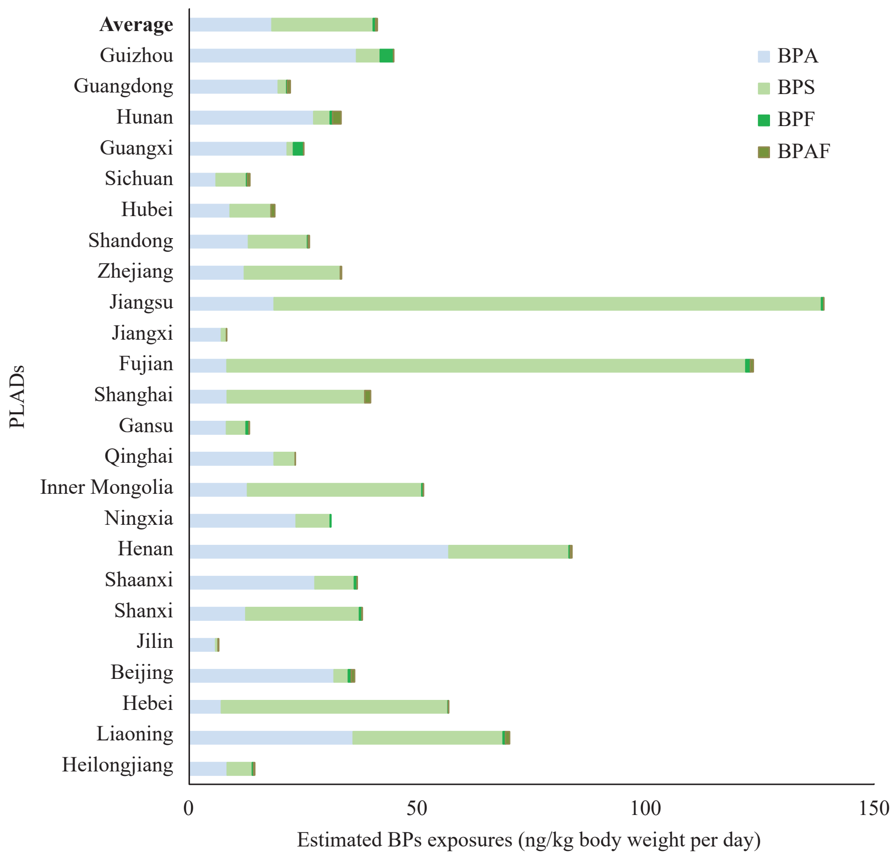

FIGURE 1. EDI of BPA, BPS, BPF, and BPAF among sampling PLADs from the Sixth TDS.
Abbreviations: BPs=bisphenolic compounds; EDI=estimated daily intakes; BPA=bisphenol A; BPS=bisphenol S; BPF=bisphenol F; BPAF=bisphenol AF; PLADs=provincial-level administrative divisions; TDS=Total Diet Study.

average male adult are given in Figure 1. For BPA, the highest exposure was found in Henan (56.9 ng/kg body weight per day), while the lowest was found in Jilin (5.74 ng/kg body weight per day). Mean exposure to BPA was estimated to be 18.1 ng/kg body weight per day, significantly below the t-TDI (4 μg/kg body weight per day) recommended by the EFSA (*2*). The EDI of BPS in the Sixth TDS for an average Chinese male adult was 22.2 ng/kg body weight per day. Jiangsu (120 ng/kg body weight per day) and Fujian (114 ng/kg body weight per day) posed the two highest exposures in this TDS; while the exposure in Jilin residents (0.559 ng/kg body weight per day) was the lowest. BPF and BPAF presented dietary exposures of 0.485 ng/kg body weight per day and 0.384 ng/kg body weight per day, respectively.

The contributions of different food categories to total EDI of BPs are shown in Figure 2. The main dietary contributors for BPA were cereals (40.3%), water and beverage (17.4%) as well as vegetables (13.7%). As for BPS, the dominant contribution food groups were cereals (31.4%), followed by meats (25.4%), legumes (11.7%), vegetables (11.7%) and water and beverages (8.76%). Legumes (41.2%), meats (20.7%), and fruits (11.7%) were the top three contributors of BPF. Exposure to BPAF was mainly from cereals (22.6%), aquatic foods (21.5%) and vegetables (21.2%).

DISCUSSION

In the Sixth China TDS, BPS posed a comparable rate of detection as BPA, demonstrating the wide use of BPS. Compared to BPA and BPS, BPF and BPAF appeared to possess evidently lower rates of detection and detection levels. Similar trends were found in the Fifth China TDS (*8*) and several other reports (*10–11*).

