Methamphetamine use during pregnancy: A tale of 2 toxins!

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Lifespan Development of Children Born to Mothers who use Drugs During Pregnancy

**Prenatal Effects**
- Teratogenic
  - Immediate
    - Transient
    - Ongoing
  - Latent

**Postnatal Effects**
- Caregiving Environment
  - Specific to Drug Using Lifestyle
  - General Risk Factors

**Protective Factors**
• Powerful stimulant drug
• Odourless crystalline substance
• Colour changes with ingredients
• Smoked, snorted, injected
• Manufactured in man-made labs
How big is the problem?

- Fastest growing drug problem worldwide (UNODC World Drug Report, 2010)
- Prevalence of use in population aged 16-64 highest in NZ with 2.2% of population having tried it compared to 1.1% in US (UNODC World Drug Report, 2010)
- Admissions for drug treatment for pregnant women in US highest for methamphetamine—increased from 8% in 1994 to 26.7% in 2006 (Terplan et al., 2006)
- Referrals to ADAPT team at Auckland Hospital increased from 10% in 2001 to 59% in 2003 (Wouldes et al., 2004)
- Still a big problem?
Infant Development, Environment And Lifestyle Study

Brown Center for the Study of Children at Risk

- Oklahoma
- California
- Iowa
- Hawaii
- Auckland

IDEAL
Inclusion/Exclusion Criteria

• Inclusion
  – 17 years or older
  – English speaking
  – Mother must self-report that she has used methamphetamine, any amphetamine including “speed” or “Ecstasy” or meconium assay confirms use
  – Comparison mothers had to self-report no use of meth and have confirmation with a meconium assay

• Exclusion
  – Mother has been institutionalized for retardation or emotional disorders; was overtly psychotic or had a documented history of psychosis
  – Mother living outside of the Auckland area or planned to move in next 12 months
Exclusion at Birth

- Mother and Newborn Child ineligible if...
  - Multiple births (twins)
  - Infant critically ill
  - Infant is born with a major life threatening congenital anomaly or documented chromosomal abnormality associated with mental or neurologic deficiency
Mothers and Babies who delivered at:
 Waitemata DHB
   Waitakere Hospital
   North Shore Hospital
 Auckland DHB
   National Women’s Health

Groups (Meth-exposed & comparison) matched for ethnicity, maternal education, infant birth weight
Developmental Follow-up

Birth, 1, 3, 9, 12, 24, 30, 36 months & 4.5, 5.5, 6.5 & 9 years?

- Social-emotional
- Cognitive
- Motor
- Growth/Health
- Behaviour
- Environment
Maternal and Environmental Data

- Maternal Lifestyle Interview
  - Neighborhood characteristics
  - Domestic Violence
  - Family Resources
- Medical Chart Review
- Beck Depression Interview (BDI)
- Brief Symptom Inventory (BSI)
- Substance Use Inventory (SUI)
- Substance Abuse Subtle Screening Inventory-3 (SASSI-3)
- Addiction Severity Index (ASI)
Self-Identified Ethnicity METH

**US**
- White: 40%
- Hispanic: 25%
- Hawaiian/Pacific Islands: 18%
- Asian: 10%
- Black: 5%
- American Indian: 2%

**NZ**
- Maori: 31%
- White: 57%
- Pacific Islands: 8%
- Asian: 4%
## Comparison of Biological Mothers Background

<table>
<thead>
<tr>
<th>Maternal Characteristics</th>
<th>US METH N = 126</th>
<th>US COMP N = 193</th>
<th>NZ METH N = 93</th>
<th>NZ COMP N = 107</th>
</tr>
</thead>
<tbody>
<tr>
<td>White/European</td>
<td>41%</td>
<td>40%</td>
<td>58%</td>
<td>47%</td>
</tr>
<tr>
<td>Maori</td>
<td>-</td>
<td>-</td>
<td>32%</td>
<td>36%</td>
</tr>
<tr>
<td>Hawaiian/Pacific Is</td>
<td>18%</td>
<td>17%</td>
<td>8%</td>
<td>13%</td>
</tr>
<tr>
<td>Asian</td>
<td>10%</td>
<td>14%</td>
<td>2%</td>
<td>4%</td>
</tr>
<tr>
<td>Black</td>
<td>5%</td>
<td>14%</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>American Indian</td>
<td>2%</td>
<td>2%</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Education &lt; high school</td>
<td>38%</td>
<td>38%</td>
<td>62%</td>
<td>50%</td>
</tr>
<tr>
<td>Mean Maternal Age</td>
<td>25.71</td>
<td>24.55</td>
<td>26.72</td>
<td>25.57</td>
</tr>
<tr>
<td>Low SES &lt;5 Hollings.</td>
<td>29%*</td>
<td>12%</td>
<td>46%*</td>
<td>18%</td>
</tr>
<tr>
<td>Income &lt;$20,000</td>
<td>60%*</td>
<td>40%</td>
<td>33%*</td>
<td>18%</td>
</tr>
<tr>
<td>No Partner</td>
<td>52%*</td>
<td>34%</td>
<td>52%*</td>
<td>27%</td>
</tr>
</tbody>
</table>
Percent of US and NZ Mothers who used Marijuana, Tobacco and Alcohol prenatally (Substance Use Inventory)

