Supplementary Materials

for

A meta-analysis to correlate lead bioavailability and bioaccessibility and predict lead bioavailability

Zhaomin Dong[a,b], Kaihong Yan[a,b], Yanju Liu[a,b], Ravi Naidu*[,a,b], Luchun Duan[a,b], Ayanka Wijayawardena[a,b a], Kirk T. Semple[c], Mohammad Mahmudur Rahman[a,b]

[a] *Global Center for Environmental Research (GCER), The Faculty of Science and Information Technology, University of Newcastle, University Drive, Callaghan, NSW 2308, Australia*

[b] *Cooperative Research Centre for Contamination Assessment and Remediation of the Environment (CRC CARE), Mawson Lakes, SA 5095, Australia*

[c] Lancaster Environment Centre, Lancaster University, LA1 4YQ Lancaster, United Kingdom

Address for Correspondence: Ravi Naidu

ATC Building, Global Center for Environmental Remediation, Faculty of Science and Information Technology, University of Newcastle, Callaghan, NSW 2308

Email: ravi.naidu@newcastle.edu.au
Phone : +61 02 4913 8705

Procedure for estimating variances of RBA. A mixed linear model has been used to estimate group variance of relative bioavailability (RBA). The schematic is shown in Figure S1. The model can be described using Equations S1 and S2

$$Ln(s_{ij}^2) \sim N(\mu_{ij}, \delta^2) \quad \text{S1}$$

$$\mu_{ij} = \beta + \alpha_0 \times Ln(y_{ij}) + (\gamma_i + \lambda_j) \times Ln(y_{ij}) \quad \text{S2}$$

where the variance was subjected to a log-normal distribution with geometric mean exp(μ) and geometric standard deviation exp(δ). A linear correlation was used to link dependent variable (μ) and independent variable (the log-transformation of RBA). The raw data can be seen in Table S1.

Pseudocode for meta-analysis.

Matlab:

```
study
clear
clc
load metadata
%% variance estimation
datastruct=struct('nrow',length(allpoint),'nstudy',length(unique(studyindex(allpoint))),'nendpoi
nt',length(unique(endpointindex(allpoint))),...
'study',methodindex(allpoint),'endpoint',endpointindex(allpoint),'y',log(s(allpoint)),'x',log(y(all
point))); %model data
init1 =
struct('tau',0.1,'pstudy',0.1,'pendpoint',0.1,'gamma0',1,'gamma1',zeros(length(unique(studyind
ex(allpoint))),1),'gamma2',zeros(length(unique(endpointindex(allpoint))),1),'beta0',0); %initi-
al data
[samples, stats, structArray] = matbugs(datastruct, ...
            fullfile(pwd,'erroestimation.txt'), ...
            'init', init1, ...
            'nChains', 1, ...
            'view', 0, 'nburnin', 5000, 'nsamples', 20000, ...
            'thin', 1, 'DICstatus' ,1,...
            'monitorParams', {'beta0','gamma0','gamma1','gamma2','pstudy','pendpoint'}, ...
            'Bugdir', 'd:/Program Files/WinBUGS14');
    %% meta analysis
sigma=exp(mean(samples.gamma0)*log(y(allpoint))+mean(samples.beta0));
datastruct=struct('nrow',length(allpoint),'nmethod',length(unique(methodindex(allpoint))),'nen
dpoint',length(unique(endpointindex(allpoint))),...
'method',methodindex(allpoint),'endpoint',endpointindex(allpoint),'y',y(allpoint),'s',1./(sigma.^
2),'x',x(allpoint));
init1 =
struct('tau',0.1,'pmethod',0.1,'pendpoint',0.1,'gamma0',1,'gamma1',zeros(length(unique(studyin
dex(allpoint))),1),'gamma2',zeros(length(unique(endpointindex(allpoint))),1),'beta0',0);
[samples, stats, structArray] = matbugs(datastruct, ...
            fullfile(pwd,'metaanalysis.txt'), ...
            'init', init1, ...
            'nChains', 1, ...
            'view', 0, 'nburnin', 5000, 'nsamples', 20000, ...
            'thin', 1, 'DICstatus' ,1,...
            'monitorParams', {'beta0','gamma0','gamma1','gamma2','pmethod','pendpoint'}, ...
            'Bugdir', 'd:/Program Files/WinBUGS14');
```

Winbugs for variance estimation:

```
model
{
for (i in 1:nrow)
{
y[i] ~ dnorm(mu[i],tau)
mu[i] <- beta0+ gamma0* x[i]+gamma1[study[i]]*x[i]+gamma2[endpoint[i]]*x[i]
}
for (i in 1:nstudy)
{ gamma1[i]~dnorm(0,pstudy)
```

```
}
for (i in 1:nendpoint)
{gamma2[i]~dnorm(0,pendpoint)
}
gamma0~ dnorm(0,1.0E-4)
beta0~dnorm(0,1.0E-4)
pstudy~dgamma(0.001,0.001)
pendpoint~dgamma(0.001,0.001)
tau~dgamma(0.001,0.001)
}
```

Winbugs for meta-analysis:

```
model
{
for (i in 1:nrow)
{
y[i] ~ dnorm(mu[i],s[i])
mu[i]~dnorm(muu[i],tau)
muu[i] <- beta0+ gamma0* x[i]+gamma1[method[i]]*x[i]+gamma2[endpoint[i]]*x[i]
}
for (i in 1:nmethod)
{ gamma1[i]~dnorm(0,pmethod)
}
for (i in 1:nendpoint)
{gamma2[i]~dnorm(0,pendpoint)
}
gamma0~ dnorm(0,1.0E-4)
beta0~dnorm(0,1.0E-4)
pmethod~dgamma(0.001,0.001)
pendpoint~dgamma(0.001,0.001)
tau~dgamma(0.001,0.001)
}
```

