# National Collaborating Centre for Environmental Health

Intervention Strategies to Reduce Residential Pesticide Exposures

AIHce 2009 Toronto, ON

June 2, 2009

PO 119

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# Objectives

- To identify:
  - The current state of knowledge about residential pesticide exposures
  - Intervention strategies to reduce pesticide exposure

# Outline

- Residential pesticide use
- Take-home exposures
- Intervention strategies
  - Reduction of residential pesticide use
  - Reduction of take-home exposures
  - Integrated Pest Management (IPM)

# Pesticides

- Pesticides:
  - Toxic to organisms: plants, insects, rodents, mold
  - Different toxicological characteristics
  - Heterogeneous group of chemicals
- Commonly used residential pesticides:
  - Herbicides: 2,4-D, glyphosphate, diacamba, Mecoprop
  - Combination: fertilizer-pesticide: ‘Weed and Feed’
  - Insecticides: carbaryl, diazanon, malathion
- Sources: recreational areas and fields, yards, golf courses, schools and day care facilities

# Residential pesticide use

- 74% of US households used pesticides in 2002 (US EPA)
- 2,4-D most used active ingredient
- Seven of the top ten in the home and garden sector are herbicides and three are insecticides
- Insecticides comprised nearly 60% of all expenditures in the home and garden sector

Ref: Pesticide Industry Sales and usage 2000-2001 Market estimates US EPA


# Residential pesticide use

Outdoors

# Residential pesticide use

- Assessing organophosphorus (OP) pesticide exposure among children living in two Seattle metropolitan area communities
- Measured urinary metabolites; 110 children, 96 households
- Identified possible exposure risk factors through a parental interview
- Urine samples were analyzed for six diakylphosphate (DAP) compounds, the common metabolites of the OP pesticides

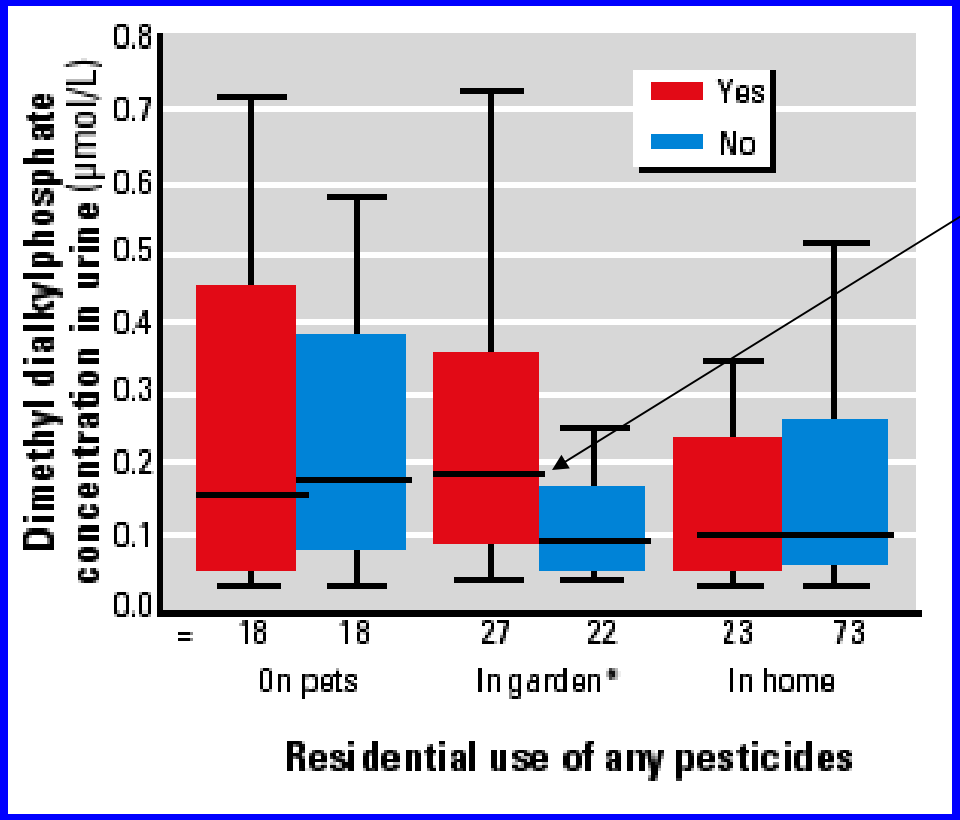
Ref: Lu et al., 2001

# Residential pesticide use

- At least one of the DAP metabolites was measured in 99% of the children
- Higher DAP concentrations for children who
  - Lived with a **garden** (diethyl DAP)
  - Lived in households where **garden pesticide** use was reported (both dimethyl and diethyl DAP)
  - **Had pets** in the households (dimethyl DAP) but **no association** for use of pesticides **on pets**.