**US Study**
- Marijuana: 34% (MA Exposed), 4% (Comparison)
- Tobacco: 26% (MA Exposed), 13% (Comparison)
- Alcohol: 5% (MA Exposed)
- Ecstasy: 2% (MA Exposed)
- Methamphetamine: 97% (MA Exposed)

**NZ Study**
- Marijuana: 21% (MA Exposed), 62%* (Comparison)
- Tobacco: 51% (MA Exposed), 86%* (Comparison)
- Alcohol: 51% (MA Exposed), 63% (Comparison)
- Ecstasy: 19% (MA Exposed)
- Amphetamine: 15% (MA Exposed), 94% (Comparison)

*Significant difference
Birth Outcomes

• US Study found exposed infants were 3.5 times more likely to be born SGA—(Smith et al. 2006)
  – NZ babies bigger at birth than US babies (WHO)

• Neurobehaviour at Birth and 1 Month – exposed infants in both US and NZ
  – Under arousal, low tone, poorer quality of movement, increased stress
  – NZ only more asymmetric reflexes

LaGasse, Wouldes et al. (2011)
Not Living with Biological Mother

<table>
<thead>
<tr>
<th>% Not Living with Biological Mother</th>
<th>1 Month</th>
<th>12 Months</th>
<th>24 Months</th>
</tr>
</thead>
<tbody>
<tr>
<td>US METH</td>
<td>33</td>
<td>37</td>
<td>44</td>
</tr>
<tr>
<td>NZ METH</td>
<td>3</td>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td>US COMP</td>
<td>2</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>NZ COMP</td>
<td>3</td>
<td>2</td>
<td>4</td>
</tr>
</tbody>
</table>
Positive Diagnosis Psychiatric Illness (BSI)

1 Month:
- US METH: 38%
- US COMP: 27%
- NZ METH: 42%
- NZ COMP: 22%

12 Month:
- US METH: 34%
- US COMP: 32%
- NZ METH: 43%
- NZ COMP: 26%
Maternal SUD and Mental Illness

• US and NZ Mothers who used METH 10 times more likely to meet criteria for a Substance Use Disorder (SUD)
  – US and NZ Mothers who used METH over 2.5 times more likely to meet criteria for a diagnosis of a Psychiatric Disorder (PD)
  – NZ only mothers were 5.5 times more likely to meet criteria for both SUD and PD

Wouldes, LaGasse et al. (2013)
Prenatal Care

<table>
<thead>
<tr>
<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Mean Number of Visits</td>
<td>11.4</td>
<td>14.4*</td>
<td>15.8**</td>
<td>17.0</td>
</tr>
<tr>
<td>GA first visits (weeks)</td>
<td>14.8</td>
<td>9.5*</td>
<td>15.9*</td>
<td>13.2</td>
</tr>
<tr>
<td>Inadequate Prenatal Care (%)</td>
<td>23</td>
<td>5*</td>
<td>8***</td>
<td>4</td>
</tr>
</tbody>
</table>

*Significant Difference between MA & Comparison Groups
**Significant Difference between US & NZ MA Groups

Wu, LaGasse, Wouldes et al. (2013)
Reasons for Child Protection Referral

40% Drugs Only
3% Other
57% Drugs + Social/Other

15% Drugs Only
3% Other
83% Drugs + Social Other

Wu, LaGasse, Wouldes et al. 2013
3 Months

Auditory evoked arousal during sleep

Galland, Mitchell, Thompson, Wouldes & NZ IDEAL Study Group 2012
Cognitive & Motor Development over first 3 years