Table S1. *In vitro* and *in vivo* data used for meta-analysis

Num-ber	*in vitro* method	Biomark-er	Pb conc. (mg/kg)	BAc (%)		RBA (%)	SE (%)[a]	Reference
				Raw	AD[d]			
1	RBALP	BLOOD	1590	47.0	47.0	34.00	6.33	
2	RBALP	BLOOD	6330	37.8	37.8	30.00	5.86	
3	RBALP	BLOOD	10800	69.3	69.3	65.00	9.85	
4	RBALP	BLOOD	4050	79.0	79.0	94.00	15.01	
5	RBALP	BLOOD	11700	64.3	64.3	47.00	7.97	
6	RBALP	BLOOD	6940	85.3	85.3	84.00	14.78	
7	RBALP	BLOOD	14200	64.9	64.9	69.00	7.74	
8	RBALP	BLOOD	3870	71.4	71.4	72.00	8.21	
9	RBALP	BLOOD	8170	17.4	17.4	21.00	3.75	
10	RBALP	BLOOD	8530	22.3	22.3	19.00	3.52	
11	RBALP	BLOOD	7510	65.1	65.1	88.00	16.89	
12	RBALP	BLOOD	4320	87.2	87.2	116.00	21.81	
13	RBALP	BLOOD	10600	9.4	9.4	26.00	3.99	
14	RBALP	BLOOD	3230	63.6	63.6	82.00	10.32	
15	RBALP	BLOOD	2150	69.7	69.7	62.00	7.74	
16	RBALP	BLOOD	3200	74.7	74.7	70.00	8.21	
17	RBALP	BLOOD	8350	72.5	72.5	86.00	10.09	
18	RBALP	BLOOD	11200	4.5	4.5	1.00	0.47	
19	RBALP	BLOOD	1270	11.2	11.2	7.00	2.11	
20	RBALP	LIVER	1590	47.0	47.0	28.00	4.46	
21	RBALP	LIVER	6330	37.8	37.8	24.00	3.99	
22	RBALP	LIVER	10800	69.3	69.3	56.00	7.74	(U.S. EPA 2007)
23	RBALP	LIVER	4050	79.0	79.0	100.00	13.84	
24	RBALP	LIVER	11700	64.3	64.3	51.00	12.90	
25	RBALP	LIVER	6940	85.3	85.3	86.00	21.81	
26	RBALP	LIVER	14200	64.9	64.9	87.00	19.00	
27	RBALP	LIVER	3870	71.4	71.4	77.00	16.65	
28	RBALP	LIVER	8170	17.4	17.4	13.00	1.88	
29	RBALP	LIVER	8530	22.3	22.3	13.00	2.35	
30	RBALP	LIVER	7510	65.1	65.1	75.00	13.84	
31	RBALP	LIVER	4320	87.2	87.2	99.00	18.06	
32	RBALP	LIVER	10600	9.4	9.4	19.00	4.93	
33	RBALP	LIVER	3230	63.6	63.6	60.00	11.73	
34	RBALP	LIVER	2150	69.7	69.7	53.00	9.85	
35	RBALP	LIVER	3200	74.7	74.7	58.00	8.91	
36	RBALP	LIVER	8350	72.5	72.5	73.00	11.96	
37	RBALP	LIVER	11200	4.5	4.5	2.00	0.94	
38	RBALP	LIVER	1270	11.2	11.2	11.00	3.99	
39	RBALP	KIDNEY	1590	47.0	47.0	22.00	3.75	
40	RBALP	KIDNEY	6330	37.8	37.8	27.00	4.22	
41	RBALP	KIDNEY	10800	69.3	69.3	58.00	8.44	
42	RBALP	KIDNEY	4050	79.0	79.0	91.00	13.13	
43	RBALP	KIDNEY	11700	64.3	64.3	31.00	5.63	
44	RBALP	KIDNEY	6940	85.3	85.3	70.00	12.20	

45	RBALP	KIDNEY	14200	64.9	64.9	73.00	18.76	
46	RBALP	KIDNEY	3870	71.4	71.4	78.00	19.70	
47	RBALP	KIDNEY	8170	17.4	17.4	12.00	2.35	
48	RBALP	KIDNEY	8530	22.3	22.3	15.00	3.05	
49	RBALP	KIDNEY	7510	65.1	65.1	73.00	14.54	
50	RBALP	KIDNEY	4320	87.2	87.2	125.00	24.16	
51	RBALP	KIDNEY	10600	9.4	9.4	14.00	3.99	
52	RBALP	KIDNEY	3230	63.6	63.6	51.00	14.31	
53	RBALP	KIDNEY	2150	69.7	69.7	41.00	11.02	
54	RBALP	KIDNEY	3200	74.7	74.7	36.00	6.33	
55	RBALP	KIDNEY	8350	72.5	72.5	55.00	9.38	
56	RBALP	KIDNEY	11200	4.5	4.5	1.00	0.47	
57	RBALP	KIDNEY	1270	11.2	11.2	5.00	1.64	
58	RBALP	FEMUR	1590	47.0	47.0	24.00	2.35	
59	RBALP	FEMUR	6330	37.8	37.8	26.00	2.35	
60	RBALP	FEMUR	10800	69.3	69.3	65.00	7.04	
61	RBALP	FEMUR	4050	79.0	79.0	75.00	8.21	
62	RBALP	FEMUR	11700	64.3	64.3	31.00	4.22	
63	RBALP	FEMUR	6940	85.3	85.3	89.00	11.49	
64	RBALP	FEMUR	14200	64.9	64.9	67.00	8.91	
65	RBALP	FEMUR	3870	71.4	71.4	73.00	9.62	
66	RBALP	FEMUR	8170	17.4	17.4	11.00	2.81	
67	RBALP	FEMUR	8530	22.3	22.3	10.00	3.52	
68	RBALP	FEMUR	7510	65.1	65.1	53.00	14.07	
69	RBALP	FEMUR	4320	87.2	87.2	80.00	20.87	
70	RBALP	FEMUR	10600	9.4	9.4	20.00	3.99	
71	RBALP	FEMUR	3230	63.6	63.6	47.00	5.39	
72	RBALP	FEMUR	2150	69.7	69.7	40.00	4.69	
73	RBALP	FEMUR	3200	74.7	74.7	39.00	4.22	
74	RBALP	FEMUR	8350	72.5	72.5	74.00	7.97	
75	RBALP	FEMUR	11200	4.5	4.5	1.00	0.01	
76	RBALP	FEMUR	1270	11.2	11.2	1.00	0.02	
77	RBALP	BLOOD	13992	93.0	93.0	102.00	6.51	
78	RBALP	BLOOD	15705	90.0	90.0	101.00	6.51	
79	RBALP	BLOOD	14372	100.0	100.0	89.00	7.71	
80	RBALP	BLOOD	23409	83.0	83.0	111.00	10.62	
81	RBALP	LIVER	15667	94.0	94.0	191.00	18.84	
82	RBALP	LIVER	23333	98.0	98.0	124.00	12.16	
83	RBALP	LIVER	13992	93.0	93.0	132.00	14.04	(Bannon et al. 2009)
84	RBALP	LIVER	15705	90.0	90.0	125.00	12.33	
85	RBALP	LIVER	14372	100.0	100.0	144.00	41.44	
86	RBALP	LIVER	19464	100.0	100.0	114.00	14.38	
87	RBALP	LIVER	23409	83.0	83.0	113.00	40.58	
88	RBALP	LIVER	4503	99.0	99.0	90.00	11.47	
89	RBALP	KIDNEY	15667	94.0	94.0	134.00	12.50	
90	RBALP	KIDNEY	23333	98.0	98.0	102.00	9.42	

