Stable isotopes to assess the intake of human milk in breastfed infants: The deuterium oxide dose-to-mother technique

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Introduction

WHO recommendation is exclusive breastfeeding up to 6 months and continue to breastfeed up to 2 years. In many countries, only limited information is available on breastfeeding practices (quantity of milk consumed by the babies, time of introduction of other food). The deuterium oxide dose-to-mother technique can help to overcome the practical problems linked to the test weighting, which is the conventional method to measure breastmilk intake. Deuterium oxide is metabolized in the body in the same way as water and can be sampled in the form of saliva or urine. The enrichment of deuterium in saliva or urine can be measured by isotope ratio mass spectrometry (IRMS) or Fourier transform infrared spectrometry (FTIR). FTIR is easy to use and suitable for resource-limited settings.

Method

1-The deuterium oxide dose-to-mother technique (1, 2)

[Image: Mother and baby with text indicating method steps]

Weigh the mother in light clothing (to 0.1kg)
Weigh the baby naked (to 0.01kg)
Baseline saliva samples are collected from the mother and her baby.
The mother drinks 30g of deuterium oxide (D₂O or ²H₂O).
The mother feeds her baby as usual and the baby ingests ²H via breast milk.
The post dose saliva samples are collected from the mother and her baby, 1, 2, 3, 4, 13 and 14 days after the dose was given.

2- Analysis of samples

The deuterium enrichment in saliva samples is measured by FTIR, and the results are given in ppm (mg/kg).

3-Deuterium kinetic

After the mother has taken the dose of D₂O, the deuterium gradually disappears from her body and appears in the body of the baby. Deuterium in the baby’s body comes only from the milk consumed during breastfeeding. As the deuterium is eliminated from the mother’s body, the enrichment in her milk declines and therefore the enrichment in the baby’s body also falls.

4-Calculation of human milk intake

A mathematical model is used to determine how much of the deuterium given to the mother appears in the baby’s saliva. This is related to the amount of human milk consumed by the baby. The model also gives an estimate of the amount of water from sources other than its mother’s milk, and therefore whether the baby is exclusively breastfed or not.

Results (output)

1-Enrichment from 2 mother-baby pairs

Baby A is exclusively breastfed and baby B is not exclusively breastfed

[Graphs showing D₂O enrichment in body water (saliva) collected from mother (o) and baby (+)]

2 -Fluid intake in breastfed babies

Results from a Technical Cooperation project:

<table>
<thead>
<tr>
<th>Fluid intake</th>
<th>Quantity ingested by the babies at each period (n=39)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>birth</td>
</tr>
<tr>
<td>HM (ml/d)</td>
<td>[507.1-624.7]</td>
</tr>
<tr>
<td>Non-HM (ml/d)</td>
<td>[25.5-63.8]</td>
</tr>
</tbody>
</table>

HM: human milk, Non-HM: non human milk water intake
a: mean, b: 95% confidence interval

Conclusion

The deuterium oxide dose-to-mother technique helps to assess breastfeeding practices. Stable isotopes techniques can be used to evaluate national breastfeeding promotion campaigns and can be applied in resource-limited settings.

References:
2 International Atomic Energy Agency. Stable Isotope Technique to Assess Intake of Human Milk in Breastfed Infants, IAEA Human Health Series no 7, IAEA/NAHRES, Vienna, Austria (2010).