Environmental Issues in Children Living in Rural Areas

Barbara Huggins, MD
The Southwest Center for Pediatric Environmental Health
The University of Texas Health Center at Tyler

Supported by the Association of Occupational and Environmental Clinics (AOEC) through a cooperative agreement (U50/ATU300014) with ATSDR and EPA
Hawaii, Guam and American Samoa are included in Region 9.
The University of Texas Health Center at Tyler
Children vs Adults

- Consume more food and water
  - Caloric consumption is $2\frac{1}{2}$ X greater
  - Ingest more dust and soil
- Resting respiratory rate 2X greater
- Skin surface area/body weight is 2X greater
- Longer potential lifetime for exposure
- Immature livers and kidneys for elimination of toxins
FETUS

- Rapid cell growth creates susceptibility to damage
- Preconception exposure (Pb, PCBs)
- Placenta – not complete filter (DES, ETS, Hg)
NEWBORN

- Decreased metabolism & excretion
- GI tract highly permeable
- Skin highly permeable (i.e. methemoglobinemia, hexachlorophene, lindane, DEET)
INFANT AND TODDLER

- **ORAL**
  - Normal exploratory behavior
  - Diet

- **RESPIRATORY**
  - Increased because of metabolic needs
PRESCHOOL AND SCHOOL-AGE CHILD

- Exploration of the “neighborhood”
  - School
  - Home
  - Playground

- Importance of past exposures – delayed effects
ADOLESCENT

- Route of absorption same as adult
- Sensitive reproductive system
- Occupational exposure
- Risk taking behavior
- Physical strength vs maturity level
FAIR LABOR STANDARDS ACT

- > 14 y/o may work on farm unlimited hours outside school hours
- < 12 y/o may work on farm with consent of parents
- < 16 y/o prohibited from working with hazardous substances, but are not considered hazardous
- Children of farmers can work on family farm at any age
- Other industries - <18 are forbidden to work in hazardous conditions
ASTHMA

- 3 times greater in adults exposed to agricultural dusts
- Exposures include molds and pollens, dusts in silos and barns, silica from soil, animal dander
- Farm is home, playground, and workplace
## ASTHMA
### RURAL VS URBAN

<table>
<thead>
<tr>
<th>Location</th>
<th>n</th>
<th>Age (years)</th>
<th>Airway Hyperreactivity (%)</th>
<th>Asthma (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>South Africa</td>
<td>1375</td>
<td>6-9</td>
<td>22.0</td>
<td>3.17</td>
</tr>
<tr>
<td>Australia</td>
<td>170</td>
<td>8-12</td>
<td>21.3</td>
<td></td>
</tr>
<tr>
<td>Australia</td>
<td>915</td>
<td>5-18</td>
<td></td>
<td>20.6</td>
</tr>
<tr>
<td>Kenya</td>
<td>1172</td>
<td>8-17</td>
<td></td>
<td>9.3</td>
</tr>
<tr>
<td>Iran</td>
<td>400</td>
<td>5-11</td>
<td></td>
<td>0.5</td>
</tr>
</tbody>
</table>
ASTHMA MORBIDITY

- Genetics
- Recurrent airway inflammation mediated by environmental exposure
  - Persistent airway hyper-responsiveness
  - Development of chronic airway disease
- Role of anti-inflammatory medications
- Barriers to health care
BARRIERS

HEALTH CARE

INSURANCE

GEOGRAPHICAL DISTANCE

PROVIDER SHORTAGE
PESTICIDES

- 2 y/o boy died after playing near flattened storage drums of toxaphene
- Bro & sis died after playing in a swing made from a burlap sack contaminated with parathion
- 4 y/o played with a bag of parathion stored in barn – admitted near death
- 1 ½ y/o poisoned with Demeton by exposure to father’s shoes
CLOTHING EXPOSURE
(CALIFORNIA)

- 20% exposed workers shower or change clothes after work
- Only ½ receive training on how to handle pesticides
- Contamination of car and home

DOES WASHING HELP?

- Use hot water
- Sorting laundry
- Neb. – parathion
  - after 10 washings, 34% remained (enough to kill insects)
  - 40-90% sort laundry
  - 25-50% use hot water
  - Most did not clean washer between loads of laundry

  Laughlin, J Laundering Pesticide Contaminated Clothing, U of Nebraska
OUTSIDE IN

- Pesticides tracked in can accumulate
- Pesticides outdoors are broken down by sun, rain, and soil microbes
- Pesticides indoors accumulate and persist for many years
- Hazard to small children
- Iowa – atrazine in all houses of farm families compared to 4% of non-farm (1997)
- Simcox et al. (1995) higher [OP] in agricultural homes compared to reference
“The first field we visited could have been mistaken for a day care center. There were many small children in the field with their parents. Some were sitting in the dirt, just being near their families. Some were picking strawberries just like their parents and older siblings. We saw a baby stroller which was advanced a few feet occasionally to keep up with the progress of the picking. The families were together, but there wasn’t much joy. At 12 cents a pound for the strawberries, minus room and board costs, this “day care center” was a part of survival”

- Scott Pike, *Testimonies from the Fields*, Woodburn, OR, 1997
The Spraying Fields

- Lack of appropriate day care
- Over – spray
- Work in newly sprayed fields
WHY SHOULD WE WORRY?