91	RBALP	KIDNEY	13992	93.0	93.0	136.00	10.62	
92	RBALP	KIDNEY	15705	90.0	90.0	133.00	10.45	
93	RBALP	KIDNEY	14372	100.0	100.0	93.00	8.56	
94	RBALP	KIDNEY	19464	100.0	100.0	129.00	12.16	
95	RBALP	KIDNEY	23409	83.0	83.0	104.00	9.42	
96	RBALP	KIDNEY	4503	99.0	99.0	82.00	7.88	
97	RBALP	FEMUR	15667	94.0	94.0	92.00	7.71	
98	RBALP	FEMUR	23333	98.0	98.0	83.00	7.02	
99	RBALP	FEMUR	13992	93.0	93.0	95.00	4.45	
100	RBALP	FEMUR	15705	90.0	90.0	86.00	3.94	
101	RBALP	FEMUR	14372	100.0	100.0	92.00	11.64	
102	RBALP	FEMUR	19464	100.0	100.0	101.00	7.02	
103	RBALP	FEMUR	23409	83.0	83.0	98.00	6.85	
104	RBALP	FEMUR	4503	99.0	99.0	67.00	4.62	
105	SBRC	BLOOD	576	94.0	95.0	85.00	33.40	(Smith et al. 2011a; Smith et al. 2011b)
106	SBRC	BLOOD	1801	99.0	99.9	89.00	15.30	
107	SBRC	BLOOD	1343	45.0	46.9	43.00	6.00	
108	SBRC	BLOOD	1140	58.0	59.7	28.00	19.00	
109	SBRC	BLOOD	2248	39.0	41.1	13.00	3.20	
110	SBRC	BLOOD	954	34.0	36.2	13.00	5.90	
111	SBRC	BLOOD	586	43.0	45.0	10.00	2.80	
112	SBRC	BLOOD	805	91.0	92.0	61.00	6.50	
113	SBRC	BLOOD	1272	85.0	86.1	30.00	6.30	
114	SBRC	BLOOD	1392	74.0	75.4	43.00	11.40	
115	SBRC	BLOOD	835	42.0	44.0	17.00	7.50	
116	SBRC	BLOOD	661	96.0	96.9	63.00	11.00	
117	SBRC	BLOOD	738	73.9	75.3	55.50	6.70	(Li et al. 2014)
118	SBRC	BLOOD	440	76.2	77.5	42.20	6.40	
119	SBRC	BLOOD	306	47.6	49.5	29.10	8.40	
120	SBRC	BLOOD	235	88.0	89.1	47.90	3.70	
121	SBRC	BLOOD	229	84.2	85.4	52.10	11.10	
122	SBRC	BLOOD	200	74.8	76.1	46.50	12.90	
123	SBRC	BLOOD	150	87.0	88.1	59.90	6.70	
124	SBRC	BLOOD	142	56.4	58.1	38.40	14.10	
125	SBRC	BLOOD	141	88.6	89.7	60.10	14.00	
126	SBRC	BLOOD	105	86.4	87.5	56.30	11.40	
127	SBRC	BLOOD	75	74.9	76.2	49.40	8.80	
128	SBRC	BLOOD	63	74.8	76.1	58.00	7.70	
129	SBRC	BLOOD	646	61.0	62.6	17.70	2.32	(Juhasz et al. 2009)
130	SBRC	BLOOD	765	35.7	37.8	19.23	5.11	
131	SBRC	BLOOD	2885	64.1	65.7	11.43	1.79	
132	SBRC	BLOOD	2980	73.4	74.7	10.17	3.01	
133	SBRC	BLOOD	3905	60.9	62.5	14.77	1.05	
134	UBM[e]	LIVER	1460	72.9	79.7	80.00	9.32	(Denys et al. 2012)
135	UBM[e]	LIVER	1630	82.6	89.5	85.00	7.46	
136	UBM[e]	LIVER	1830	81.4	88.3	78.00	6.53	

