

## *Supplemental Materials*

### **METHODS**

#### **Screening level risk assessment**

A screening level risk assessment was conducted for 50 toothpastes noted in **Table S1** [the three tooth powders (i.e., products #50, 52, and 53) were not included in the assessment]. For toothpastes that had non-detectable metal concentrations, the metal concentrations were estimated as one-half the limit of detection (LOD) (e.g., <5 ppb would yield an estimated concentration of 2.5 ppb). The metal concentrations in “ppb” were divided by 1000 to obtain concentrations in “μg/g”.

The lead, cadmium, and mercury exposure average daily doses (ADDs) resulting from toothpaste ingestion were calculated in children (2-4 years) and adults (25-30) using parameters in **Table S2** and **Equation 1**. The toothpaste ingestion rates reported by Barnhart et al.<sup>1</sup> and cited by Bremmer et al.<sup>2</sup> were used, since they captured a wide range of age groups. Specifically, the mean ingestion rates of 0.30 and 0.04 g/brushing in children (2-4 years) and adults (20-35 years), respectively, were considered (i.e., typical use scenario). Due to the higher toothpaste ingestion rate in younger children, the youngest children group was selected to represent exposure to children. The 90<sup>th</sup> percentile ingestion rates of 0.73 and 0.12 g/brushing in children (2-4 years) and adults (20-35 years), respectively, were also considered (i.e., upper bound use scenario). For the number of daily brushings, a value of 2 was used, because the U.S. Centers for Disease Control and Prevention (CDC) recommends that persons aged ≥2 years brush their teeth twice daily<sup>3</sup>.

$$ADD = C \times IR \times N$$

**Equation 1**

Where, *ADD* is the exposure dose (μg/day), *C* is the metal concentration in toothpaste (μg/g), *IR* is the toothpaste ingestion rate (g/brushing), and *N* is the number of daily brushings.

The arsenic lifetime average daily doses (LADDs) resulting from toothpaste ingestion over a lifetime (70 years or 25550 days) were calculated using parameters in **Table S2** and **Equation 2**. An example calculation is provided in **Table S3**. The mean toothpaste ingestion rates ranging from 0.30 g/brushing in children (2-4 years) to 0.04 g/brushing in adults (20-35 years) were considered. The 90<sup>th</sup> percentile ingestion rates were not available for all age groups; thus, upper bound use scenario calculations were not possible for arsenic. For the number of daily brushings, a value of

2 was used as before. For body weight information, the U.S. Environmental Protection Agency (EPA) exposure factor handbook was relied upon<sup>4</sup>. Lifetime was assumed to be 70 years or 25550 days.

$$LADD = \frac{\sum((C \times IR_{age} \times N \div BW_{age}) \times ED)}{AT} \quad \text{Equation 2}$$

Where, *LADD* is the lifetime average daily dose (µg/kg/day), *C* is the metal concentration in toothpaste (µg/g), *IR<sub>age</sub>* is the age-specific toothpaste ingestion rate (g/brushing), *N* is the number of daily brushings, *BW<sub>age</sub>* is the age-specific body weight (kg), *ED* is the exposure duration over which the child/adult in each age group brushed teeth (i.e., 365 days), and *AT* is the averaging time (i.e., 25550 days, which equates to a 70-year lifetime).

The ADDs and LADDs were compared to the available health guidance values (HGVs) (Table S2) and hazard quotients (HQs) were calculated (Equations 3 and 4). The HGVs were selected according to the U.S. Environmental Protection Agency (EPA) Office of Solid Waste and Emergency Response (OSWER) guidance<sup>5</sup>. For lead, the maximum allowable dose level (MADL) of 0.5 µg/day established by the California Office of Environmental Health Hazard Assessment (OEHHA) was selected<sup>6</sup>. For mercury, the intermediate-duration minimal risk level (MRL) of 0.01 µg/kg/day established by Agency for Toxic Substances and Disease Registry (ATSDR) was selected<sup>7</sup>; this HGV was converted to 0.14 and 0.8 µg/day in children and adults, respectively, using body weights of 13.8 and 80 kg in children (2 to <3 years) and adults, respectively<sup>4</sup>. For cadmium, the reference dose (RfD) of 1 µg/kg/day established by EPA Integrated Risk (IRIS) was selected<sup>8</sup>; this HGV was converted to 13.8 and 80 µg/day in children and adults, respectively, using and body weights of 13.8 and 80 kg in children (2 to <3 years) and adults, respectively<sup>4</sup>. For arsenic, the cancer slope factor (CSF) of 1.5 per mg/kg/day established by EPA IRIS was selected as the HGV<sup>9</sup> and converted to 6.67×10<sup>-4</sup> µg/kg/day by assuming a 1 in 1,000,000 risk level. For all metals, HQs greater than 1.0 were considered to represent an increased potential for health risk.

