US EPA ARCHIVE DOCUMENT

Consideration of Working Children In Exposure Assessment

Pesticide Program Dialogue Committee Meeting

December 2013

Jeff Dawson, Kristin Rury, Bayazid Sarkar, Elizabeth Holman

U.S. EPA, Office of Pesticide Programs

Overview

- Background
- Project Objective
- Current Exposure Assessment Methods
- Study Analysis & Findings
- Path Forward

Background

- Post-application worker exposure assessments
  - Addresses worker activities across agriculture
    - e.g., exposure rates differ for row vs. tree crop harvest
  - Extensive collaboration with partner agencies
  - Approach has undergone FIFRA SAP review

http://www.epa.gov/scipoly/sap/meetings/2008/120208_mtg.htm

  - Details available on method

http://www.epa.gov/pesticides/science/post-app-exposure-data.html

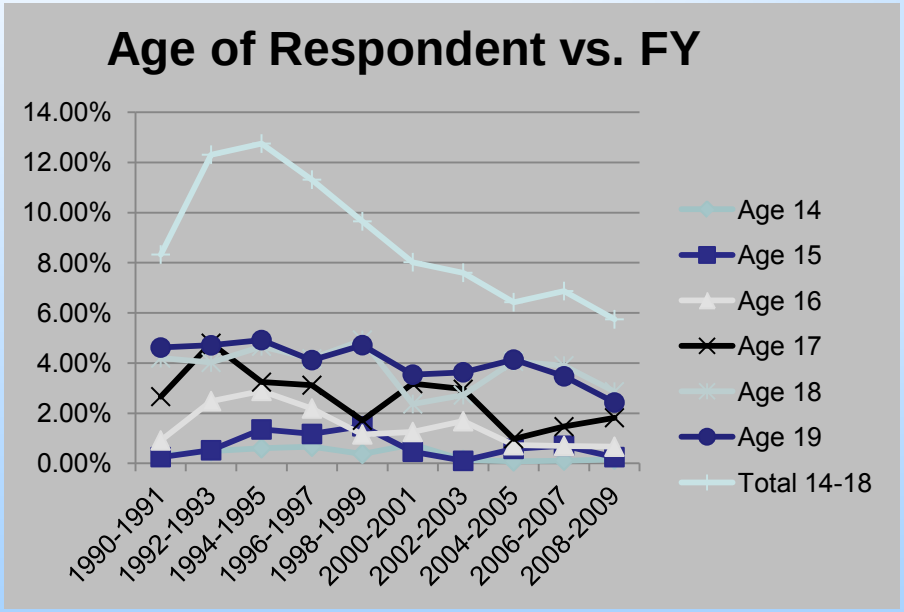
Background

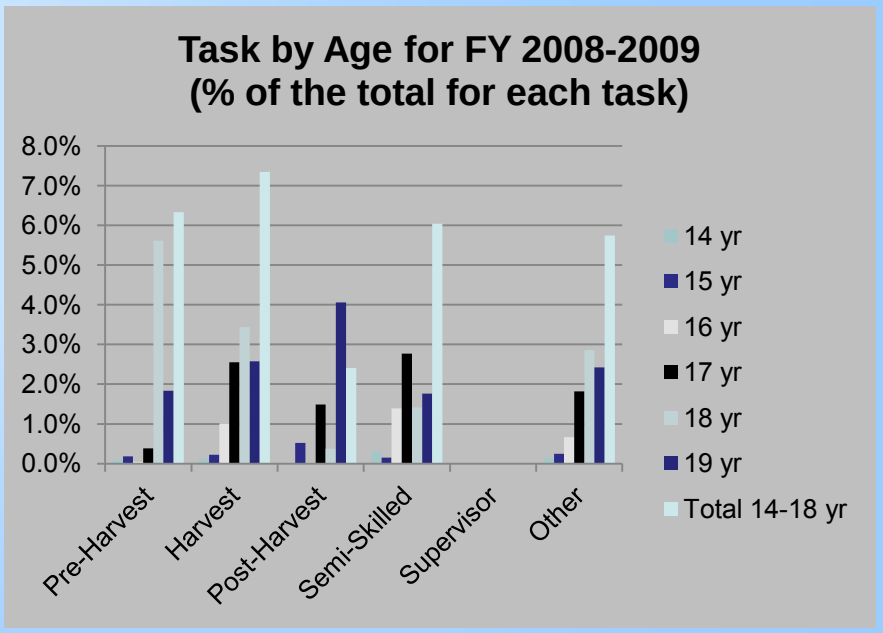
- Current information indicates children work in hand labor activities in agriculture
- Overview of Fair Labor Standards Act
  - Youths ages 16 and above may work in any farm job at any time
  - Youths 12 and 13 years of age may work outside of school hours in non-hazardous jobs on farms
  - Youths 10-12 years old may work under specific circumstances
  - Youths of any age may work at any time in any job on a farm owned or operated by their parents.

