Supplemental Material

Polybrominated Diphenyl Ethers in Human Milk and Serum from the US EPA MAMA Study: Modeled Predictions of Infant Exposure and Considerations for Risk Assessment

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First Visit Questionnaire, U.S. EPA MAMA Study (Fenton 2004)

Title of Study: Methods Advancement for Milk Analysis (MAMA)
Sponsored by: U.S. Environmental Protection Agency
Study number: 03-EPA-207 Today’s Month /Year: ____________
Interviewer’s Name:____________________________ Interview start time:___________

Subject code: ____________________________

Attach Consent code here once signed. Attach Questionnaire code here and proceed with questions.

We would like you to answer the following questions for us so that we can obtain information about your lifestyle and surroundings. The subject matter should in no way alarm you, as this is just an information-gathering device to help us understand other information that is obtained from your samples. Some of the questions may have multiple answers. Please feel free to ask questions if you have any. We want you to be comfortable answering the following:

1. What is your month and year of birth? ______________
2. What is your height? __________
3. What is your weight? __________
4. What is your child’s age? (round to the nearest week) __________
5. How many children have you given birth to previously? __________
6. How many children have you previously breastfed? __________
7. If you have had previously breastfed a child(ren), about how long? __________
8. Were you informed at any time during your pregnancy that you had gestational diabetes Yes ______ No ______
   pre-eclampsia/toxemia Yes ______ No ______
   excessive weight gain Yes ______ No ______
9. How many times have you breast-fed your baby since midnight? __________
10. Is your baby being fed formula in addition to breast milk? (yes/no) ______
    How many times in a 24-hour period are you breast-feeding? __________
    How many times in a 24-hour period is your baby drinking formula? ______


Questionnaire (Cont’d)

*Title of Study: Methods Advancement for Milk Analysis (MAMA)*

11. Are you currently taking any prescription medication(s) on a regular basis?  
   *If yes, please specify: ________________________________*

12. Have you taken any non-prescription medications in the last 24 hours?  
   *If yes, please specify: ________________________________*

13. Do you have any cold/flu symptoms (sore throat, runny nose, fever, sore muscles) today?  
   *Yes _________  No _________*

14. Are you currently experiencing any allergy symptoms?  
   *Yes _________  No _________*

15. What county do you live in and how long have you lived in this county? _________

16. How long have you lived in North Carolina? _________ The United States? ___

What is your race? (circle one) white, black or African American, Asian, Hispanic or Latino, Native American (Indian, Alaskan, Hawaiian), mixed.

17. What is your approximate household income? (circle one)  
   *Under $29,999  $30K to 50K  $50K to 75K  $75K to 100K  over $100K*

18. What is the highest grade of formal schooling completed? ________________

19. How long have you lived in your present dwelling? ________________

20. How old is your home or rental unit? ________________

21. Does your home have an enclosed garage attached? ________________

22. How old is the carpeting in your home? ________________

23. How old are any of the upholstered pieces of living room furniture in your home? ___

24. Do you have vinyl blinds on your windows that are over 5-6 years old?  
   *Yes _________  No _________  How many? ________________*

25. Do you have any lead-containing paint or asbestos in your home? (circle one)  
   *Yes to both  No  Don’t know  Probably yes to one _________
26. What are the average hours you spend in your home each day? _____________

27. How many hours do you spend in your vehicle each day? _________________
   Make and year: _______________

28. Are you exposed to second-hand cigarette smoke in your workplace or at home?
   Yes ________  No ____________
   If yes, approximately how many hours/day are you exposed? ________________

29. Are you presently on maternity leave from your place of employment?
   Yes ____________  No ____________
   If you work outside the home:
   How many hours a day are you away from your home? ________________
   In which county do you work? ________________

30. Estimate how many hours a week you spend within 6 feet of a computer.
    ________________

31. Estimate how many hours per day you spend within 6 feet of a television.
    ________________

32. Do you pursue any of the following hobbies?
   Furniture upholstery/refinishing  Yes ___ No ___
   Pillow making  Yes ___ No ___
   Painting  Yes ___ No ___
   Gardening  Yes ___ No ___
   Computer repair  Yes ___ No ___
   Hobbies that require the use of airplane glue or solvents  Yes ___ No ___
   Talk on a cellular phone more than 1 hour per day  Yes ___ No ___
   Talk on a cellular phone more than 3 hours per day  Yes ___ No ___