$$HQ = ADD \div HGV \quad \text{Equation 3}$$

Where, *HQ* is the hazard quotient (unitless), *D* is the exposure dose (µg/day), *HGV* is the health guidance value (µg/day).

$$HQ = LADD \div HGV \quad \text{Equation 4}$$

Where,  $HQ$  is the hazard quotient (unitless),  $LADD$  is the lifetime average daily dose ( $\mu\text{g}/\text{kg}/\text{day}$ ), and  $HGV$  is the health guidance value ( $\mu\text{g}/\text{kg}/\text{day}$ ).

**SUPPLEMENTAL TABLES**

**Table S1. Summary of 53 dentifrice products tested by Lead Safe Mama as reported by Perkins<sup>10</sup>. The numbers highlighted in gray represent non-detects.**

Product number	Attributes				Metal concentration (ppb)			
	Flavor	Sold for kids?	Country of origin	Contains fluoride?	Pb	Cd	Hg	As
1	Strawberry	YES	USA	No	<5	<5	<5	<10
2	Original	YES	USA	No	<5	<5	<5	<10
3	Watermelon	YES	France (?)	Low	<5	<5	<5	<10
4	Berry Fruity	YES	USA	No	<5	<5	<5	<5
5	Mint	NO	Australia	No	<5	<5	<5	<10
6	Coconut Banana	YES	USA	No	16.8	5.3	<5	21.0
7	Cake Batter	YES	USA	No	26.0	9.0	<5	8.0
8	Orange Cream	YES	USA	No	27.4	<5	8.2	<10
9	Ela Mint	NO	USA	No	32.0	<5	10.0	21.0
10	Strawberry	YES	USA	No	47.3	<5	<5	66.1
11	Bubblegum	YES	USA	No	54.4	6.2	<5	19.7
12	Spearmint	YES	Switzerland	No	55.0	<5	<5	6.0
13	Mint	NO	USA	No	56.9	51.4	7.5	125.9
14	Mint	YES	Germany	No	72.6	10.9	7.5	49.4
15	/	/	/	/	79.4	<5	<5	20.9
16	Strawberry	YES	Israel	No	83.6	<5	<5	<10
17	Strawberry Sky	YES	USA	No	86.0	36.0	10.0	121.0
18	Vanilla Vibes	YES	USA	No	89.0	<5	<5	16.0
19	Fruity Bubble	YES	USA	Yes	100.1	<5	12.0	<10
20	Strawberry	YES	Israel	Yes	112.0	<5	<5	<10
21	Cool Mint	NO	USA	Yes	116.0	<5	<5	16.0
22	Strawberry	YES	Australia	No	120.0	<5	<5	<5
23	Bubblegum	YES	USA	Yes	132.0	<5	<5	10.1
24	Peppermint	YES	USA	No	160.0	<5	6.0	23.0
25	/	/	/	/	195.8	26.3	<5	53.7
26	Strawberry	YES	USA	No	200.0	9.0	6.0	60.0
27	/	/	/	/	206.5	33.5	<5	103.1
28	/	/	/	/	210.0	<5	5.5	<10
29	/	/	/	/	217.5	<5	8.0	<10
30	Silly Strawberry	YES	USA	No	240.0	<5	<12	40.0
31	Bubble Gum	YES	India	No	243.0	25.0	<25	40.0
32	/	/	/	/	258.4	16.4	<5	21.3
33	None	NO	USA	No	268.7	<5	<5	58.9
34	Strawberry	YES	USA	No	273.0	8.0	<5	133.0
35	Vanilla Frosting	YES	USA	No	283.7	14.5	7.5	24.4
36	/	/	/	/	285.8	<5	13.0	21.5
37	None	NO	Canada	No	292.0	29.0	11.0	274.0
38	Watermelon	YES	USA	Yes	302.1	<5	6.9	<10
39	Citrus	YES	USA	No	307.7	50.3	12.6	125.4
40	/	/	/	/	336.4	<5	5.7	<10
41	Mint	NO	USA	Yes	399.0	<5	6.0	6.0
42	Mint	NO	USA	No	421.0	<5	9.0	12.0
43	Blue Raspberry	YES	USA	Yes	428.4	<5	11.8	<10
44	/	/	/	/	446.4	<5	12.2	<10
45	Natural Peppermint	NO	USA	No	457.0	<25	<25	202.0
46	Strawberry	YES	USA	Yes	477.8	<5	8.1	<10
47	Fresh Watermelon	YES	USA	No	493.0	<5	19.0	6.0
48	Mint	NO	USA	Yes	539.0	<5	10.4	<10
49	Natural Bubblegum	YES	USA	Yes	568.1	<5	14.6	28.5
50	Fresh Citrus	YES	USA	No	593.0	267.0	<12	1500.0
51	Lemon Twist	YES	USA	No	3500.0	31.0	<5	2700.0
52	Mint-Bone	NO	USA	No	4258.4	48.6	8.5	5820.9
53	Sweet Bubblegum	YES	USA	No	7800.0	82.0	<63	5500.0