Source: http://www.dol.gov/whd/regs/compliance/whdfs40.pdf

Background

NAWS describes age and activities of working children





NAWS Details available http://www.doleta.gov/agworker/naws.cfm

Project Objective

Evaluate if current assessment methods adequately account for the exposures of all youth who are working legally

Exposure Assessment

- Cultural practices and chemical use are evaluated to define exposure potential
  - Timing
  - Degree of mechanization
  - Need for hand labor
- Exposure rates (i.e., transfer coefficients) for hand labor activities
- Residue levels and persistence also considered

Factors Considered In Exposure Assessment

Exposure measures

- Consider different activities like tree fruit harvest and pruning
- 1000s of crop & activity combinations

Residues (exposure sources)

- Referred to as *Dislodgeable Foliar Residue (DFR)*
- Residues based on leaf area collected (i.e., $\mu g/cm^2$)

Body weight

- Varies by age

Analysis

- Multiple lines of evidence
  - Observational exposure monitoring
  - Qualitative observation
  - Biomechanical evaluation

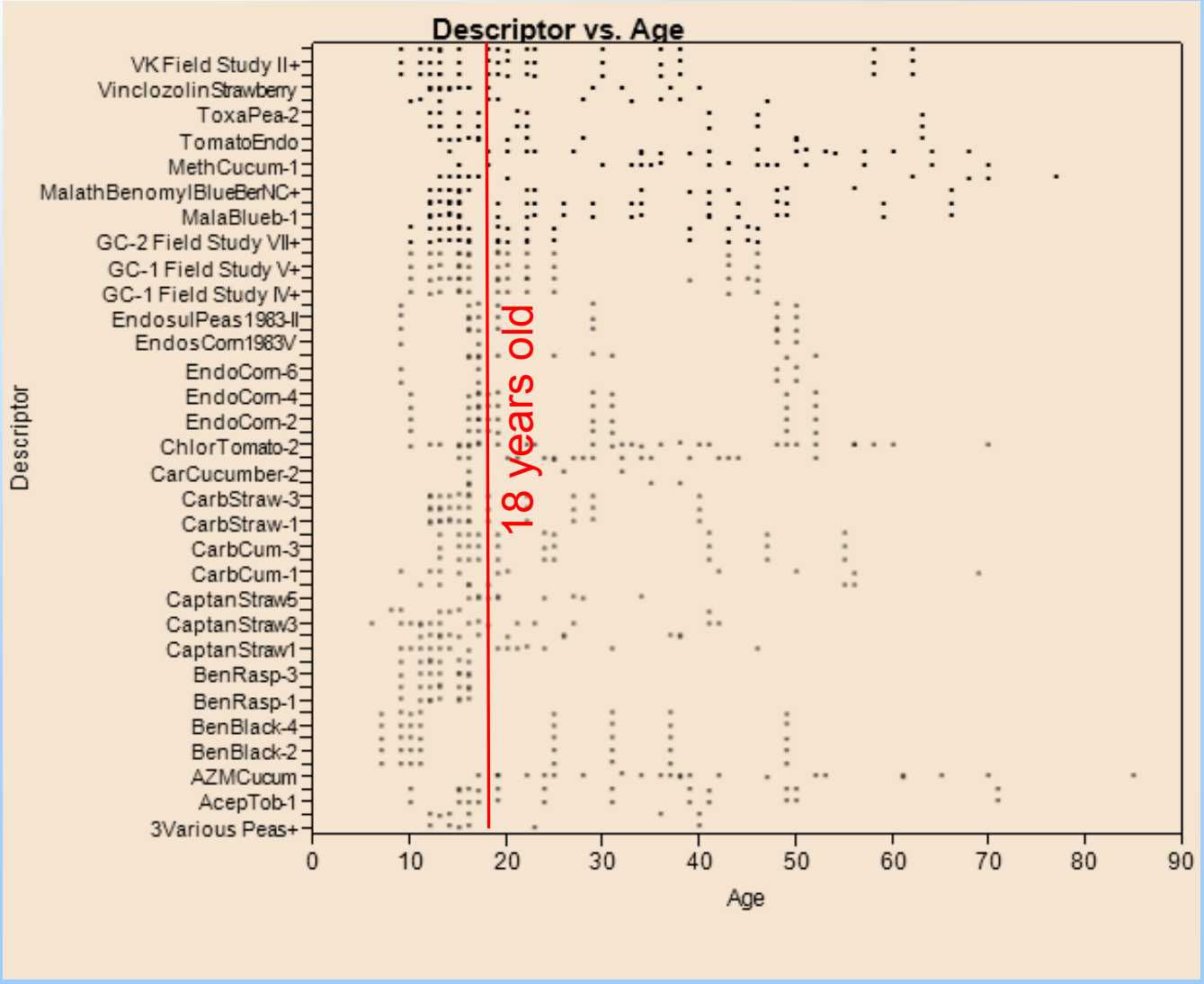
Observational Exposure Monitoring Data

- US EPA/Department of Labor "Pesticide Hazard Assessment Project (1980-1986)"
  - 1980 Interagency agreement between EPA & DOL
- Research completed by 7 cooperating universities
  - Observational exposures
    - Reviewed for ethical compliance
  - Standard sampling methods of the day were used

Observational Exposure Monitoring Data

- Harvesting monitored (adults & children)
- Data used 84 unique field conditions
  - Studies conducted in 8 states (CA, MS, MI, NC, SC, OR, TX, WI)
  - Harvesting 11 different crops (e.g., berries, corn, tobacco, tomatoes, apples, cucumbers)
  - 16 pesticides (e.g., acephate, carbaryl, methomyl, chlorothalonil, azinphos-methyl)
  - Monitored on varied number of days after application

Monitoring Data By Age



- N=1472 Monitored Exposures
- Ages range from 6 to 85

Monitoring Data – Factors For Consideration

Focus on differences between children and adults in same fields because the nature of the available data limits comparisons across studies

- Field conditions can impact exposure
  - Different pesticides
  - Time varies between application and harvest
  - Climate differences
  - Application rates and equipment

Monitoring Data – Factors For Consideration

● = monitor

- Varied study design precludes additivity of data
- Design differences may have been due to investigator, activity, willingness of participants, costs, etc.