- Disproportionate exposure
  - Greater intake of food, water, air / kilogram
  - Narrower food choices
  - Hand-to-mouth behavior
- Inability to detoxify and eliminate chemicals
- Bodies still growing and developing
- Longer lifetime to develop complications
“Late in the afternoon of April 1, 1990, a 3 year old girl playing in front of her trailer home in California’s San Joaquin Valley suddenly lost control of her body and began foaming at the mouth. By the time the girl arrived at the local emergency room, she was near death. She recovered eventually.

A report filed with the California Department of Pesticide Regulation concluded the child had been poisoned by aldicarb, a highly toxic that works the same way on people as it does on bugs – like nerve gas. Somebody had parked a tractor with pesticide material on it right in front of the play area” – Matt Crenson, Associated Press, December 9 1997
Review of medical records of 20 severely poisoned infants transferred to major medical center

- 16/20 misdiagnosed at time of transfer (brain hemorrhage, head trauma, DKA, severe gastroenteritis, pneumonia, whooping cough)
- 5 patients – household application of pesticide
- 1 patient – mowing recently sprayed lawn

Zweiner, R. Organophosphate and Carbamate Poisoning in Infants and Children, Pediatrics, 1988
MORE EFFECTS

NEUROLOGIC
MEXICO-2 FARMING COMMUNITIES

Heavy pesticide use –
poor hand-eye coordination, short-term memory impairment, difficulty drawing

Little/no pesticide use
Less aggressive and anti-social behavior

CANCER
NO SPECIFIC LINK TO A PARTICULAR PESTICIDE

LEUKEMIA
NEUROBLASTOMA
WILM’S TUMOR
SARCOMAS
NON-HODGKIN’S LYMPHOMA
BRAIN CANCER
PESTICIDE USE IS ON THE RISE

  - General use up 31%
  - Use of potential human carcinogens up 129%
  - Use of neurotoxic pesticides up 52%

- California the only state with required reporting

- Less than 3% farms inspected/year
NEW YORK STATE SURVEY
(50 FARM WORKER CHILDREN)

- 10% < 18 YEARS OLD HAD MIXED AND APPLIED PESTICIDES
- 40% HAD WORKED IN FIELDS STILL WET WITH PESTICIDES
- 40% HAD BEEN SPRAYED BY CROP DUSTERS OR BY DRIFT
- 15% HAD SYMPTOMS CONSISTENT WITH ORGANOPHOSPHATE POISONING BUT HAD NOT SOUGHT MEDICAL ATTENTION
MINNESOTA CHILDREN’S PESTICIDE EXPOSURE STUDY

- Homes of children 3-13 years old
- 308 households
- No significant differences in residential pesticides stored or used between urban and non-urban households

A ‘LEAD’LE GOOD NEWS

Study of association of soil lead concentration and blood lead levels in children living in metropolitan New Orleans and in rural LaFourche parish.
A ‘LEAD’LE GOOD NEWS

Environmental Health Perspectives, 105:9, Sept. 1997

### Table 1. Frequencies of census tracts exhibiting median blood lead concentrations for children <6 years old in metropolitan New Orleans and Lafourche Parish, Louisiana

<table>
<thead>
<tr>
<th>Blood lead (µg/dl)</th>
<th>New Orleans</th>
<th>Number</th>
<th>Percent</th>
<th>Lafourche</th>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;5</td>
<td>25</td>
<td>16.2</td>
<td></td>
<td>16</td>
<td>64.2</td>
<td></td>
</tr>
<tr>
<td>5–9</td>
<td>72</td>
<td>46.8</td>
<td></td>
<td>3</td>
<td>15.8</td>
<td></td>
</tr>
<tr>
<td>10–14</td>
<td>50</td>
<td>32.5</td>
<td></td>
<td>0</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>15–19</td>
<td>6</td>
<td>3.9</td>
<td></td>
<td>0</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>20–24</td>
<td>0</td>
<td>0.0</td>
<td></td>
<td>0</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>≥25</td>
<td>1</td>
<td>0.6</td>
<td></td>
<td>0</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>154</td>
<td>100.0</td>
<td></td>
<td>19</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>
HARVEST OF HARM
Percent of Childhood Farm Injuries by Age