**Table S2. Summary of exposure parameters used to calculate exposure doses for lead, cadmium, and mercury, as well as lifetime average daily doses for arsenic.**

Parameter	Value(s)	Reference(s)	Metal			
			Pb	Cd	Hg	As
Toothpaste ingestion rate (g/brushing)	• 0.30 (age 2-4 years, mean) • 0.04 (age 20-35 years, mean)	Barnhart et al. <sup>1</sup> , Bremmer et al. <sup>2</sup>	•	•	•	
	• 0.73 (age 2-4 years, 90 <sup>th</sup> percentile) • 0.12 (age 20-35 years, 90 <sup>th</sup> percentile)		•	•	•	
	• 0.30 (age 2-4 years, mean) • 0.13 (age 5-7 years, mean; also assumed for 8-10 years) • 0.07 (age 11-13 years, mean; also assumed for 14-19 years) • 0.04 (age 20-35 years, mean; also assumed for 36-71 years)					•
Number of brushings per day	2 times per day	Thornton-Evans et al. <sup>3</sup>	•	•	•	•
Body weight (kg)	• 13.8 (2 to < 3 years) • 80 (adults)	EPA <sup>4</sup>	•	•	•	
	• 13.8 (2 to < 3 years) • 18.6 (3 to < 6 years) • 31.8 (6 to < 11 years) • 56.8 (11 to < 16 years) • 71.6 (16 to < 21 years) • 80 (adults)					•
Exposure Duration	• 1 year = 365 days					•
Averaging Time	• Lifetime = 25550 days (i.e., 70 years)					•
Health guidance value	MADL = 0.5 µg/day	OEHHA <sup>6</sup>	•			
	RfD = 1 µg/kg/day (converted to 13.8 and 80 µg/day in children and adults)	EPA IRIS <sup>8</sup>		•		
	MRL = 0.01 µg/kg/day (converted to 0.14 and 0.8 µg/day in children and adults)	ATSDR <sup>7</sup>			•	
	CSF = 1.5 per mg/kg/day (converted to 6.67×10 <sup>-4</sup> µg/kg/day)	EPA IRIS <sup>9</sup>				•

Abbreviations: MADL: maximum allowable daily limit; RfD: reference dose; MRL: minimal risk level; CSF: cancer slope factor.