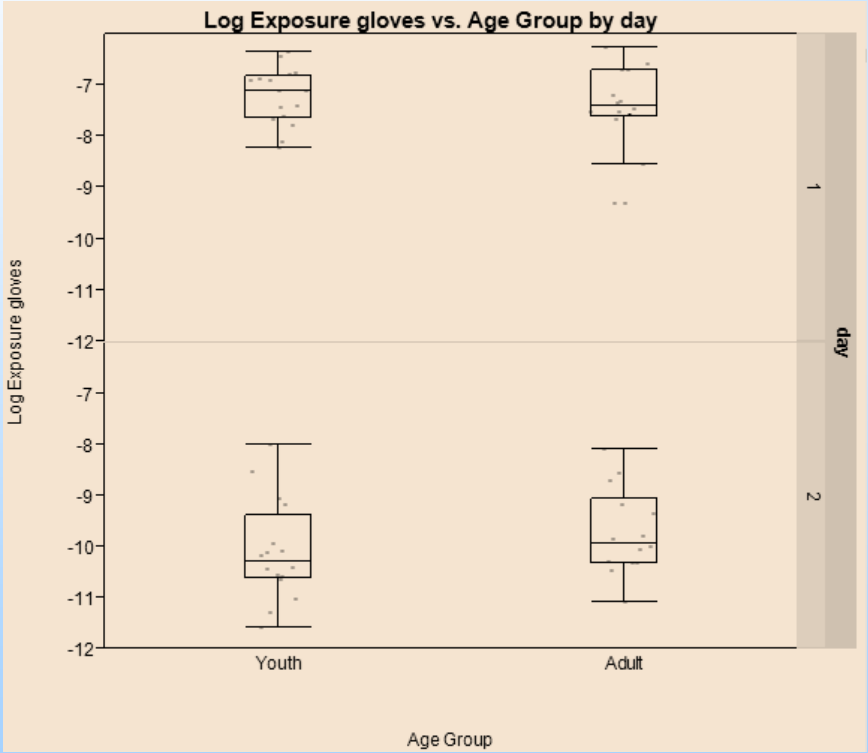
Analysis & Findings

- Statistical analysis of exposure monitoring data
  - 2 case study examples which include 4 field conditions
- Biomechanical considerations
- Behavioral observations by investigators

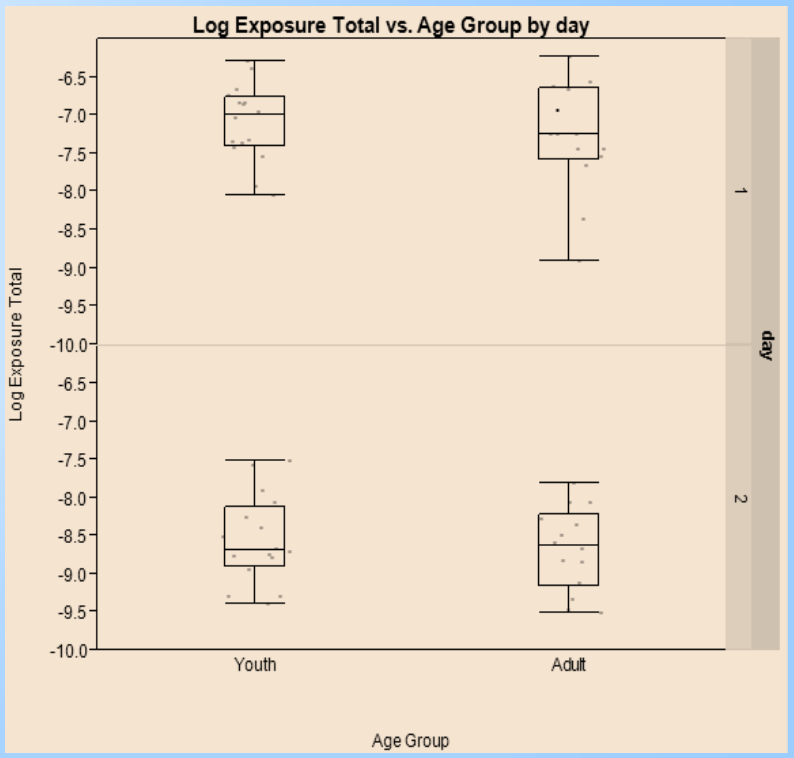
Case 1: Malathion Blueberry

- Harvesting
- Location: Duplin County, North Carolina
- Activity monitored (6/7 & 6/8/82)
- Malathion
  - applied 6/3/82 by ultra low volume (ULV) aerial application
  - 0.73 lb malathion per acre
- Monitoring
  - 30 participants incl.15 children (12-15 yrs old)

Malathion Blueberry Descriptive Statistics



Hands Only



Total Exposure

(hands, arms, torso)

Malathion Blueberry Statistical Analysis

- Exposure has been log transformed
- Gender, age-group, day are used as covariates in the model
- Same workers were monitored for two days.
- Error covariance structure was modeled using compound symmetric matrix