• **US study found:**
  – No differences between MA and Comparison on cognitive outcomes over the first 3 years
  – Significant difference in one aspect of fine motor development “grasping” Smith et al.(2006)

• **NZ study found:**
  – No differences in cognitive outcomes in longitudinal analyses over first 3 years
  – Time trends for psychomotor development showed decreasing trends across the first three years.....
Predictors of delayed motor development

• Peabody Development Motor Scale
  – Gross Motor -- Prenatal MA exposure
  – Fine Motor – Male

• Bayley-II
  – Mental Development – Maori & Male
  – Psychomotor Development – Prenatal MA exposure & Birth weight

Woulde, LaGasse et al. (2014)
At preschool (age 4 ½)........

Are there still effects of prenatal exposure or is methamphetamine “toxic”? 

What part does the child’s environment play in any observed development outcomes or is the environment “toxic”? 

## Characteristics of the Postnatal Environment

<table>
<thead>
<tr>
<th>Postnatal Measures</th>
<th>METH</th>
<th>NO METH</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Maternal Outcome Measures</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caregiver Psychological Symptoms at 1,12,36 &amp; 54 mths (Mean)</td>
<td>-0.59</td>
<td>-0.42</td>
<td>.004</td>
</tr>
<tr>
<td>Postnatal Drug Use (Mean heavy use)</td>
<td>6.89</td>
<td>4.25</td>
<td>&lt;.001</td>
</tr>
<tr>
<td><strong>Maternal Covariates</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HOME (Mean at 30 mths)</td>
<td>33.70</td>
<td>35.28</td>
<td>.100</td>
</tr>
<tr>
<td>PPVT (Mean at 30 mths)</td>
<td>93.40</td>
<td>92.09</td>
<td>.430</td>
</tr>
<tr>
<td>% Parent Training (by age 54 mths)</td>
<td>54%</td>
<td>34%</td>
<td>.010</td>
</tr>
<tr>
<td>% Alcohol/Drug Tx (by age 54 mths)</td>
<td>49%</td>
<td>10%</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>% Mental Health Tx (by age 54 mths)</td>
<td>58%</td>
<td>33%</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>
Early Analyses suggest...

1. Consistent with earlier research **boys** are lagging behind in cognitive and motor development.

2. Alcohol-exposure associated with more problem behaviours.

3. Maori children at preschool age lagging behind in cognitive and motor development and exhibiting more problem behaviours.
Executive Function

• Behaviours associated with inhibition, working memory and flexibility
• Poor executive function or dysfunction associated with problem behaviours (conduct disorder, poor learning outcomes)
### Maternal Report of Everyday Executive Function or Executive Control

<table>
<thead>
<tr>
<th>Model</th>
<th>Inhibit</th>
<th>Emotional Control</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>β</td>
<td>P value</td>
</tr>
<tr>
<td>Model 1. (Child Ethnicity &amp; Gender)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Prenatal Methamphetamine Exposure</strong></td>
<td>.04</td>
<td>.560</td>
</tr>
<tr>
<td></td>
<td>.12</td>
<td>.100</td>
</tr>
<tr>
<td>Model 2. (Child Ethnicity &amp; Gender)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Maternal Postnatal Drug Use</strong></td>
<td>.22</td>
<td>.028</td>
</tr>
<tr>
<td></td>
<td>.26</td>
<td>.002</td>
</tr>
<tr>
<td>Model 3. (Model 2 with mother’s psychological functioning)</td>
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<td></td>
</tr>
<tr>
<td><strong>Postnatal Drug Use</strong></td>
<td>.03</td>
<td>.71</td>
</tr>
<tr>
<td></td>
<td>.12</td>
<td>.16</td>
</tr>
<tr>
<td><strong>Psychological Distress</strong></td>
<td>.49</td>
<td>&lt;.001</td>
</tr>
<tr>
<td></td>
<td>.37</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Model 4. (Model 3 with prenatal methamphetamine exposure &amp; covariates: prenatal alcohol, tobacco, marijuana, child IQ, HOME, SES, maternal age and education)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Postnatal Drug Use</strong></td>
<td>-.02</td>
<td>.810</td>
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<tr>
<td></td>
<td>.08</td>
<td>.340</td>
</tr>
<tr>
<td><strong>Psychological Distress</strong></td>
<td>.44</td>
<td>&lt;.001</td>
</tr>
<tr>
<td></td>
<td>.33</td>
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</tbody>
</table>
### Maternal Report of Behavioral Problems (SDQ)