**Table S3. Example calculation for arsenic lifetime average daily dose for product #51.**

Age	Toothpaste ingested (g/brushing)	Number of brushings per day	As concentration in toothpaste (µg/g)	Number of days in a year	As ingested (µg/year)	Body weight (kg)	As ingested (µg/year/kg)
2	0.3	2	2.7	365	591.3	13.8	42.85
3	0.3	2	2.7	365	591.3	18.6	31.79
4	0.3	2	2.7	365	591.3	18.6	31.79
5	0.13	2	2.7	365	256.23	18.6	13.78
6	0.13	2	2.7	365	256.23	31.8	8.06
7	0.13	2	2.7	365	256.23	31.8	8.06
8	0.13	2	2.7	365	256.23	31.8	8.06
9	0.13	2	2.7	365	256.23	31.8	8.06
10	0.13	2	2.7	365	256.23	31.8	8.06
11	0.07	2	2.7	365	137.97	56.8	2.43
12	0.07	2	2.7	365	137.97	56.8	2.43
13	0.07	2	2.7	365	137.97	56.8	2.43
14	0.07	2	2.7	365	137.97	56.8	2.43
15	0.07	2	2.7	365	137.97	56.8	2.43
16	0.07	2	2.7	365	137.97	71.6	1.93
17	0.07	2	2.7	365	137.97	71.6	1.93
18	0.07	2	2.7	365	137.97	71.6	1.93
19	0.07	2	2.7	365	137.97	71.6	1.93
20	0.04	2	2.7	365	78.84	71.6	1.10
21	0.04	2	2.7	365	78.84	80	0.99
22	0.04	2	2.7	365	78.84	80	0.99
23	0.04	2	2.7	365	78.84	80	0.99
24	0.04	2	2.7	365	78.84	80	0.99
25	0.04	2	2.7	365	78.84	80	0.99
26	0.04	2	2.7	365	78.84	80	0.99
27	0.04	2	2.7	365	78.84	80	0.99
28	0.04	2	2.7	365	78.84	80	0.99
29	0.04	2	2.7	365	78.84	80	0.99
30	0.04	2	2.7	365	78.84	80	0.99
31	0.04	2	2.7	365	78.84	80	0.99
32	0.04	2	2.7	365	78.84	80	0.99
33	0.04	2	2.7	365	78.84	80	0.99
34	0.04	2	2.7	365	78.84	80	0.99
35	0.04	2	2.7	365	78.84	80	0.99
36	0.04	2	2.7	365	78.84	80	0.99
37	0.04	2	2.7	365	78.84	80	0.99
38	0.04	2	2.7	365	78.84	80	0.99
39	0.04	2	2.7	365	78.84	80	0.99
40	0.04	2	2.7	365	78.84	80	0.99
41	0.04	2	2.7	365	78.84	80	0.99
42	0.04	2	2.7	365	78.84	80	0.99
43	0.04	2	2.7	365	78.84	80	0.99
44	0.04	2	2.7	365	78.84	80	0.99
45	0.04	2	2.7	365	78.84	80	0.99
46	0.04	2	2.7	365	78.84	80	0.99
47	0.04	2	2.7	365	78.84	80	0.99
48	0.04	2	2.7	365	78.84	80	0.99
49	0.04	2	2.7	365	78.84	80	0.99
50	0.04	2	2.7	365	78.84	80	0.99
51	0.04	2	2.7	365	78.84	80	0.99
52	0.04	2	2.7	365	78.84	80	0.99
53	0.04	2	2.7	365	78.84	80	0.99
54	0.04	2	2.7	365	78.84	80	0.99
55	0.04	2	2.7	365	78.84	80	0.99
56	0.04	2	2.7	365	78.84	80	0.99
57	0.04	2	2.7	365	78.84	80	0.99
58	0.04	2	2.7	365	78.84	80	0.99
59	0.04	2	2.7	365	78.84	80	0.99
60	0.04	2	2.7	365	78.84	80	0.99
61	0.04	2	2.7	365	78.84	80	0.99
62	0.04	2	2.7	365	78.84	80	0.99
63	0.04	2	2.7	365	78.84	80	0.99
64	0.04	2	2.7	365	78.84	80	0.99
65	0.04	2	2.7	365	78.84	80	0.99
66	0.04	2	2.7	365	78.84	80	0.99
67	0.04	2	2.7	365	78.84	80	0.99
68	0.04	2	2.7	365	78.84	80	0.99
69	0.04	2	2.7	365	78.84	80	0.99
70	0.04	2	2.7	365	78.84	80	0.99
71	0.04	2	2.7	365	78.84	80	0.99

