PRENATAL EXPOSURE TO MERCURY AND EFFECTS ON BIRTH OUTCOMES OF WOMEN FROM SURINAME’S INTERIOR

GAITREE K. BALDEWSINGH\textsuperscript{1,4}, JEFFREY K. WICKLIFFE\textsuperscript{3}, EDWARD D. VAN EER\textsuperscript{1}, MAUREEN Y. LICHTVELD\textsuperscript{3}, CORNELIS W. ZIJLMANS\textsuperscript{2,3,4}

\textsuperscript{1}MEDICAL MISSION PRIMARY HEALTH CARE SURINAME, SURINAME
\textsuperscript{2}SCIENTIFIC RESEARCH CENTER SURINAME / ACADEMIC HOSPITAL PARAMARIBO, PARAMARIBO, SURINAME
\textsuperscript{3}TULANE UNIVERSITY SCHOOL OF PUBLIC HEALTH AND TROPICAL MEDICINE, GLOBAL ENVIRONMENTAL SCIENCES DEPARTMENT, NEW ORLEANS, USA
\textsuperscript{4}FACULTY OF MEDICAL SCIENCES, ANTON DE KOM UNIVERSITY OF SURINAME
DISCLAIMER

This work is supported in part by the National Institutes of Health (NIH) Fogarty International Center (grant numbers R24TW009570, R24TW009561, U01TW010087, and U2RTW010104)

The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.
OBJECTIVES

• Background

• Methods

• Results

• Discussion

• Future directions
Mercury (Hg) has high toxic potential - especially for developing children – and is widely used in Suriname’s interior for artisanal gold mining.

Suriname is a middle upper income country in the north-east of South America.

The study population is a subset of the Caribbean Consortium of Environmental and Occupational Health environmental epidemiologic cohort study (CCREOH) aimed at examining the effects of chemical and non-chemical stressors on birth outcomes and pediatric neurodevelopment.
STUDY AIM

• To determine prenatal Hg exposure and explore the potential association of Hg exposure and birth outcomes in pregnant women living in Suriname’s interior

• Objectives:
  • measure the Hg level in Interior pregnant women
  • analyze the association between Hg level and birth outcome
MEDICAL MISSION

• White dots MM health centers
• Population: ± 50,000
• 15 recruitment areas (red dots)
METHODS

• Hair samples from pregnant women were collected and analyzed for total Hg using Cold Vapour Atomic Absorption Spectrometry (CVAAS).

• Data on birthweight (BW), and adverse birth outcomes categorized as low birthweight (LBW<2,500g) and preterm birth (PTB<37 weeks) were collected from pregnant women seeking care at the Medical Mission health centers.

• Women were prospectively recruited from April 2017-December 2018.
• 76 live births out of 79 singleton births were included
  • 2 stillbirths and 1 miscarriage

• Simple correlation analysis between hair-Hg and BW treating both as continuous variables

• Exposures were categorized as below or above the median

• Fisher’s exact test and odds ratios to evaluate associations with LBW and PTB
RESULTS
TOTAL HAIR HG PER REGION

- Total mercury in hair from pregnant women in Suriname
- Letters indicate significant differences between regions at p<0.0001 (Kruskal-Wallis)
- USEPA action level 1.1 µg/g hair
## RESULTS

### HAIR Hg INTERIOR

<table>
<thead>
<tr>
<th>[Hg] in hair</th>
<th>Median (ug/g)</th>
<th>Min</th>
<th>Max</th>
<th>25th percentile</th>
<th>75th percentile</th>
</tr>
</thead>
<tbody>
<tr>
<td>[Hg] in hair</td>
<td>2.42</td>
<td>0.6</td>
<td>18.20</td>
<td>1.55</td>
<td>6.64</td>
</tr>
</tbody>
</table>

Table 1. Hair Hg concentration of interior women

- Adverse birth outcomes:
  - 8.6% LBW
  - 15.2% PTB
RESULTS
HAIR HG EXPOSURE LEVELS BY AGE (1)

<table>
<thead>
<tr>
<th>Age (yrs)</th>
<th>Below median (%, n)</th>
<th>Above median* (%,n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 - 19</td>
<td>5.3 (4)</td>
<td>7.9 (6)</td>
</tr>
<tr>
<td>20 - 24</td>
<td>11.8 (9)</td>
<td>15.8 (12)</td>
</tr>
<tr>
<td>25 - 34</td>
<td>15.8 (12)</td>
<td>19.7 (15)</td>
</tr>
<tr>
<td>35 - 44</td>
<td>14.5 (11)</td>
<td>7.9 (6)</td>
</tr>
<tr>
<td>≥ 45</td>
<td>1.3 (1)</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>48.7% (37)</td>
<td>51.3% (39)</td>
</tr>
</tbody>
</table>

Table 2. Age distribution in the study population (n=76)

*71.8% of the Indigenous women were above the median
53.8% live in far remote areas only accessible by air
RESULTS
HAIR HG EXPOSURE LEVELS BY AGE (2)

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Below Median</th>
<th>Above Median</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 - 19 yrs.</td>
<td>5.3</td>
<td>7.9</td>
</tr>
<tr>
<td>20 - 24 yrs.</td>
<td>11.8</td>
<td>15.8</td>
</tr>
<tr>
<td>25 - 34 yrs.</td>
<td>15.8</td>
<td>19.7</td>
</tr>
<tr>
<td>35 - 44 yrs.</td>
<td>14.5</td>
<td>7.9</td>
</tr>
<tr>
<td>≥ 45 yrs.</td>
<td>1.3</td>
<td>0</td>
</tr>
</tbody>
</table>
RESULTS
TOTAL HAIR HG COMPARED TO USEPA ACTION LEVELS

Hair Hg levels (ug/g)

Number of participants n= 76

Hg in hair (ug/g)
Median (ug/g)
USEPA action level
There was no significant correlation between:

- **Hair Hg and LBW** (Fisher's exact test, $p<0.43$, $OR=0.45$ 95%CI--0.08-2.04) or

- **Hair Hg and PTB** (Fisher's exact test, $p<0.51$, $OR=0.59$ 95%CI--0.18-2.12).
DISCUSSION

• Hair Hg levels in the interior are well above the USEPA action levels

• Even though interior women have higher Hg concentrations compared to the coastal area, prevalence of adverse birth outcomes is lower than the coastal area; health system MM

• High Hg is most likely due to consumption of contaminated food, predominantly locally caught fish

• Our results are consistent with the literature regarding exposure to Hg during pregnancy at these concentrations
FUTURE DIRECTIONS

• The findings related to birth outcomes in this sub-cohort will be validated by ongoing analyses of the larger study cohort of the interior (n=200)

• Ongoing monitoring of Hg in both humans and fish is necessary to ensure the effectiveness of public health risk management

• Suriname has no national standards on Hg concentration levels in blood or hair
ACKNOWLEDGEMENTS

• We are extremely thankful to all the women who took part in this study, Medical Mission’s health workers for their help in recruiting, and the Meki Tamara research team.

• A special thanks to my promoters
  • Dr. Wickliffe
  • Dr. Lichtveld
  • Dr. Zijlmans and
  • Edward van Eer, MPH, former director of the Medical Mission