Considering the similar endocrine disrupting properties and other toxicological effects of BPs, the exposure levels of BPA, BPS, BPF, and BPAF were summed up to assess the risks through dietary intake. The combined exposure levels (6.45–139 ng/kg body

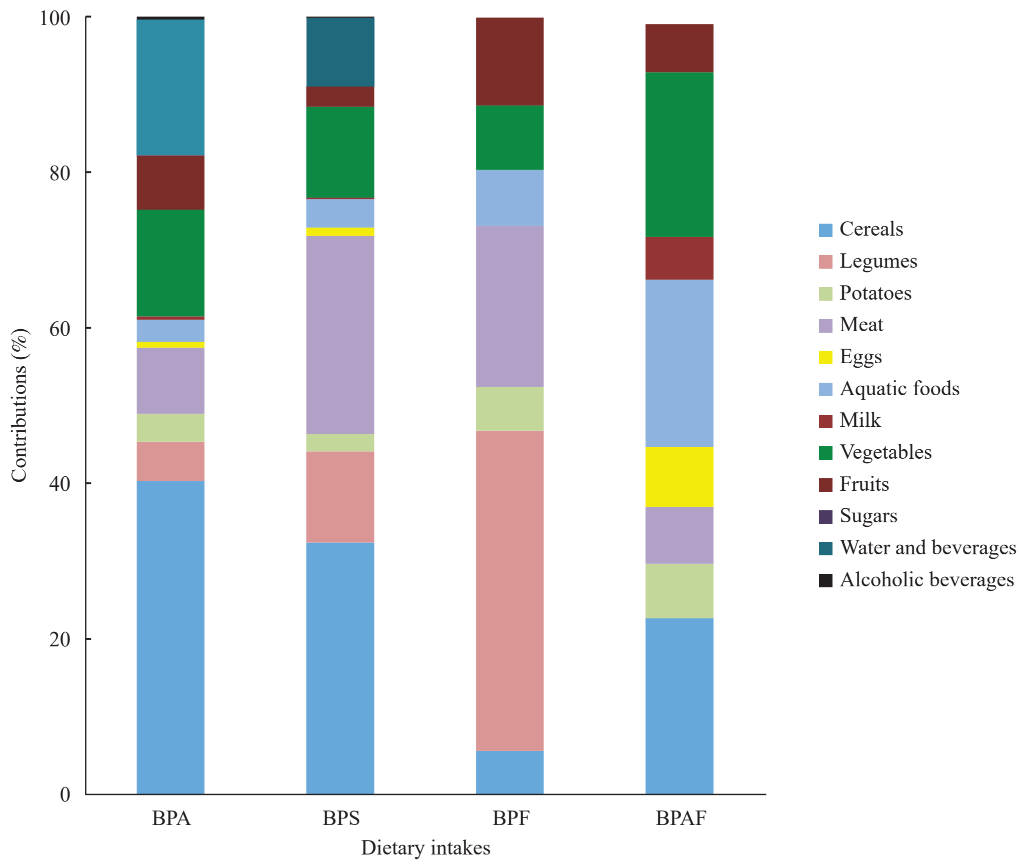

FIGURE 2. Contribution (% of daily intake) of the food categories to dietary BP intakes for the general Chinese population.
Abbreviation: BP=bisphenolic compound; BPA=bisphenol A; BPS=bisphenol S; BPF=bisphenol F; BPAF=bisphenol AF.

weight per day, Figure 1) were far below the t-TDI of BPA set by EFSA, which implied that the exposure to BPs for Chinese adults was safe.

BPs were concerning in the past three China TDSs (Supplementary Table S5, available in https://weekly.chinacdc.cn/). The BPA exposures in the Fourth and Fifth TDS were 43.0 ng/kg body weight per day (*7* and 217 ng/kg body weight per day (*8*), respectively. The increase of BPA exposure might be attributed to the feverish growth of China's BPA consumption from 2000 to 2014. The exposure to BPA in this study was significantly less than that in the Fifth TDS, which may be related to the measures and restrictions of BPA use in China. The exposures to BPS, BPF, and BPAF in the Sixth TDS were also lower than that in the Fifth one.

The most remarkable change was that the exposure to BPS exceeded BPA and became the most dominant BP in the Sixth TDS. In Fujian and Jiangsu, the only two provincial-level administrative divisions (PLADs) where BPs intakes were higher than 100 ng/kg body weight per day, BPS contributed more than 80% of the total BP exposure due to the high levels of BPS in meat from Fujian and cereals from Jiangsu.