Summary:		
As ingested over lifetime	231.71	µg/kg
Lifetime	25550	days (i.e., 70 years)
LADD	9.07E-03	µg/kg/day
HGV	6.67E-04	µg/kg/day
HQ	13.6	

**Table S4. Hazard quotients for lead, cadmium, mercury, and arsenic in 50 toothpastes. Hazard quotients highlighted in gray are < 1.0. The hazard quotients were calculated by dividing the exposure doses by the respective health guidance values as explained in the Methods.**

Product number	Children (2-4 years)			Adults (20-35 years)			Lifetime As
	Pb	Cd	Hg	Pb	Cd	Hg	
<i>Typical use scenario</i>							
1	3.00E-03	1.09E-04	1.09E-02	4.00E-04	2.50E-06	2.50E-04	2.52E-02
2	3.00E-03	1.09E-04	1.09E-02	4.00E-04	2.50E-06	2.50E-04	2.52E-02
3	3.00E-03	1.09E-04	1.09E-02	4.00E-04	2.50E-06	2.50E-04	2.52E-02
4	3.00E-03	1.09E-04	1.09E-02	4.00E-04	2.50E-06	2.50E-04	1.26E-02
5	3.00E-03	1.09E-04	1.09E-02	4.00E-04	2.50E-06	2.50E-04	2.52E-02
6	2.02E-02	2.30E-04	1.09E-02	2.69E-03	5.30E-06	2.50E-04	1.06E-01
7	3.12E-02	3.91E-04	1.09E-02	4.16E-03	9.00E-06	2.50E-04	4.03E-02
8	3.29E-02	1.09E-04	3.57E-02	4.38E-03	2.50E-06	8.20E-04	2.52E-02
9	3.84E-02	1.09E-04	4.35E-02	5.12E-03	2.50E-06	1.00E-03	1.06E-01
10	5.68E-02	1.09E-04	1.09E-02	7.57E-03	2.50E-06	2.50E-04	3.33E-01
11	6.53E-02	2.70E-04	1.09E-02	8.70E-03	6.20E-06	2.50E-04	9.92E-02
12	6.60E-02	1.09E-04	1.09E-02	8.80E-03	2.50E-06	2.50E-04	3.02E-02
13	6.83E-02	2.23E-03	3.26E-02	9.10E-03	5.14E-05	7.50E-04	6.34E-01
14	8.71E-02	4.74E-04	3.26E-02	1.16E-02	1.09E-05	7.50E-04	2.49E-01
15	9.53E-02	1.09E-04	1.09E-02	1.27E-02	2.50E-06	2.50E-04	1.05E-01
16	1.00E-01	1.09E-04	1.09E-02	1.34E-02	2.50E-06	2.50E-04	2.52E-02
17	1.03E-01	1.57E-03	4.35E-02	1.38E-02	3.60E-05	1.00E-03	6.09E-01
18	1.07E-01	1.09E-04	1.09E-02	1.42E-02	2.50E-06	2.50E-04	8.06E-02
19	1.20E-01	1.09E-04	5.22E-02	1.60E-02	2.50E-06	1.20E-03	2.52E-02
20	1.34E-01	1.09E-04	1.09E-02	1.79E-02	2.50E-06	2.50E-04	2.52E-02
21	1.39E-01	1.09E-04	1.09E-02	1.86E-02	2.50E-06	2.50E-04	8.06E-02