<table>
<thead>
<tr>
<th>Model</th>
<th>Conduct Problems</th>
<th>Hyperactivity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>β</td>
<td>P value</td>
</tr>
<tr>
<td>Model 1. (Child Ethnicity &amp; Gender)</td>
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<td>Prenatal Methamphetamine Exposure</td>
<td>.05</td>
<td>.498</td>
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<tr>
<td>Model 2. (Child Ethnicity &amp; Gender)</td>
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<td>Model 3. (Model 2 with mother’s psychological functioning)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Postnatal Drug Use</td>
<td>.12</td>
<td>.180</td>
</tr>
<tr>
<td>Psychological Distress</td>
<td>.39</td>
<td>&lt;.001</td>
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<tr>
<td>Model 4. (Model 3 with prenatal methamphetamine exposure &amp; covariates: prenatal alcohol, tobacco, marijuana, child IQ, HOME, SES, maternal age and education)</td>
<td></td>
<td></td>
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<tr>
<td>Postnatal Drug Use</td>
<td>.07</td>
<td>.380</td>
</tr>
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<td>.37</td>
<td>&lt;.001</td>
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</tbody>
</table>
## Observations of Inhibitory Behaviour – The Gift Wrap Delay

<table>
<thead>
<tr>
<th>Model</th>
<th>Gift Wrap Delay</th>
<th>(\beta)</th>
<th>(\text{P value})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model 1. (Child Ethnicity &amp; Gender)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td><strong>Prenatal Methamphetamine Exposure</strong></td>
<td></td>
<td>.03</td>
<td>.720</td>
</tr>
<tr>
<td>Model 2. (Child Ethnicity &amp; Gender)</td>
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<tr>
<td><strong>Maternal Postnatal Drug Use</strong></td>
<td></td>
<td>.02</td>
<td>.890</td>
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<tr>
<td>Model 3. (Model 2 with mother’s psychological functioning)</td>
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<td>Model 4. (Model 3 with prenatal methamphetamine exposure &amp; covariates: prenatal alcohol, tobacco, marijuana, child IQ, HOME, SES, maternal age and education)</td>
<td></td>
<td>.15</td>
<td>.104</td>
</tr>
<tr>
<td><strong>Postnatal Drug Use</strong></td>
<td></td>
<td>.35</td>
<td>&lt;.001</td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Meth Labs Toxic Environments

http://pugetsoundblogs.com

What are the Implications?

- **Mother**
  Treatment – consider both addiction and mental illness

- **Child**
  Consequences of “toxic” environments where there may be:
  - Ongoing drug use
  - Mental Illness
  - Domestic Violence
  - Poverty
Adverse Child Events

ACE Study (Filetti et al. 1998)

- 17,000 adult members of U.S. Health Care Plan Questionnaire asking about ACE
  - Family characteristics
  - Sexual Abuse
  - Physical Abuse
  - Psychological Abuse

- Linear relationship between a number of adult health outcomes and ACE - 4 or more ACE compared to those with none
  - 2.2 times more likely to have Ischaemic heart disease
  - 1.9 times more likely to have any cancer
  - 2.4 times more likely to have had a stroke
  - 3.9 times more likely to have chronic bronchitis or emphysema
  - 1.6 times more likely to have diabetes
Development of Children Born to Mothers who use Drugs During Pregnancy

• Prenatal Effects

Teratogenic

Immediate

Transient

Latent

Ongoing

• Postnatal Effects

Caregiving Environment

Specific to Drug Using Lifestyle

General Risk Factors

Culture

Ethnicity

Legal System

Health Care System

Protective Factors
Prenatal Exposure to METH + **Maternal Psychopathology** + Ongoing drug use = Poor Executive Control
1. **Educate:**
   - Health care professionals
   - Women during antenatal care and/women of childbearing age

2. **Screen:**
   - Recognize common signs & symptoms of Mental Illness & Substance Abuse

3. **Treat:**
   - Treat the whole-family not the individual
   - Treat psychopathology and substance abuse together
     - Early Intervention for children - At risk for learning disabilities, ADHD, Behavioural Problems and Substance Abuse
THANKS TO OUR FUNDERS

- National Institute of Drug Abuse (NIH)
- Auckland Medical Research Foundation
- NZ Child Health Research Foundation
- Neurological Foundation