137	UBM[e]	LIVER	3710	64.9	71.7	38.00	2.80	
138	UBM[e]	LIVER	4482	31.3	37.7	37.00	3.73	
139	UBM[e]	LIVER	5532	82.0	88.9	82.00	3.73	
140	UBM[e]	LIVER	5590	53.7	60.4	30.00	3.73	
141	UBM[e]	LIVER	6791	37.1	43.6	23.00	3.73	
142	UBM[e]	LIVER	11264	22.9	29.3	28.00	1.86	
143	UBM[e]	LIVER	11665	15.4	21.7	18.00	2.80	
144	UBM[e]	KIDNEY	1460	72.9	79.7	75.00	6.06	
145	UBM[e]	KIDNEY	1630	82.6	89.5	100.00	6.06	
146	UBM[e]	KIDNEY	1830	81.4	88.3	100.00	6.06	
147	UBM[e]	KIDNEY	3710	64.9	71.7	51.00	1.86	
148	UBM[e]	KIDNEY	4482	31.3	37.7	33.00	2.80	
149	UBM[e]	KIDNEY	5532	82.0	88.9	76.00	1.86	
150	UBM[e]	KIDNEY	5590	53.7	60.4	46.00	1.40	
151	UBM[e]	KIDNEY	6791	37.1	43.6	22.00	2.80	
152	UBM[e]	KIDNEY	11264	22.9	29.3	25.00	0.93	
153	UBM[e]	KIDNEY	11665	15.4	21.7	21.00	0.93	
154	UBM[e]	FEMUR	1460	72.9	79.7	100.00	5.59	
155	UBM[e]	FEMUR	1630	82.6	89.5	100.00	5.59	
156	UBM[e]	FEMUR	1830	81.4	88.3	100.00	5.59	
157	UBM[e]	FEMUR	3710	64.9	71.7	45.00	2.80	
158	UBM[e]	FEMUR	4482	31.3	37.7	37.00	4.66	
159	UBM[e]	FEMUR	5532	82.0	88.9	77.00	5.13	
160	UBM[e]	FEMUR	5590	53.7	60.4	42.00	3.73	
161	UBM[e]	FEMUR	6791	37.1	43.6	31.00	3.73	
162	UBM[e]	FEMUR	11264	22.9	29.3	34.00	1.86	
163	UBM[e]	FEMUR	11665	15.4	21.7	12.00	4.66	
164	UBM[e]	URINE	1460	72.9	79.7	100.00	6.53	
165	UBM[e]	URINE	1630	82.6	89.5	100.00	6.53	
166	UBM[e]	URINE	1830	81.4	88.3	100.00	6.53	
167	UBM[e]	URINE	3710	64.9	71.7	56.00	2.80	
168	UBM[e]	URINE	4482	31.3	37.7	34.00	6.53	
169	UBM[e]	URINE	5532	82.0	88.9	82.00	5.13	
170	UBM[e]	URINE	5590	53.7	60.4	39.00	5.59	
171	UBM[e]	URINE	6791	37.1	43.6	31.00	5.59	
172	UBM[e]	URINE	11264	22.9	29.3	32.00	1.86	
173	UBM[e]	URINE	11665	15.4	21.7	20.00	1.86	
174	UBM[e]	BLOOD	4050	11.6	17.8	94.00	15.01	(Wragg et al. 2011)
175	UBM[e]	BLOOD	11500	6.9	13.1	47.00	7.97	
176	UBM[e]	BLOOD	8530	10.3	16.5	19.00	3.52	
177	UBM[e]	BLOOD	3200	3.2	9.4	70.00	8.21	
178	UBM[e]	BLOOD	8170	0.6	6.7	21.00	3.75	
179	UBM[e]	BLOOD	10600	0.9	7.0	26.00	3.99	
180	UBM[e]	LIVER	4050	11.6	17.8	100.00	13.84	
181	UBM[e]	LIVER	11500	6.9	13.1	51.00	12.90	
182	UBM[e]	LIVER	8530	10.3	16.5	13.00	2.35	
183	UBM[e]	LIVER	3200	3.2	9.4	58.00	8.91	

184	UBM[e]	LIVER	8170	0.6	6.7	13.00	1.88	
185	UBM[e]	LIVER	10600	0.9	7.0	19.00	4.93	
186	UBM[e]	KIDNEY	4050	11.6	17.8	91.00	13.13	
187	UBM[e]	KIDNEY	11500	6.9	13.1	31.00	5.63	
188	UBM[e]	KIDNEY	8530	10.3	16.5	15.00	3.05	
189	UBM[e]	KIDNEY	3200	3.2	9.4	36.00	6.33	
190	UBM[e]	KIDNEY	8170	0.6	6.7	12.00	2.35	
191	UBM[e]	KIDNEY	10600	0.9	7.0	14.00	3.99	
192	UBM[e]	FEMUR	4050	11.6	17.8	75.00	8.21	
193	UBM[e]	FEMUR	11500	6.9	13.1	31.00	4.22	
194	UBM[e]	FEMUR	8530	10.3	16.5	10.00	3.52	
195	UBM[e]	FEMUR	3200	3.2	9.4	39.00	4.22	
196	UBM[e]	FEMUR	8170	0.6	6.7	11.00	2.81	
197	UBM[e]	FEMUR	10600	0.9	7.0	20.00	3.99	
198	UBM[e]	BLOOD	975	95.0	99.2	58.00	16.24	
199	UBM[e]	BLOOD	593	17.0	23.3	47.00	14.57	
200	UBM[e]	BLOOD	1887	87.0	94.0	56.00	14.56	
201	RIVM[b]	BLOOD	468	90.0	83.8	59.00	19.47	(Kesteren 2014)
202	RIVM[b]	BLOOD	593	30.0	25.6	47.00	14.57	
203	RIVM[b]	BLOOD	3014	56.0	50.8	84.00	12.60	
204	RIVM[b]	BLOOD	1887	68.0	62.4	56.00	14.56	
205	RIVM[b]	BLOOD	4050	89.7	83.5	94.00	15.01	
206	RIVM[b]	BLOOD	11500	82.5	76.5	47.00	7.97	
207	RIVM[b]	BLOOD	6940	85.7	79.6	84.00	14.78	
208	RIVM[b]	BLOOD	8530	25.9	21.6	19.00	3.52	
209	RIVM[b]	BLOOD	4320	90.4	84.2	116.00	21.81	
210	RIVM[b]	BLOOD	3200	87.3	81.2	70.00	8.21	
211	RIVM[b]	BLOOD	8350	76.3	70.5	86.00	10.09	
212	RIVM[b]	BLOOD	11200	4.0	0.4	1.00	0.47	
213	RIVM[b]	BLOOD	1270	13.3	9.4	7.00	2.11	
214	RIVM[b]	LIVER	4050	89.7	83.5	100.00	13.84	
215	RIVM[b]	LIVER	11500	82.5	76.5	51.00	12.90	
216	RIVM[b]	LIVER	6940	85.7	79.6	86.00	21.81	
217	RIVM[b]	LIVER	8530	25.9	21.6	13.00	2.35	(Oomen et al. 2006)
218	RIVM[b]	LIVER	4320	90.4	84.2	99.00	18.06	
219	RIVM[b]	LIVER	3200	87.3	81.2	58.00	8.91	
220	RIVM[b]	LIVER	8350	76.3	70.5	73.00	11.96	
221	RIVM[b]	LIVER	11200	4.0	0.4	2.00	0.94	
222	RIVM[b]	LIVER	1270	13.3	9.4	11.00	3.99	
223	RIVM[b]	KIDNEY	4050	89.7	83.5	91.00	13.13	
224	RIVM[b]	KIDNEY	11500	82.5	76.5	31.00	5.63	
225	RIVM[b]	KIDNEY	6940	85.7	79.6	70.00	12.20	
226	RIVM[b]	KIDNEY	8530	25.9	21.6	15.00	3.05	
227	RIVM[b]	KIDNEY	4320	90.4	84.2	125.00	24.16	
228	RIVM[b]	KIDNEY	3200	87.3	81.2	36.00	6.33	
229	RIVM[b]	KIDNEY	8350	76.3	70.5	55.00	9.38	

