Chronic Exposure to Pesticides and Intellectual Performance in Children

Patricia Moulton, Ph.D., Thomas Petros, Ph.D., Sally Pyle, Ph.D., Ric Ferraro, Ph.D., Jason Douglas, M.A., Patrick Kerr, M.A., Sue Offutt, Ph.D. & Dana Barr, Ph.D.

American Psychological Association Annual Conference
New Orleans, Louisiana
August 13, 2006

Funding provided by the National Institute of Environmental and Health Science

Connecting resources and knowledge to strengthen the health of people in rural communities.

Center for Rural Health

- Established in 1980, at the University of North Dakota School of Medicine and Health Sciences in Grand Forks, ND
- Focuses on:
  - Education, Training, & Resource Awareness
  - Community Development & Technical Assistance
  - Native American Health
  - Rural Health Workforce
  - Rural Health Research
  - Rural Health Policy
- Web site: http://medicine.nodak.edu/crh
Pesticide Research Team

UND Faculty
Thomas Petros
Patricia Moulton
Ric Ferraro
Sally Pyle
Sue Offutt
Steve Hawthorne
Ruth Paur

CDC Pesticide Laboratory
Dana Barr
Charles Dodson
Ralph Whitehead

Phlebotomists
Sandie Antonson
Kristi Grove
Tara Johnso
Dawn Korynta
Naomi Sterf
Tara Waldal

Graduate Students
Holly Dannewitz
Matt Garlinghouse
Shyla Muse
Matthew Myrvik
Anna Marie Carlson
Jason Douglas
Patrick Kerr
Karyn Plumm
Kristi Sather
Caitlin Schultz
Jen Short

Undergraduate Students
Cassandra Lee
Silje Lynne
Ashley Olson
Bethany Reuter
Christine Wegner
Catherine Woell

What are Pesticides?

- Herbicides
- Insecticides
- Rodenticides
- Fungicides
Pesticide Exposure and Children

A Summary of Recent Findings on Birth Outcomes and Developmental Effects of Prenatal TCE, PAX, and Pesticide Exposures

Concentrations of Environmental Chemicals Associated with Neurodevelopmental Effects in U.S. Population

Neurobehavioral Performance in Preschool Children from Agricultural and Non-Agricultural Communities in Oregon and North Carolina

Pesticide Exposure and Cognitive Ability in Children
Objectives of Current Study

Objective 1
Examine the impact of chronic routine exposure to pesticides on cognitive and motor performance in children between 7 and 12 years of age, including memory performance, executive function performance, motor performance, and performance on school-related achievement tests.

Objective 2
Measure the concentration of several pesticides and cholinesterase in the blood or urine in children between 7 and 12 years of age and examine associations between pesticide and cholinesterase concentration and cognitive and motor performance.

Red River Valley
Pesticides in North Dakota

Participants

**Pesticide Group** = 64 children and their parents living on or next to an active farm or field

**Control Group** = 68 Children and their parents living at least one mile from an active farm or field
# Measurements - Children

**Physiological**
- Height and Weight
- Blood and Urine: pesticides, cholinesterase, trace minerals

**Motor**
- Grooved Pegboard Test
- Benton Visual Retention Test
- Finger Tapping Test
- Hand-eye Coordination Test

**Cognitive**
- Wechsler Intelligence Scale for Children-IV
- California Verbal Learning Test Children
- Verbal Fluency Test
- Continuous Performance Test
- Wisconsin Card Sorting Test
- Wechsler Individual Achievement Test- 2nd ed- Reading & Listening Comprehension

# Measurements - Parents

**Cognitive**
- Wechsler Adult Intelligence Scale-III
  - Vocabulary & Block Design

**Behavioral**
- Child Behavior Checklist
- ADHD Rating Scale-IV

**Nutritional Status**
- NIH Diet History Questionnaire
- Food Security module
- 24-Hour Dietary Recall

**Developmental**
- Tanner Pubertal Development Test
- Developmental Milestones

**Environmental**
- Pesticide use and exposure questionnaire
- Surveys on family and child medical history, sleep, occupation, income, education level
Measurements - Teachers

**Behavioral**

Teacher Report Form for Child Behavior Checklist
Teacher Report Form for ADHD Rating Scale-IV

---

Intelligence Test Results

![Image of children in a field]
### Working Memory Index

<table>
<thead>
<tr>
<th></th>
<th>Male</th>
<th>Female</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pesticide</td>
<td>98.08</td>
<td>96.76</td>
<td>100.00</td>
<td>100.15</td>
</tr>
<tr>
<td>Control</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Processing Speed Index**

<table>
<thead>
<tr>
<th></th>
<th>Male</th>
<th>Female</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pesticide</td>
<td>91.46</td>
<td>98.40</td>
<td>94.26</td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td></td>
<td>101.00</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Parents Estimated Full Scale IQ

Estimated FSIQ | DuncanSES | HollingsheadSES
--- | --- | ---
108.39 | 47.34 | 32.63
109.01 | 52.32 | 30.81

Pesticide | Control

Biological Measurements
**Conclusions**

- A decrease in IQ was found in children living in areas of a great amount of pesticide use.

- This decrease was independent of parents IQ and their socio-economic status.

- There is evidence of exposure to pesticides based on biological measurements. However, both groups were found to have been exposed to a number of pesticides.

- Next step is to run a multiple regression to examine the association between the biological measurements of pesticides and the IQ results along with the other cognitive tasks.
Limitations and Future Directions

- The measurement of pesticide exposure is complex due to the large number of potential pesticides to measure and the number of variations in exposure.

- Future studies are needed to further explore the association between particular groups of pesticides and IQ and to examine the longitudinal effects of pesticide exposure.

For more information contact:

Center for Rural Health
University of North Dakota
School of Medicine and Health Sciences
Grand Forks, ND 58202-9037

Tel: (701) 777-3848
Fax: (701) 777-6779

http://medicine.nodak.edu/crh