It is noteworthy that Jilin implemented the "Restriction on Plastic Bags" from January 1, 2015, stipulating that the production and sale of non-degradable plastic shopping bags and plastic tableware were prohibited throughout the province. It has become China's first PLAD to fully ban "plastics". The EDIs of BPA and BPS in Jilin in this study were 5.74 ng/kg body weight per day and 0.559 ng/kg body weight per day, respectively, ranking lowest among the 24 PLADs. These values were lower by more than an order of magnitude than the results in the Fifth TDS (300 ng/kg body weight per day for BPA and 11.7 ng/kg body weight per day for BPS, respectively), indicating that the implementation of the restrictions affected the reduction of BPs contaminants.

The total dietary exposure to BPA in the Sixth China TDS (18.13 ng/kg body weight per day) was lower than that in France (42.4 ng/kg body weight per day) (*12*), Canada (52–81 ng/kg body weight per day) (*6*), the United States (44.6 ng/kg body weight per day) (*11*), and the EFSA (116–159 ng/kg body weight per day) (*2*). However, it was higher than that of a recent survey in United States (6.0 ng/kg body weight per day) (*13*). The diversity in food consumption habits may be a potential reason for the relatively high BPA exposure to these Western countries.

This study has several limitations. Only composite samples were analyzed for the dietary intake assessment of population in a given region, which could reveal realistic information by virtue of appropriate selection of the composite sample size and retesting of select individual samples. As for the samples with extremely high levels of contamination, the original individual samples can be assessed instead. The estimated BPs intake was based on a standard Chinese male adult (18–45 years). There was a lack of the dietary exposure data of 0–18 years-old people in this study. Furthermore, young-aged people and pregnant women are prone to be vulnerable to the endocrine disrupting compounds. The chlorinated derivatives of BPA and BPS reported higher estrogenic activity and other potential toxicities. It is necessary to continuously monitor the dietary exposure of the various BPs, including the chlorinated derivatives.

This study investigated the contamination of BPs in composite food samples from the Sixth China TDS during 2016–2019. BPA and BPS were detected in more than 75% of the food samples. Dietary intakes of BPs for Chinese adults were below the t-TDI, and the major contribution was from cereals, water and beverages, meat, and vegetables. The exposure of BPS in the Sixth TDS exceeded that of BPA. This implies the need to strengthen the monitoring of BPs in foodstuffs.

Conflicts of interest: No conflicts of interest.

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SUPPLEMENTARY TABLE S1. Levels of BPA in composites food samples from the Sixth China Total Diet Study (μg/kg).

Food categories	HL	LN	HE	BJ	JL	SX	SN	HA	NX	NM	QH	GS	SH	FJ	JX	JS	ZJ	SD	HB	SC	GX	HN	GD	GZ
Cereals	0.256	1.445	0.156	1.341	ND[a]	0.203	0.874	0.975	0.295	0.297	0.362	0.169	0.274	0.236	0.167	0.273	0.162	0.184	0.178	ND	0.256	1.445	0.156	1.341
Legumes	ND	0.203	0.874	0.975	0.295	0.297	0.362	0.169	0.274	0.236	0.167	0.273	0.162	0.184	0.178	ND	0.207	ND	3.389	0.508	1.166	0.563	0.185	0.723
Potatoes	0.293	0.404	ND	0.219	0.698	0.239	0.187	0.636	0.212	0.185	1.352	0.271	0.271	0.274	0.277	0.222	0.206	0.233	0.29	0.294	0.249	0.474	0.215	0.393
Meat	0.213	5.815	0.383	0.356	0.453	1.104	0.175	1.737	0.228	0.784	3.629	1.665	0.926	0.249	ND	0.904	1.028	0.184	0.263	0.473	0.849	0.480	0.386	2.209
Eggs	0.207	0.544	0.453	ND	ND	ND	0.314	ND	ND	ND	ND	0.246	0.286	ND	0.209	0.178	ND	ND	0.251	0.177	ND	0.253	0.161	0.218
Aquatic foods	0.199	3.310	0.770	0.629	0.268	2.408	0.199	1.299	0.275	0.942	2.486	0.326	0.624	0.689	0.724	0.646	1.223	1.336	0.486	0.298	0.844	0.639	0.689	0.928
Milk	0.181	0.235	0.199	ND	0.025	ND	ND	ND	ND	ND	ND	ND	0.153	ND	ND	ND	ND	ND	ND	0.168	0.385	0.215	0.236	0.249
Vegetables	0.153	0.201	0.167	0.453	ND	0.284	1.088	0.347	0.19	0.478	0.231	0.243	0.19	0.296	0.285	0.303	0.575	0.291	0.193	0.326	0.311	0.336	0.387	0.936
Fruits	0.432	0.247	0.606	0.468	0.261	1.498	0.22	1.056	2.601	0.383	ND	1.428	0.405	0.260	0.176	20.001	0.154	0.545	0.481	0.245	7.933	0.18	0.542	ND
Sugars	1.648	0.654	2.034	0.520	0.780	0.530	ND	0.784	0.197	3.256	1.066	1.516	0.252	0.543	0.387	ND	0.669	1.511	0.338	2.699	0.845	0.549	0.357	0.538
Water and beverages	ND	0.168	ND	ND	ND	ND	ND	1.569	1.534	ND	ND	ND	ND	ND	ND	ND	ND	0.161	ND	ND	ND	ND	0.763	ND
Alcoholic beverages	0.209	0.188	ND	ND	0.174	ND	ND	0.403	0.356	0.610	ND	ND	ND	ND	ND	0.478	ND	ND	0.159	ND	ND	ND	ND	0.17