230	RIVM[b]	KIDNEY	11200	4.0	0.4	1.00	0.47
231	RIVM[b]	KIDNEY	1270	13.3	9.4	5.00	1.64
232	RIVM[b]	FEMUR	4050	89.7	83.5	75.00	8.21
233	RIVM[b]	FEMUR	11500	82.5	76.5	31.00	4.22
234	RIVM[b]	FEMUR	6940	85.7	79.6	89.00	11.49
235	RIVM[b]	FEMUR	8530	25.9	21.6	10.00	3.52
236	RIVM[b]	FEMUR	4320	90.4	84.2	80.00	20.87
237	RIVM[b]	FEMUR	3200	87.3	81.2	39.00	4.22
238	RIVM[b]	FEMUR	8350	76.3	70.5	74.00	7.97
239	RIVM[b]	FEMUR	11200	4.0	0.4	1.00	0.01
240	RIVM[b]	FEMUR	1270	13.3	9.4	1.00	0.02
241	RIVM[c]	BLOOD	6940	61.3	56.2	84.00	14.78
242	RIVM[c]	BLOOD	4320	77.0	75.2	116.00	21.81
243	RIVM[c]	BLOOD	8350	68.4	64.8	86.00	10.09
244	RIVM[c]	LIVER	6940	61.3	56.2	86.00	21.81
245	RIVM[c]	LIVER	4320	77.0	75.2	99.00	18.06
246	RIVM[c]	LIVER	8350	68.4	64.8	73.00	11.96
247	RIVM[c]	KIDNEY	8530	61.3	56.2	15.00	3.05
248	RIVM[c]	KIDNEY	8350	77.0	75.2	55.00	9.38
249	RIVM[c]	KIDNEY	11200	68.4	64.8	1.00	0.47
250	RIVM[c]	FEMUR	6940	61.3	56.2	89.00	11.49
251	RIVM[c]	FEMUR	4320	77.0	75.2	80.00	20.87
252	RIVM[c]	FEMUR	8350	68.4	64.8	74.00	7.97

Abbreviations. BAc: bioaccessibility; RBA: relative bioavailability; IVIVC: *in vitro* and *in vivo* correlation; RBALP: relative bioaccessibility leaching procedure; SBRC: Solubility/Bioavailability Research Consortium; UBM: BARGE Unified Bioaccessibility; RIVM: National Institute for Public Health and Environment method.

Note: a, standard error for respective RBA; b, solid/liquid ratio is 1:375; c: solid/liquid ratio is 1:37.5; d, adjusted to RAc that is in the form of 'RBALP'; e, Relative BAc has been used in the original literature for the UBM method.

Table S2. Type-specific BAc data collected from literature

Type	Lead concentration (ppm)	Method	BAc (%)	Reference
residential	55	RBALP	71.4	(Minca et al. 2013)
residential	39	RBALP	76.9	
residential	954	RBALP	35.92	(Juhasz et al. 2013)
others	2248	RBALP	60.73	
residential	649	RBALP	61.25	
others	1140	RBALP	64.14	
others	835	RBALP	64.33	
mining/smelting	1004	SBRC	26.8	(Smith et al. 2011b)
mining/smelting	489	SBRC	35.1	
mining/smelting	142	SBRC	35.2	
mining/smelting	881	SBRC	36.3	
mining/smelting	124	SBRC	38.4	
mining/smelting	6840	SBRC	40.8	
mining/smelting	736	SBRC	41.6	
others	661	SBRC	50	
mining/smelting	820	SBRC	53.8	
mining/smelting	1186	SBRC	54.9	
mining/smelting	5101	SBRC	55.5	
others	806	SBRC	75.2	
others	3026	SBRC	76.8	
others	105	SBRC	81.6	
others	567	SBRC	85.1	
others	1373	SBRC	90.4	
mining/smelting	86	SBRC	93.1	
house dust	255	SBRC	60.3	(Li et al. 2014)
house dust	28	SBRC	64.9	
house dust	51	SBRC	66.2	
house dust	25	SBRC	66.2	
house dust	77	SBRC	72.5	
house dust	63	SBRC	72.5	
house dust	80	SBRC	75.5	
house dust	145	SBRC	76.5	
house dust	204	SBRC	80	
house dust	45	SBRC	87.2	
house dust	79	SBRC	91.5	
house dust	125	SBRC	93.3	
house dust	204	SBRC	69.5	(Dodd et al. 2013)
house dust	85	SBRC	73.9	
residential	2141	RIVM[a]	15	(Denys et al. 2007)
others	77007	RIVM[a]	50	
residential	4767	RIVM[a]	56	
residential	1941	UBM	62	(Roussel et al. 2010)
residential	539	UBM	23	(Farmer et al. 2011)
residential	1200	UBM	34	