22	1.44E-01	1.09E-04	1.09E-02	1.92E-02	2.50E-06	2.50E-04	1.26E-02
23	1.58E-01	1.09E-04	1.09E-02	2.11E-02	2.50E-06	2.50E-04	5.09E-02
24	1.92E-01	1.09E-04	2.61E-02	2.56E-02	2.50E-06	6.00E-04	1.16E-01
25	2.35E-01	1.14E-03	1.09E-02	3.13E-02	2.63E-05	2.50E-04	2.70E-01
26	2.40E-01	3.91E-04	2.61E-02	3.20E-02	9.00E-06	6.00E-04	3.02E-01
27	2.48E-01	1.46E-03	1.09E-02	3.30E-02	3.35E-05	2.50E-04	5.19E-01
28	2.52E-01	1.09E-04	2.39E-02	3.36E-02	2.50E-06	5.50E-04	2.52E-02
29	2.61E-01	1.09E-04	3.48E-02	3.48E-02	2.50E-06	8.00E-04	2.52E-02
30	2.88E-01	1.09E-04	2.61E-02	3.84E-02	2.50E-06	6.00E-04	2.01E-01
31	2.92E-01	1.09E-03	5.43E-02	3.89E-02	2.50E-05	1.25E-03	2.01E-01
32	3.10E-01	7.13E-04	1.09E-02	4.13E-02	1.64E-05	2.50E-04	1.07E-01
33	3.22E-01	1.09E-04	1.09E-02	4.30E-02	2.50E-06	2.50E-04	2.97E-01
34	3.28E-01	3.48E-04	1.09E-02	4.37E-02	8.00E-06	2.50E-04	6.70E-01
35	3.40E-01	6.30E-04	3.26E-02	4.54E-02	1.45E-05	7.50E-04	1.23E-01
36	3.43E-01	1.09E-04	5.65E-02	4.57E-02	2.50E-06	1.30E-03	1.08E-01
37	3.50E-01	1.26E-03	4.78E-02	4.67E-02	2.90E-05	1.10E-03	1.38E+00
38	3.63E-01	1.09E-04	3.00E-02	4.83E-02	2.50E-06	6.90E-04	2.52E-02
39	3.69E-01	2.19E-03	5.48E-02	4.92E-02	5.03E-05	1.26E-03	6.31E-01
40	4.04E-01	1.09E-04	2.48E-02	5.38E-02	2.50E-06	5.70E-04	2.52E-02
41	4.79E-01	1.09E-04	2.61E-02	6.38E-02	2.50E-06	6.00E-04	3.02E-02
42	5.05E-01	1.09E-04	3.91E-02	6.74E-02	2.50E-06	9.00E-04	6.04E-02
43	5.14E-01	1.09E-04	5.13E-02	6.85E-02	2.50E-06	1.18E-03	2.52E-02
44	5.36E-01	1.09E-04	5.30E-02	7.14E-02	2.50E-06	1.22E-03	2.52E-02
45	5.48E-01	5.43E-04	5.43E-02	7.31E-02	1.25E-05	1.25E-03	1.02E+00
46	5.73E-01	1.09E-04	3.52E-02	7.64E-02	2.50E-06	8.10E-04	2.52E-02
47	5.92E-01	1.09E-04	8.26E-02	7.89E-02	2.50E-06	1.90E-03	3.02E-02
48	6.47E-01	1.09E-04	4.52E-02	8.62E-02	2.50E-06	1.04E-03	2.52E-02
49	6.82E-01	1.09E-04	6.35E-02	9.09E-02	2.50E-06	1.46E-03	1.44E-01
51	4.20E+00	1.35E-03	1.09E-02	5.60E-01	3.10E-05	2.50E-04	1.36E+01