33. How often do you:  (1 = never, 2 = rarely, 3 = sometimes, 4 = often)
   wear nail polish ____________  use hair styling products _______________
   wear foundation ____________  consume/drink tofu or soy products ___
   color your hair ____________  eat processed meats ________________
   take recreational drugs ________  (sausages, hot dogs, bologna, etc)
   eat microwave popcorn_______  take herbal remedies/supplements_______
Questionnaire (Cont’d)

Title of Study: Methods Advancement for Milk Analysis (MAMA)

34. In a usual week, how many hours do you spend in these occupations, activities, or establishments?

Painting
Dry cleaning
Chemical Plant or Lab
Plastics Fabrication
Plastic or Computer Recycling
Furniture Refinishing/Repair
Firefighter/burn trash
Carpet/insulation installation
Carpet cleaning
Clean houses
Work with flame retardant chemicals
Recycle electronic goods or plastic materials
Repair computers or electronic equipment
Make plastic parts
Work with furniture parts, furniture coverings, or carpets
Computers

35. Do you eat chicken? How often in each category (per week)?
Grilled
Baked
Fried

36. How often do you:

- eat fish
  Never  _____  Less than once/week  _________  Once/week  _____  Twice/week  _____  > Twice/week  _____

List all of the kinds of fish that you eat:

- eat beef
  Never  _____  Less than once/week  _________  Once/week  _____  Twice/week  _____  > Twice/week  _____

List all of the ways that you prefer to cook your beef
Title of Study: Methods Advancement for Milk Analysis (MAMA)

36. How often do you: (con’t.)
- Eat dairy products
  - Never ______ Two times or less/week ________
  - Two times/week but not daily ______ Everyday ______
- Drink cow’s milk
  - Never ______ Two times or less/week ________
  - Two times/week but not daily ______ Everyday ______

37. What kind of milk do you typically drink?
- Skim ______ 2% or less fat ______ whole milk ______

38. Have you had any alcoholic drinks since you have been breast-feeding ______
   If yes, how many drinks/week do you have? ________________________________

39. What is the primary source of your drinking water? (city, well, bottled water)
   ________________________________________________

40. How much water do you drink each day (e.g. 4 large glasses, 6 small cups)
   ________________________________________________

Thank you very much for your time. Do you have any questions for me?

Time interview ended: __________________
Table S1. Spearman correlation between maternal age and BFR concentrations.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Serum $r_s$</th>
<th>p-value</th>
<th>Milk $r_s$</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>BB-153</td>
<td>0.47</td>
<td>&lt;0.001</td>
<td>0.35</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>BDE-28</td>
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<td>&lt;0.01</td>
<td>n.d.</td>
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<tr>
<td>BDE-47</td>
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<td>-0.25</td>
<td>0.05</td>
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<tr>
<td>BDE-85</td>
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<td>0.09</td>
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<td>0.10</td>
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<tr>
<td>BDE-100</td>
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<td>-0.33</td>
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<td>BDE-153</td>
<td>-0.27</td>
<td>&lt;0.05</td>
<td>-0.26</td>
<td>&lt;0.05</td>
</tr>
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<td>&lt;0.05</td>
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<td>ΣPBDEs</td>
<td>-0.34</td>
<td>&lt;0.01</td>
<td>-0.28</td>
<td>&lt;0.05</td>
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</tbody>
</table>

n.d., not determined.
Median maternal age = 31 yr (range, 21-39 yr).
n = 63-64 individual samples.
**Table S2.** Spearman correlation between vehicle age and BFR concentrations.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Serum</th>
<th>Milk</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$r_s$</td>
<td>$p$-value</td>
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<td>BB-153</td>
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</tr>
<tr>
<td>BDE-47</td>
<td>0.40</td>
<td>&lt;0.01</td>
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<tr>
<td>BDE-28</td>
<td>0.32</td>
<td>&lt;0.02</td>
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<tr>
<td>BDE-85</td>
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<td>&lt;0.02</td>
</tr>
<tr>
<td>BDE-99</td>
<td>0.31</td>
<td>&lt;0.02</td>
</tr>
<tr>
<td>BDE-100</td>
<td>0.39</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>BDE-153</td>
<td>0.26</td>
<td>0.05</td>
</tr>
<tr>
<td>BDE-154</td>
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<td>&lt;0.01</td>
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<tr>
<td>ΣPBDEs</td>
<td>0.24</td>
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</table>

n.d., not determined.
Median vehicle age = 5 yr (range, 0.1-11 yr).
n = 63-64 individual samples.
### Table S3. Spearman correlation between home age and BFR concentrations.