residential	441	UBM	36	
residential	602	UBM	37	
residential	1340	UBM	37	
residential	126	UBM	37	
residential	965	UBM	39	
residential	618	UBM	45	
residential	157	UBM	48	
residential	555	UBM	49	
residential	508	UBM	49	
residential	147	UBM	49	
residential	298	UBM	50	
residential	152	UBM	51	
others	227	UBM	54	
residential	1110	UBM	55	
residential	363	UBM	56	
residential	1320	UBM	57	
residential	399	UBM	57	
residential	210	UBM	61	
residential	856	UBM	62	
residential	482	UBM	64	
residential	1150	UBM	65	
residential	709	UBM	66	
residential	2160	UBM	73	
residential	500	UBM	73	
residential	663	UBM	77	
house dust	113	RBALP	48.3	The laboratary research, samples are from Bello et al. (2016)
house dust	22	RBALP	80	
house dust	48	RBALP	48.9	
house dust	110	RBALP	22.9	
house dust	422	RBALP	98.1	
house dust	627	RBALP	89.7	
house dust	2834	RBALP	54.7	
house dust	9788	RBALP	90.3	
house dust	2188	RBALP	39.9	
house dust	1358	RBALP	18.5	
house dust	1545	RBALP	22.9	
house dust	1780	RBALP	8.9	
house dust	321	RBALP	24.4	
house dust	731	RBALP	11.5	
house dust	2838	RBALP	9.9	
house dust	5231	RBALP	10.4	
house dust	508	RBALP	17.5	
house dust	98	RBALP	80.8	
mining	57	RBALP	46	
mining	26	RBALP	21.4	
mining	35	RBALP	19	

mining	11	RBALP	25
mining	16	RBALP	16.7
mining	102	RBALP	34
mining	9	RBALP	33.3
mining	2195	RBALP	43
mining	379	RBALP	54.2
mining	203	RBALP	49.4
mining	114	RBALP	37.6
mining	238	RBALP	57.3
mining	109	RBALP	31.6
mining	180	RBALP	33.6
mining	107	RBALP	47.6
mining	93	RBALP	39.3
mining	34	RBALP	32.6
mining	6	RBALP	33.3

Abbreviations. BAc: bioaccessibility; RBALP: relative bioaccessibility leaching procedure; SBRC: Solubility/Bioavailability Research Consortium; UBM: BARGE Unified Bioaccessibility; RIVM: National Institute for Public Health and Environment method used solid/liquid ratio 1:375.

Table S3. Type-specific RBA data collected from literature

Type	Lead concentration (ppm)	RBA (%)	Reference
mining/smelting	1590	27	(Schroder et al. 2004)
mining/smelting	8600	13.75	
mining/smelting	11200	0.75	
mining/smelting	10800	63.25	
mining/smelting	4050	83.75	
mining/smelting	6940	73	
mining/smelting	7510	79	
mining/smelting	4320	97.75	
mining/smelting	10600	14.75	
mining/smelting	1270	3.76	
mining/smelting	7895	11.25	
mining/smelting	11500	49.25	
mining/smelting	3200	79.75	
mining/smelting	8350	75	
mining/smelting	3230	53.25	
mining/smelting	2150	46.25	
mining/smelting	14200	70.5	
mining/smelting	3870	68.5	
mining	3940	9.3	(Ruby et al. 1996)
mining	3908	22.5	
residential	1388	35	
residential	2090	41	
smelting	2290	35.5	(Hettiarachchi et al. 2003)
smelting	8170	14	(Casteel et al. 2006)
smelting	10800	61	
smelting	11700	40	
smelting	10600	20	
mining	3230	60	
mining	2150	49	
smelting	3200	51	
mining	11200	1	
mining	1270	6	
others	6330	27	
others	6940	82	
others	8530	14	
residential	14200	74	
residential	4050	90	
residential	7510	72	
residential	4320	105	
residential	8350	72	
residential	1590	27	
residential	3870	75	
mining/smelting	15667	139	(Bannon et al. 2009)
mining/smelting	23333	103	
mining/smelting	13992	116.25	

mining/smelting	15705	111.25	
mining/smelting	14372	104.5	
mining/smelting	19464	114.67	
mining/smelting	23409	106.5	
mining/smelting	4503	79.67	
mining	805	61	
smelting	1272	30	
smelting	1392	43	
others	576	85	
others	1801	89	
others	1343	43	(Smith et al. 2011a)
others	1140	28	
others	2248	13	
others	954	13	
others	586	10	
others	835	17	
smelting	40214	8.25	
smelting	32598	8.25	
smelting	11665	17.75	
smelting	11264	29.75	
smelting	30155	32.25	
residential	4482	35.25	
residential	6791	26.75	
residential	19291	46.75	(Denys et al. 2012)
residential	37532	58.67	
residential	32833	57	
residential	5590	39.25	
residential	3710	47.5	
residential	1460	88.75	
residential	1830	94.5	
residential	1630	96.25	
house dust	2280	52	(Wragg et al. 2011)
house dust	738	55.5	
house dust	440	42.2	
house dust	306	29.1	
house dust	235	47.9	
house dust	229	52.1	
house dust	200	46.5	(Li et al. 2014)
house dust	150	59.9	
house dust	142	38.4	
house dust	141	60.1	
house dust	105	56.3	
house dust	75	49.4	
house dust	63	58	
residential	975	58	(Kesteren 2014)
residential	468	59	
residential	593	47	

residential	3014	84	
residential	1887	56	
residential	3573	95	
residential	2090	41	(Schoof et al. 1995)
mining/smelting	810	10.08	(Freeman et al. 1992)
mining/smelting	3908	14.11	

Abbreviation. RBA: relative bioavailability.

Table S4. Correlations among the *in vitro* methods (Kaihong Yan et al. 2015).

Independent variable (x)`	Dependent variable (y)	Predictive model
SBRC	RBALP	$y=0.98x+2.83$, $r^2=0.96$, n=10, $p<0.01$
UBM	RBALP	$y=1.02x+6.13$, $r^2=0.81$, n=8, $p<0.01$
RIVM[a]	RBALP	$y=0.97x-3.52$, $r^2=0.84$, n=10, $p<0.01$
RIVM[b]	RBALP	$y=1.21x-17.96$, $r^2=0.85$, n=8, $p<0.01$

Abbreviations. RBALP: relative bioaccessibility leaching procedure; SBRC: Solubility/Bioavailability Research Consortium; UBM: BARGE Unified Bioaccessibility; RIVM[a]: National Institute for Public Health and Environment method used solid/liquid ratio 1:375; RIVM[b]: National Institute for Public Health and Environment method used solid/liquid ratio 1:37.5.