**Table S4. (continued)**

Product number	Children (2-4 years)			Adults (20-35 years)			Lifetime
	Pb	Cd	Hg	Pb	Cd	Hg	As <sup>a</sup>
<i>Upper bound use scenario</i>							
1	7.30E-03	2.64E-04	2.64E-02	1.20E-03	7.50E-06	7.50E-04	-
2	7.30E-03	2.64E-04	2.64E-02	1.20E-03	7.50E-06	7.50E-04	-
3	7.30E-03	2.64E-04	2.64E-02	1.20E-03	7.50E-06	7.50E-04	-
4	7.30E-03	2.64E-04	2.64E-02	1.20E-03	7.50E-06	7.50E-04	-
5	7.30E-03	2.64E-04	2.64E-02	1.20E-03	7.50E-06	7.50E-04	-
6	4.91E-02	5.61E-04	2.64E-02	8.06E-03	1.59E-05	7.50E-04	-
7	7.59E-02	9.52E-04	2.64E-02	1.25E-02	2.70E-05	7.50E-04	-
8	8.00E-02	2.64E-04	8.68E-02	1.32E-02	7.50E-06	2.46E-03	-
9	9.34E-02	2.64E-04	1.06E-01	1.54E-02	7.50E-06	3.00E-03	-
10	1.38E-01	2.64E-04	2.64E-02	2.27E-02	7.50E-06	7.50E-04	-
11	1.59E-01	6.56E-04	2.64E-02	2.61E-02	1.86E-05	7.50E-04	-
12	1.61E-01	2.64E-04	2.64E-02	2.64E-02	7.50E-06	7.50E-04	-
13	1.66E-01	5.44E-03	7.93E-02	2.73E-02	1.54E-04	2.25E-03	-
14	2.12E-01	1.15E-03	7.93E-02	3.48E-02	3.27E-05	2.25E-03	-
15	2.32E-01	2.64E-04	2.64E-02	3.81E-02	7.50E-06	7.50E-04	-
16	2.44E-01	2.64E-04	2.64E-02	4.01E-02	7.50E-06	7.50E-04	-
17	2.51E-01	3.81E-03	1.06E-01	4.13E-02	1.08E-04	3.00E-03	-
18	2.60E-01	2.64E-04	2.64E-02	4.27E-02	7.50E-06	7.50E-04	-
19	2.92E-01	2.64E-04	1.27E-01	4.80E-02	7.50E-06	3.60E-03	-
20	3.27E-01	2.64E-04	2.64E-02	5.38E-02	7.50E-06	7.50E-04	-
21	3.39E-01	2.64E-04	2.64E-02	5.57E-02	7.50E-06	7.50E-04	-
22	3.50E-01	2.64E-04	2.64E-02	5.76E-02	7.50E-06	7.50E-04	-
23	3.85E-01	2.64E-04	2.64E-02	6.34E-02	7.50E-06	7.50E-04	-
24	4.67E-01	2.64E-04	6.35E-02	7.68E-02	7.50E-06	1.80E-03	-
25	5.72E-01	2.78E-03	2.64E-02	9.40E-02	7.89E-05	7.50E-04	-
26	5.84E-01	9.52E-04	6.35E-02	9.60E-02	2.70E-05	1.80E-03	-
27	6.03E-01	3.54E-03	2.64E-02	9.91E-02	1.01E-04	7.50E-04	-
28	6.13E-01	2.64E-04	5.82E-02	1.01E-01	7.50E-06	1.65E-03	-
29	6.35E-01	2.64E-04	8.46E-02	1.04E-01	7.50E-06	2.40E-03	-
30	7.01E-01	2.64E-04	6.35E-02	1.15E-01	7.50E-06	1.80E-03	-
31	7.10E-01	2.64E-03	1.32E-01	1.17E-01	7.50E-05	3.75E-03	-
32	7.55E-01	1.74E-03	2.64E-02	1.24E-01	4.92E-05	7.50E-04	-
33	7.85E-01	2.64E-04	2.64E-02	1.29E-01	7.50E-06	7.50E-04	-
34	7.97E-01	8.46E-04	2.64E-02	1.31E-01	2.40E-05	7.50E-04	-
35	8.28E-01	1.53E-03	7.93E-02	1.36E-01	4.35E-05	2.25E-03	-
36	8.35E-01	2.64E-04	1.38E-01	1.37E-01	7.50E-06	3.90E-03	-
37	8.53E-01	3.07E-03	1.16E-01	1.40E-01	8.70E-05	3.30E-03	-
38	8.82E-01	2.64E-04	7.30E-02	1.45E-01	7.50E-06	2.07E-03	-
39	8.98E-01	5.32E-03	1.33E-01	1.48E-01	1.51E-04	3.78E-03	-
40	9.82E-01	2.64E-04	6.03E-02	1.61E-01	7.50E-06	1.71E-03	-
41	1.17E+00	2.64E-04	6.35E-02	1.92E-01	7.50E-06	1.80E-03	-
42	1.23E+00	2.64E-04	9.52E-02	2.02E-01	7.50E-06	2.70E-03	-
43	1.25E+00	2.64E-04	1.25E-01	2.06E-01	7.50E-06	3.54E-03	-
44	1.30E+00	2.64E-04	1.29E-01	2.14E-01	7.50E-06	3.66E-03	-
45	1.33E+00	1.32E-03	1.32E-01	2.19E-01	3.75E-05	3.75E-03	-
46	1.40E+00	2.64E-04	8.57E-02	2.29E-01	7.50E-06	2.43E-03	-
47	1.44E+00	2.64E-04	2.01E-01	2.37E-01	7.50E-06	5.70E-03	-
48	1.57E+00	2.64E-04	1.10E-01	2.59E-01	7.50E-06	3.12E-03	-
49	1.66E+00	2.64E-04	1.54E-01	2.73E-01	7.50E-06	4.38E-03	-
51	1.02E+01	3.28E-03	2.64E-02	1.68E+00	9.30E-05	7.50E-04	-