Ref: Lu et al., 2001

# Residential pesticide use data




Garden pesticide use was associated with elevated metabolite levels; most significant

Residential use of pesticides and the distribution of dimethyl dialkylphosphate concentrations (µmol/L) in children living in the Seattle metropolitan area. *Significantly higher dimethyl DAP concentrations were found in children whose parents reported use of pesticides in their gardens, Mann-Whitney *U*-Wilcoxon rank-sum *W* test, $p = 0.05$.

Ref: Lu C, Knutson DE et al., Environmental Health Perspectives 2001

# Pesticides indoors

Pesticide application indoors

Tracking of pesticides from outdoors

# Indoor environment

- On average, people in moderate climates are assumed to spend up to 95% of their time indoors
- 87% in enclosed buildings, 6% of their time in enclosed vehicles
- Home environment source of exposure to pesticides

# Residential pesticide use

- Over-use is common in poorly-maintained multi-unit dwellings
- OP pesticides most heavily applied throughout New York State in 1997
  - Heaviest use of OP pesticides in Manhattan and Brooklyn
- Often banned or restricted-use pesticides used (*tres pasitos* a carbamate, tiza china, and methyl parthion)

References:
Adgate et al., 2000, Surgan et al., 2002, Dingle 1999 Landrigan et al., 1999)

# Other exposure pathways

- Important pathway for residential contamination of homes of agricultural workers
  - Spray drift, volatilization, soil/foliar resuspension, track-in on shoes, and transport on clothing
- Only a couple of studies of track-in in urban or non-agricultural settings
  - 2,4-D
  - Organophosphate application of orchards – pesticides detected in non-applicator homes 50 feet from orchard

Ref Nishioka et al.,2001 Morgan et al.,2008

# Factors that affect exposure

- The application: e.g. amount used, application method, personal protective equipment
- Ambient conditions: temperature, humidity, wind
- Post-application interventions: removing shoes, storing clothes outside
- Population exposed: applicator (professional, residential), resident, neighbours, children etc.

# Nishioka et al., 1996, 1999, 2001

- Lawn application of 2,4-D
- Dislodgeable 2,4-D turf residue and correlation to carpet dust
- Collected indoor air, surface wipes and floor dust samples
  - 2 year study
  - 13 homes
  - 1 week before application
  - 1 week after

# Main findings

- Track-in dominant contributor to floor loadings
- Spray drift and foliar resuspension accounted for only 1% of 2,4-D on floors
- Bare floors 5-20x lower loading than carpet
- Highest loading at entry ways
- Entry mats decreased carpet dust residue by average of 33%

# Main findings

- Higher air levels associated with active children (esp w/ shoes) and pets
- Assumption 2,4-D on floors is resuspended to tables and sills through high activity
- Estimated non-dietary ingestion (1-2 yr olds) from contact with floors post-application
  - Median 1 μg/day (max 6.7 μg/day) vs. 1.3 μg/day from diet
  - 10 x higher than pre-application exposures

# Main findings

- Amount sprayed externally was not related to amount of residue inside homes
  - Track-in and high activity more important than any application factor

# Intervention strategies

Reduction of residential pesticide exposure

Reduction of take-home exposures

Integrated Pest Management (IPM)

# Reduction of residential pesticide exposure

- Bans or restrictions on use on public, municipal and/or private property
- Alternatives to pesticides
- Production of locally grown organic produce

# Reduction of take-home exposure

- Remove shoes
- Replace carpet with bare floors
- Use entry mat
- Reduce track in by active pets, homeowner applicator
- Increase vacuuming (entry)

# Integrated Pest Management (IPM)

- Method of pest control based on modifying the physical environment and reducing the use of chemicals
- Common components
  - Repair, sealing of entry points
  - Least toxic pest control application
  - Professional cleaning
  - Education

# Intervention Studies

| Study | Intervention | Location | N | Methodology | Duration | Findings |
|---|---|---|---|---|---|---|
| Campbell et al., 1999 | IPM (cockroach) | Apt complex | 80 | Educational session, booklet. Questionnaire before and after | 8 mo | Improvement of:<br>Knowledge<br>Attitudes<br>Practices |
| Brenner et al., 2003 | IPM (cockroach) | Urban households | 131 | Monitoring biweekly (2mo), then monthly (4 mo) | 6 mo | Decline from 80.5 to 39% in households with cockroaches |
| Gergen, 1999 | House-cleaning and professional extermination (cockroach) | Inner-city dwelling | 48 | Measured Bla g1 in settled dust in 48 homes, 0, 2, 6, 12 mo | 1 year | No difference. |
| Williams et al., 2006 | IPM (reduce prenatal exposure) | Inner city homes New York City | 25 | 2-week integrated indoor air samples before and after, 21 maternal blood and umbilical cord | 1 mo | IPM is effective |

# Conclusions

- Limited # of intervention studies
- Track-in and household activity levels more important than application factors for take-home exposures
- IPM is effective for reducing pesticide exposure in residences

# Questions?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