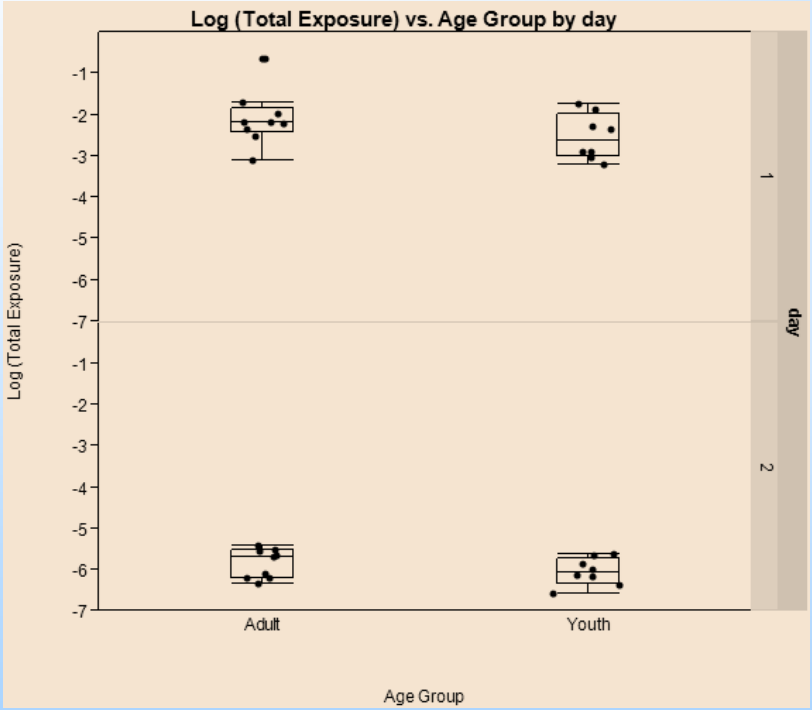
Malathion Blueberry: SAS Outputs & Findings

Glove Data: Differences of Least Squares Means										
Effect	age_gp	_age_gp	Estimate	Standard Error	DF	t Value	Pr > |t|	Alpha	Lower	Upper
age_gp	Adult	Youth	0.2136	0.2415	27	0.88	0.3842	0.05	-0.2819	0.7091

Total Exposure Data: Differences of Least Squares Means										
Effect	age_gp	_age_gp	Estimate	Standard Error	DF	t Value	Pr > |t|	Alpha	Lower	Upper
age_gp	Adult	Youth	-0.1090	0.1706	27	-0.64	0.5284	0.05	-0.4591	0.2411

- No statistically significant difference (p value > 0.05) was found between youth and adult workers for glove exposure as well as for total exposure.

Case 2: Acephate Tobacco



- NC Tobacco Harvest
  - Applied 0.75 lb acephate/A on 7/12/82
  - Harvest on 2 days (7/13/82 & 7/14/82)
  - 17 participants incl. 8 youth ages 10-17
- Total exposure has been log transformed.
- Analyzed using mixed model in SAS, Compound symmetric* variance-covariance matrix.
- Adult age group has higher exposure than youth

Differences of Least Squares Means

Effect	age_group	_age_group	Estimate	Standard Error	DF	t Value	Pr > |t|	Alpha	Lower	Upper
age_group	Adult	Youth	0.9700	0.3708	14	2.62	0.0203	0.05	0.1747	1.7653

Summary of Statistical Analysis

- Data from 84 monitored field conditions
  - Analysis completed for 82 conditions (e.g., hand/total exposure, multiple chemicals, etc.)
  - No statistically significant difference in 76 conditions & adults were higher in 3 others
- Factors to consider
  - Data too limited in some cases for analysis
  - Variability
    - e.g., Wide age range in monitored individuals