Table S5. Comparisons of meta-analysis models to correlate BAc and RBA

	β	α_0	c	DIC
Linear	0.063	0.81	--	-449.17
two parameters exponential	-0.32	0.47	--	-446.26
three parameters exponential	-3.71	3.75	0.24	-445.28

Abbreviation. DIC: Deviance information criterion. The model definitions are provided as Equations (3)-(5)

Table S6. Ordinary least squares regressions and weighted least squares regressions to correlate BAc and RBA for different studies

Method (n)[c]	OLS[d]		WLS[e]		Reference
	Constant	Coefficient	Constant	Coefficient	
RBALP & Point (19)	-0.054	1.03***	-0.025	0.84***	(U.S. EPA 2007)
RBALP & Point (8)	1.68	-0.62	2.46	-1.47	(Bannon et al. 2009)
SBRC & Blood (12)	-0.22	0.94***	-0.18	0.78***	(Smith et al. 2011a; Smith et al. 2011b)
SBRC & Blood (5)	0.28	-0.23	0.33	-0.30	(Juhasz et al. 2009)
SBRC & Blood (12)	0.032	0.61***	0.15	0.44*	(Li et al. 2014)
UBM & Point (10)	-0.11	1.08***	0.021	0.80***	(Denys et al. 2012)
UBM & Point (6)	-0.0083	3.31	0.16	0.41	(Wragg et al. 2011)
RIVM[a] & Blood (9)	-0.068	0.94**	-0.017	0.70***	(Oomen et al. 2006)

Note: a, S/L ratio 1:375; b, S/L ratio 1:37.5; c, In this column, point represents average bioavailability of the multiple biomarkers; d: ordinary linear regressions; e: weighted linear regressions.
*: $p<0.05$; **: $p<0.01$; ***: $p<0.001$

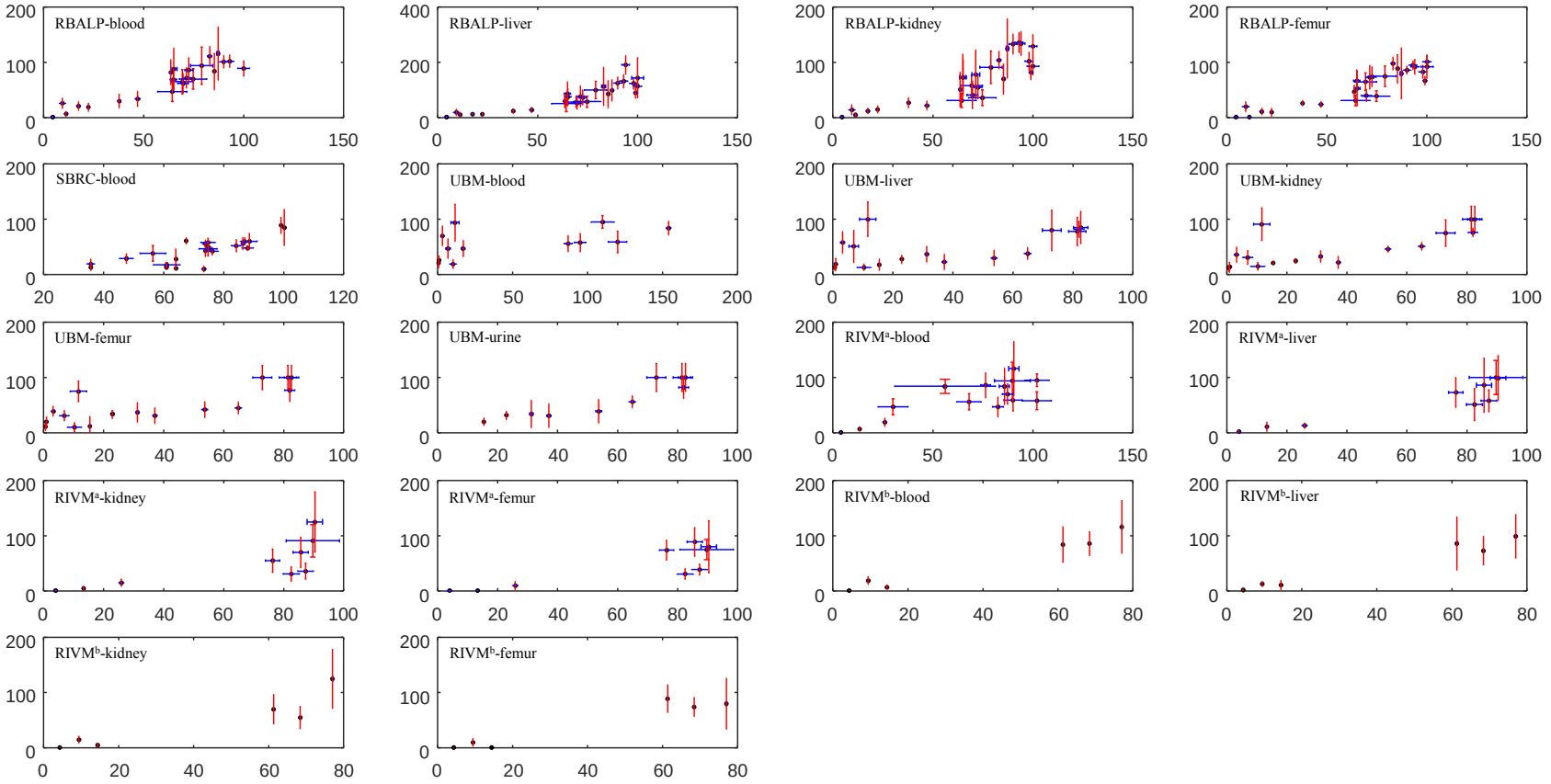

Figure S1. The scatter plot for bioaccessibility and relative bioavailability with individual variations. a: 1:375 Solid/Liquid ratio; b: 1:37.5 Solid/Liquid ratio.