Gender Differences in Childhood Rural Injuries

Girls: 21%
Boys: 79%

### Relative frequency of agents involved in farm injuries in children

<table>
<thead>
<tr>
<th>Agent</th>
<th>Relative Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Machinery</strong></td>
<td></td>
</tr>
<tr>
<td>Tractors</td>
<td>++++</td>
</tr>
<tr>
<td>Tillage Equipment</td>
<td>++++</td>
</tr>
<tr>
<td>Combine</td>
<td>++</td>
</tr>
<tr>
<td>Balers</td>
<td>+</td>
</tr>
<tr>
<td>Wagons</td>
<td>+</td>
</tr>
<tr>
<td>Elevators/conveyors/augers</td>
<td>+++</td>
</tr>
<tr>
<td>ATV/motorbikes</td>
<td>++</td>
</tr>
<tr>
<td>Forklifts</td>
<td>++</td>
</tr>
<tr>
<td><strong>Animals</strong></td>
<td></td>
</tr>
<tr>
<td>Cows</td>
<td>+++</td>
</tr>
<tr>
<td>Horses</td>
<td>++</td>
</tr>
<tr>
<td><strong>Structures (barns, buildings, silos)</strong></td>
<td>+++</td>
</tr>
<tr>
<td>Chemicals (pesticides and cleaners)</td>
<td>+</td>
</tr>
<tr>
<td>Water (drownings)</td>
<td>++</td>
</tr>
<tr>
<td>+++ Very frequent</td>
<td>++Occasional</td>
</tr>
<tr>
<td>+++ Frequent</td>
<td>+Infrequent but reported</td>
</tr>
</tbody>
</table>

1,255 farmers surveyed

What influenced their decision to put < 14 y/o at risk

Reasons not well understood
  - Bonding time > risk
  - Need to supervise child > risk
  - Gain work experience > risk
  - Strong work ethic and self-confidence > risk
Lack of supervision
- Proximity of children to equipment
- Parents distracted by their work
- Operator fatigue, esp during harvest

Children given tasks inappropriate for their age

Financial stresses (older equipment, child labor)
Smith County exceeds all of Texas counties

- 21 deaths over 6 months
- 12 were injury related and could have been prevented
  - 11 were traffic related
    - 7 were not wearing seat belts
IOWA STUDY

- 2250 junior high and high school students
- 54% used seat belts in front seat
- 15% used seat belt in back seat
- Less likely to use helmets

Shootman, M, *AJPH*, Nov, 1993
Urban and rural child passenger mortality rates
In Alabama
1978-1989. Z=4.48 P<0.001. Mortality rate per 100,000

Pediatric Emergency Care, 1994
Child passenger mortality rates by urban & rural strata in Alabama

Pediatric Emergency Care, 1994
ADDED RISKS

- Poorer road conditions
- Excessive speed used on roads without traffic
- Allowable speed may be in excess of safe speed
- Delayed access to pediatric trauma care
TRAUMA (MVA)

- 1/3 of population resides in rural area but contributes 57% of death after MVA
- Rural trauma pediatric deaths (1995) 87% do not survive to reach a hospital
- Death rate following trauma is inversely related to the population density
OTHER INJURIES

- MVA statistically elevated
- Firearms – more involved
  - Unintentional deaths in > 4 yr old
  - Homicide deaths in <5 yr old
- Drownings
  - Significantly increased in <4 yr old
  - Occurred in natural bodies of water and drainage ditches
RURAL WATER QUALITY

- Domestic wells susceptible to contamination
- EPA estimates
  - Nitrate levels
  - Pesticide levels
- Hand dug wells unfit for drinking
- Poor resources of small utility companies
FLY ME TO THE MOON

- N. Carolina – 8% used no septic tank or public sewer
- Septic tanks
  - 81-93% use in rural counties
  - Need maintenance
  - Potential for contamination of ground and surface water

ADVOCACY – RURAL HEALTH
ADVOCACY - HEALTH

- Medically underserved – eligible for grants and programs
- Shortages of health care pros – now using more PAs and NPs
- Fewer rural hospitals
- Geographic barriers
- Continuity of care
CRITICAL ACCESS HOSPITAL PROGRAM

- Created in 1997 under Balanced Budget Act
- Provides acute care beds, lab and radiology and emergency services
- Suggest EMS be allowed to administer more aggressive therapy
Saving lives and reducing injuries

Reducing economic costs associated with MDA

Changing behavior in Texas
ADVOCACY - PESTICIDES

- Food Quality Protection Act
- Phase out most harmful pesticides
- Affordable day care
- Research/reporting
- Integrated Pest Management (IPM)
ADVOCACY - FARM INJURY

- Tasks appropriate for developmental age
- Day care away from work setting
- Training to professionals to recognize and counsel at-risk families
- Revision of child labor laws
- Expand programs geared for youth
- Enhance training of rescue/emergency personnel
Local governments require local drillers to install wells so that groundwater is protected and that well is located a safe distance from contamination.

- Testing of water for biologic or chemical contamination.
RURAL VS URBAN

RURAL
- Resistant to change
- Traditional
- Informal community networks
- Personal networks
- Concrete thinkers
- Self-reliant

URBAN
- More reliant on scientific method
- Embrace change
- Abstract thinkers
- Believe in the authority of the state
Disclaimer, acknowledgements & fine print

- This presentation represents the views of the authors and does not constitute endorsement of any specific item.
- This presentation was prepared with sponsorship from the Association of Occupational and Environmental Clinics under a cooperative agreement with the Agency for Toxic Substances and Disease Registry with additional support from the Environmental Protection Agency.
- This presentation represents the intellectual property of the authors. Use of these materials is encouraged with proper acknowledgement.
- The authors would appreciate feedback from users of this material.