<table>
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<th>Variable</th>
<th>Serum</th>
<th></th>
<th>Milk</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$r_s$</td>
<td>$p$ -value</td>
<td>$r_s$</td>
<td>$p$ -value</td>
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<tr>
<td>BB-153</td>
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<td>0.05</td>
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<td>BDE-28</td>
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<td>&lt;0.01</td>
<td>n.d.</td>
<td>--</td>
</tr>
<tr>
<td>BDE-47</td>
<td>-0.30</td>
<td>&lt;0.05</td>
<td>-0.30</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>BDE-99</td>
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<td>&lt;0.05</td>
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<td>&lt;0.05</td>
</tr>
<tr>
<td>BDE-100</td>
<td>-0.36</td>
<td>&lt;0.01</td>
<td>-0.36</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>BDE-153</td>
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<tr>
<td>BDE-154</td>
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<td>0.66</td>
</tr>
<tr>
<td>ΣPBDEs</td>
<td>-0.25</td>
<td>0.05</td>
<td>-0.24</td>
<td>0.06</td>
</tr>
</tbody>
</table>

n.d., not determined.

Median home age = 13 yr (range, 0.5-100 yr).
n = 63-64 individual samples.
Figure S1

A.  
Predicted Milk BDE-85 Concentration (ng/g lipid)
Observed Milk BDE-85 Concentration (ng/g lipid)

- $R^2 = 0.89$
- $r_s = 0.77$
- $p < 0.000001$
- $N = 41$

B.  
Predicted Milk BDE-100 Concentration (ng/g lipid)
Observed Milk BDE-100 Concentration (ng/g lipid)

- $R^2 = 0.98$
- $r_s = 0.94$
- $p < 0.000001$
- $N = 63$

C.  
Predicted Milk BDE-153 Concentration (ng/g lipid)
Observed Milk BDE-153 Concentration (ng/g lipid)

- $R^2 = 0.92$
- $r_s = 0.96$
- $p < 0.000001$
- $N = 62$

D.  
Predicted Milk BDE-154 Concentration (ng/g lipid)
Observed Milk BDE-154 Concentration (ng/g lipid)

- $R^2 = 0.87$
- $r_s = 0.77$
- $p < 0.000001$
- $N = 44$
Figure S1. Predicted milk BFR concentrations vs. observed MAMA Study milk concentrations for BDE-85 (A), BDE-100 (B), BDE-153 (C), and BDE-154 (D). Milk concentrations were predicted by applying exposure models for these BDEs (Marchitti et al., 2013) to serum BDE concentrations from MAMA study participants. Solid lines are the least-squares fit of predicted and observed milk concentrations (R² 0.87-0.98). Spearman correlation coefficients (rₛ) and related p values are given for each evaluation of the relationship between predicted and observed milk concentration values (rₛ = 0.77-0.96).
Additional Information for Models Previously Developed in Marchitti et al. 2013b.

Exposure models for predicting milk PBDE concentrations from serum concentrations have been previously developed (Marchitti et al. 2013b). Three U.S. studies met our study criteria (LaKind et al. 2009; Schecter et al. 2006, 2010) and only participants for whom lipid-adjusted (ng/g lipid) milk and serum PBDE concentrations where both > LOD were included. Data for seven PBDE congeners were available: BDE-28, BDE-47, BDE-85, BDE-99, BDE-100, BDE-153, and BDE-154.

Individual PBDE milk:serum partitioning ratios were calculated for each congener by dividing the milk concentration (ng/g lipid) by the serum concentration (ng/g lipid). Minimal interindividual variability was observed among participants, thus, we combined data from the three studies into one dataset. Pearson’s r correlation coefficients and least-squares linear regression [SigmaPlot Systat Software, version 12.3 (2011)] were used to determine if serum and milk PBDE concentrations for each congener were significantly correlated and yielded model equations:

\[ y_i' = \beta_1 x_i \]

where \( y_i \) is the breast milk PBDE concentration of the participant \( i \), \( \beta_1 \) is the slope of the regression line, and \( x_i \) is the serum PBDE concentration of the participant. \( \beta_1 \) provides an estimate of the congener’s milk:serum partitioning ratio. The predictive power of each model was determined by \( k \)-fold cross-validation followed by the quantification of its predictive ability \( (Q^2) \) (Eriksson et al. 2003). Regression models for the seven PBDE congeners exhibited high predictive abilities \( (Q^2 \geq 0.90) \).
Supplemental References