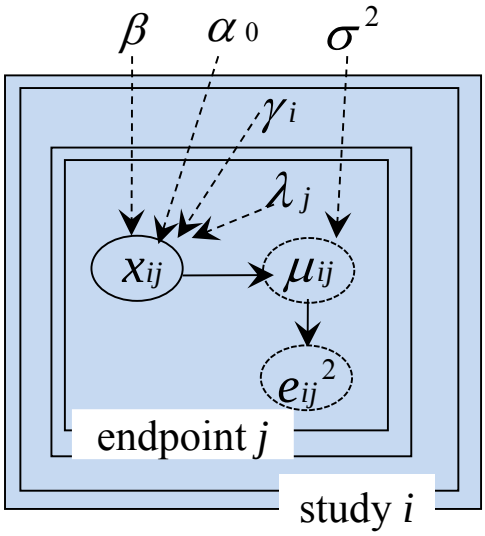

Figure S2. Schematic to estimate variance by using mixed linear model
e: variance; μ: real variance; σ^2: residuals; β: intercept; α_0: overall coefficient; γ: absolute coefficient differences among studies; λ: absolute coefficient differences among endpoints.

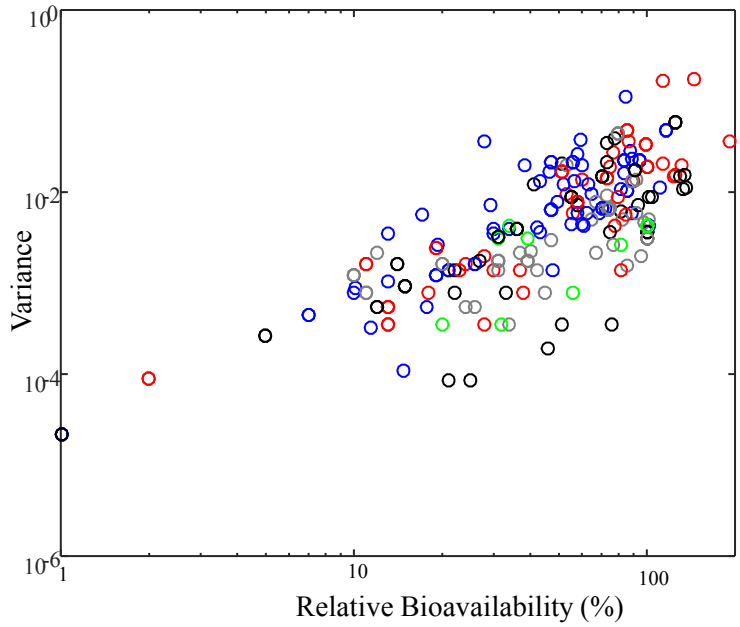

Figure S3. Scatter plot for relative bioavailability and its variance
Color: Blue (blood); Red (liver); Black (kidney); grey (femur); Green (urine).

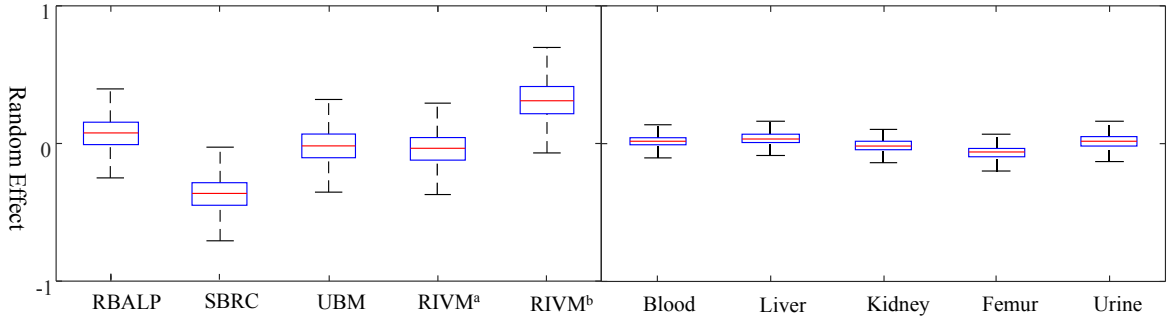

Figure S4. Boxplot for the random effects of the variances among methods and biomarkers. a: 1:37.5 Solid/Liquid ratio; b: 1:375 Solid/Liquid ratio. For each box the central mark is the median, the edges of the box are the 25th and 75th percentiles, the whiskers extend to the most extreme data points not considered outliers, and outliers are not plotted. RBALP: relative bioaccessibility leaching procedure; SBRC: Solubility/Bioavailability Research Consortium; UBM: BARGE Unified Bioaccessibility; RIVM[a]: National Institute for Public Health and Environment method used solid/liquid ratio 1:375; RIVM[b]: National Institute for Public Health and Environment method used solid/liquid ratio 1:37.5.

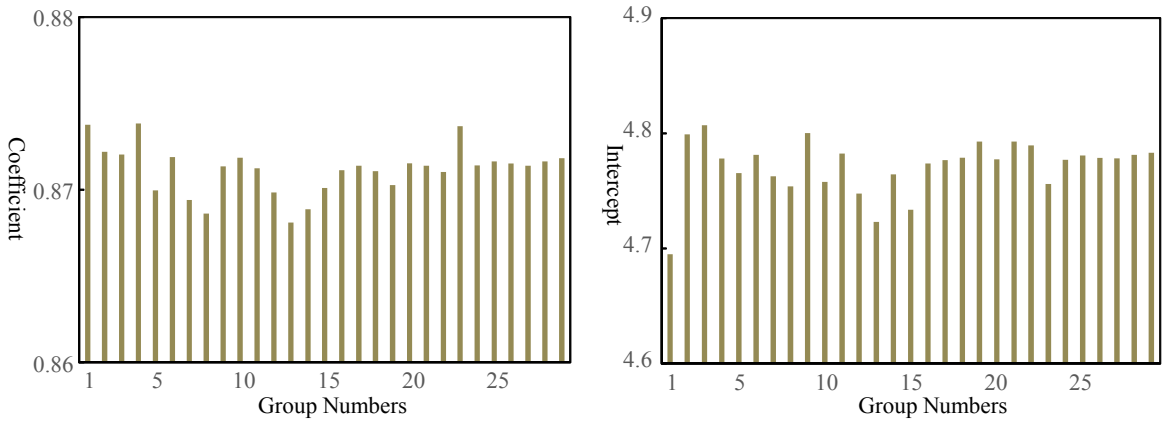

Figure S5. Robustness analysis: Re-simulated intercepts and coefficients based on Jackknife re-sampling

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