Investigator Observations

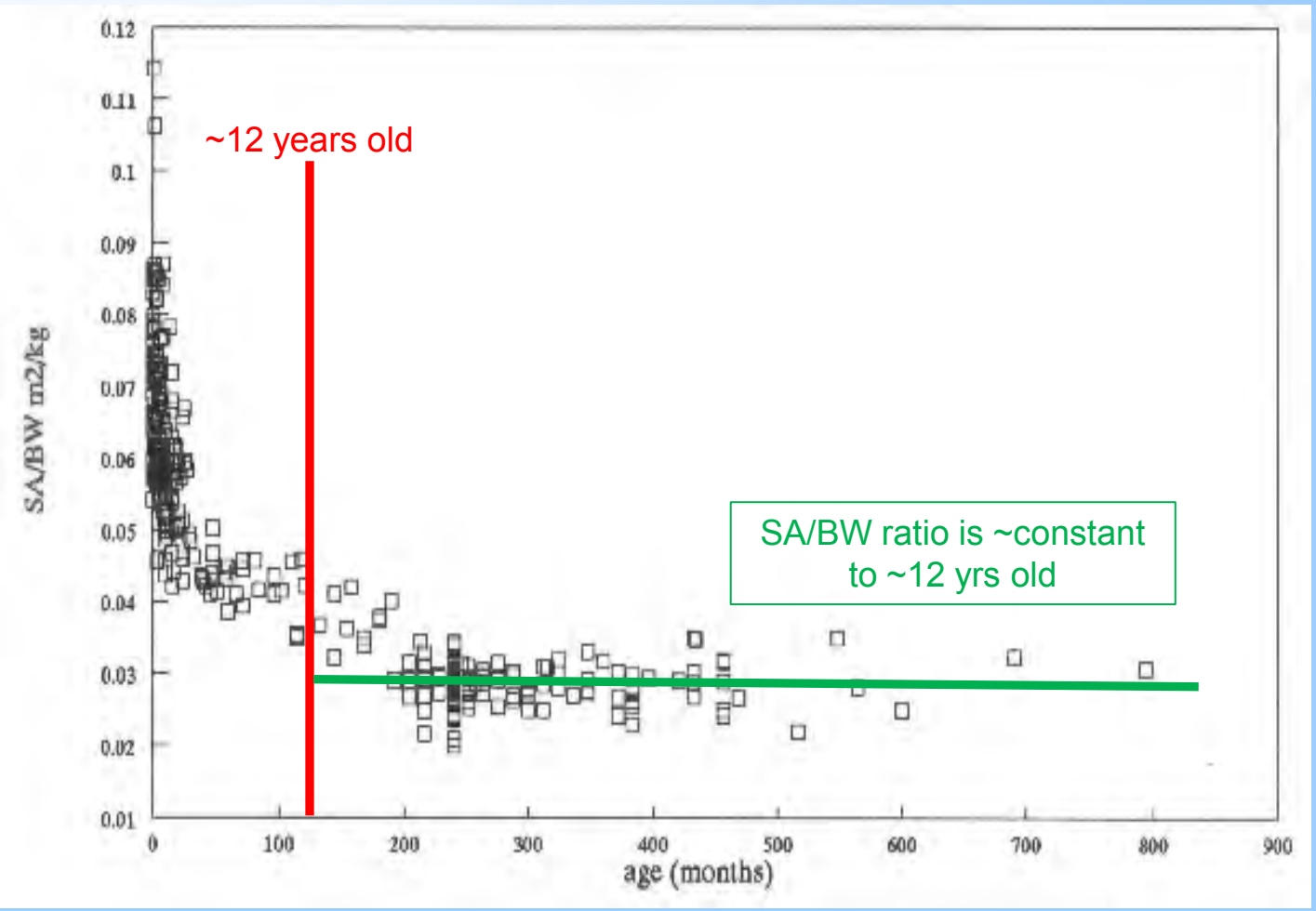
Some example conclusions by investigators:

- Increased age results in higher productivity and consequently higher dermal exposure.
- Overall, when the measured exposure is normalized by body weight, there is no difference in total body exposure as a function of age.

Biomechanical Evaluation

- Dermal exposure is key
  - Size and shape of plant/commodity is factor
    - e.g., climbing into canopy if necessary
- Exposure factor considerations
  - Skin area and body weight increase with age until adulthood
  - Total exposure higher for bigger people (more skin area)

Biomechanical Evaluation



Biomechanical Evaluation

- Given equal productivity, on an age/body weight basis, exposure is ~constant for workers >12 years old
- For children <12 years old
  - They are less productive; as such, their exposures are less
  - Supported by monitoring data

Overall Finding

- Current assessment method adequately estimates exposures of adults and legally working youth
  - Solid scientific basis
  - Multiple lines of evidence
  - Children work slower and less efficiently

Path Forward

- Finalize analysis after final QA/QC review
- Develop policy document to detail this overall effort
- Provide opportunity for public comment on policy document
- Finalize document

Thank You