Note: ND: non-detected value, assigned 1/2 LOD in calculations.

Abbrreviations: HL=Heilongjiang; LN=Liaoning; HE=Hebei; BJ=Beijing; JL=Jilin; SX=Shanxi; SN=Shaanxi; HA=Henan; NX=Ningxia; NM=Inner Mongolia; QH=Qinghai; GS=Gansu; SH=Shanghai; FJ=Fujian; JX=Jiangxi; JS=Jiangsu; ZJ=Zhejiang; SD=Shandong; HB=Hubei; SC=Sichuan; GX=Gugangxi; HN=Hunan; GD=Guangdong; GZ=Guizhou; (the same below).

SUPPLEMENTARY TABLE S2. Levels of BPS in composites food samples from the Sixth China Total Diet Study (μg/kg).

Food categories	HL	LN	HE	BJ	JL	SX	SN	HA	NX	NM	QH	GS	SH	FJ	JX	JS	ZJ	SD	HB	SC	GX	HN	GD	GZ
Cereals	0.129	0.316	1.983	0.068	ND	0.675	0.033	0.388	0.169	1.269	0.128	0.152	0.060	0.495	0.02	6.403	0.401	0.241	0.059	ND	ND	0.032	ND	0.021
Legumes	1.213	1.408	1.045	0.031	0.025	0.074	1.169	0.160	2.543	1.639	0.021	0.466	0.304	3.145	ND	0.948	0.161	1.068	1.820	4.228	0.142	ND	1.907	0.076
Potatoes	0.106	0.243	0.161	0.029	ND	0.145	0.156	0.465	0.036	0.648	0.024	0.183	0.058	0.122	0.136	0.265	0.258	0.116	0.148	0.027	ND	0.201	0.154	0.208
Meat	0.203	8.638	6.669	ND	ND	2.182	4.768	16.587	0.378	2.044	0.120	0.100	11.215	67.093	0.039	6.291	3.648	2.481	4.071	0.229	0.104	0.846	0.141	1.976
Eggs	0.073	0.044	0.619	0.314	0.025	0.029	ND	0.037	0.214	0.021	0.041	0.067	0.636	0.223	0.230	0.109	0.021	0.148	0.019	ND	ND	0.074	0.028	0.022
Aquatic foods	2.159	0.598	6.344	0.743	0.091	1.921	1.501	2.622	0.026	0.757	1.506	0.131	4.586	3.127	0.023	0.509	0.087	0.644	1.621	0.369	0.034	0.427	ND	0.159
Milk	0.148	ND	ND	ND	ND	ND	0.052	ND	0.028	0.038	0.055	0.040	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.033	ND	ND
Vegetables	0.073	0.968	0.173	0.056	0.02	0.223	0.483	0.201	0.794	1.807	0.033	0.036	0.093	0.608	0.022	1.156	0.869	0.106	0.148	0.129	0.02	0.029	0.072	0.124
Fruits	0.071	1.598	0.534	0.053	0.048	0.122	0.465	0.523	0.100	1.714	0.032	0.171	0.169	0.329	0.099	0.347	0.058	0.256	0.624	0.030	0.100	0.039	0.026	0.050
Sugars	0.114	0.029	0.069	0.022	0.019	0.021	0.021	0.021	0.016	0.103	0.02	ND	ND	ND	ND	ND	0.028	0.055	0.019	0.058	0.106	ND	ND	0.036
Water and beverages	ND	0.612	0.075	0.054	ND	ND	0.027	ND	ND	0.026	0.059	0.019	0.268	0.018	0.02	0.099	ND	ND	ND	ND	0.028	ND	ND	ND
Alcoholic beverages	0.016	0.029	0.018	0.019	ND	ND	0.019	0.02	0.083	ND	ND	1.537	ND	ND	ND	ND	ND	0.018	0.029	ND	0.024	ND	0.030	ND

Note: ND: non-detected value, assigned 1/2 LOD in calculations.