<sup>a</sup>It was not possible to calculate the upper bound LADDs, because the 90<sup>th</sup> percentile toothpaste ingestion rates were only available for children (2-4) and adults (20-35).

## REFERENCES

1. Barnhart WE, Hiller LK, Leonard GJ, Michaels SE. Dentifrice usage and ingestion among four age groups. *J Dent Res.* 1974;53(6):1317-22. doi: 10.1177/00220345740530060301.
2. Bremmer HJ, Prud'homme de Lodder LCH, van Engelen JGM. ConsExpo Fact Sheets. *Cosmetics Fact Sheet: To assess the risks for the consumer: Updated version for ConsExpo 4.* Bilthoven (NL): National Institute for Public Health and the Environment; 2006.
3. Thornton-Evans G, Junger ML, Lin M, Wei L, Espinoza L, Beltran-Aguilar E. Use of Toothpaste and Toothbrushing Patterns Among Children and Adolescents - United States, 2013-2016. *MMWR Morb Mortal Wkly Rep.* 2019; 68(4):87-90. doi: 10.15585/mmwr.mm6804a3.
4. Environmental Protection Agency (EPA). Exposure factors handbook. Chapter 8–Body weight Studies. <https://www.epa.gov/sites/default/files/2015-09/documents/efh-chapter08.pdf>. Published September, 2011. Accessed April 24, 2025.
5. Environmental Protection Agency Integrated Risk Information System (EPA IRIS). OSWER Directive 9285.7-53. <https://nepis.epa.gov/Exe/ZyPDF.cgi/91015CKS.PDF?Dockey=91015CKS.PDF>. Published December 5, 2003. Accessed April 24, 2025.
6. California Office of Environmental Health Hazard Assessment (OEHHA). 2023. Proposition 65 no significant risk levels (NSRLs) and maximum allowable dose levels (MADLs). Available from: <https://oehha.ca.gov/proposition-65/general-info/proposition-65-no-significant-risk-levels-nsrls-and-maximum-allowable-dose-levels-madls>. Published October 7, 2023. Accessed April 24, 2025.
7. Agency for Toxic Substances and Disease Registry (ATSDR). Toxicological profile for mercury. Available from: <https://www.atsdr.cdc.gov/toxprofiles/tp46.pdf>. Published October, 2024. Accessed April 24, 2025.
8. Environmental Protection Agency Integrated Risk Information System (EPA IRIS). Cadmium; CASRN 7440-43-9. [https://iris.epa.gov/static/pdfs/0141\\_summary.pdf](https://iris.epa.gov/static/pdfs/0141_summary.pdf). Published October, 1989. Accessed April 24, 2025.
9. Environmental Protection Agency Integrated Risk Information System (EPA IRIS). IRIS Toxicological Review of Inorganic Arsenic CASRN 7440-38-2. [https://iris.epa.gov/static/pdfs/0278\\_summary.pdf](https://iris.epa.gov/static/pdfs/0278_summary.pdf). Published January, 2025. Accessed April 24, 2025.
10. Perkins T. Toothpaste widely contaminated with lead and other metals, US research finds. *The Guardian.* <https://www.theguardian.com/us-news/2025/apr/17/toothpaste-lead-heavy-metals>. Published April 17, 2025. Accessed April 18, 2025.