SUPPLEMENTARY TABLE S3. Levels of BPF in composites food samples from the Sixth China Total Diet Study (μg/kg).

Food categories	HL	LN	HE	BJ	JL	SX	SN	HA	NX	NM	QH	GS	SH	FJ	JX	JS	ZJ	SD	HB	SC	GX	HN	GD	GZ
Cereals	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.169
Legumes	ND	0.184	ND	0.163	ND	0.444	0.383	ND	ND	ND	ND	0.624	ND	ND	ND	0.288	ND	0.163	ND	0.192	1.064	ND	ND	ND
Potatoes	ND	ND	ND	ND	ND	ND	ND	0.186	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Meat	ND	ND	ND	0.261	ND	ND	ND	ND	0.205	0.279	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.168	0.209	ND	ND
Eggs	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aquatic foods	0.169	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.192	ND
Milk	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vegetables	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.16	ND	ND	ND	ND	ND	ND	0.190	ND	ND	ND
Fruits	0.169	ND	0.156	ND	ND	ND	ND	ND	ND	ND	ND	0.449	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sugars	0.26	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Water and beverages	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Alcoholic beverages	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Note: ND: non-detected value, assigned 0 in calculations.

SUPPLEMENTARY TABLE S4. Levels of BPAF in composites food samples from the Sixth China Total Diet Study (μg/kg).

Food categories	HL	LN	HE	BJ	JL	SX	SN	HA	NX	NM	QH	GS	SH	FJ	JX	JS	ZJ	SD	HB	SC	GX	HN	GD	GZ
Cereals	ND	ND	ND	0.026	ND	ND	ND	0.015	ND	ND	ND	ND	0.129	0.040	ND	ND	ND	ND	0.02	0.015	ND	ND	0.051	ND
Legumes	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Potatoes	ND	0.024	0.029	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.016	0.019	0.018	0.018	ND	ND	ND	ND	ND	0.018	ND
Meat	ND	0.530	ND	0.019	ND	ND	ND	ND	ND	ND	0.024	0.018	ND	0.015	ND	ND	0.021	ND	ND	ND	ND	ND	ND	ND
Eggs	ND	ND	0.030	0.038	0.017	ND	ND	ND	ND	ND	ND	0.025	0.02	0.020	0.019	ND	ND	0.017	0.2	ND	ND	0.029	0.061	0.02
Aquatic foods	ND	0.025	0.02	0.027	ND	0.015	0.017	ND	ND	0.016	0.019	0.025	0.053	0.017	0.026	ND	0.026	0.044	0.796	0.029	0.029	1.751	0.022	0.025
Milk	ND	ND	0.015	ND	ND	ND	0.026	ND	ND	ND	0.016	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vegetables	0.041	0.036	ND	0.024	0.023	0.018	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.02	0.026	ND	0.029	ND	ND	0.023	ND
Fruits	0.021	ND	ND	0.021	ND	0.018	ND	0.015	ND	ND	0.018	0.092	ND	ND	ND	ND	0.025	0.052	0.175	0.108	ND	ND	ND	ND
Sugars	0.036	ND	0.02	ND	ND	ND	ND	ND	ND	0.043	ND	ND	ND	ND	ND	ND	ND	0.021	ND	0.02	ND	ND	ND	ND
Water and beverages	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Alcoholic beverages	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Note: ND: non-detected value, assigned 0 in calculations.

SUPPLEMENTARY TABLE S5. Estimated BPA and its analogues exposures in three Total Diet Studys (ng/kg body weight per day).

Compound	The Fourth TDS 2007	The Fifth TDS 2010−2012	The Sixth TDS (this study) 2016−2019
BPA	43	217	18.1
BPS	−	25.6	22.2
BPF	−	25.1	0.485
BPAF	−	0.499	0.384

Note: “−” means not detected.

Abbrreviations: BPA=bisphenol A; BPS=bisphenol S; BPF=bisphenol F; BPAF=bisphenol AF; TDS=Total Diet Studys.