Study Summary

PYRETHROID EXPOSURES AMONG LICENSED PEST MANAGEMENT PROFESSIONALS

January, 2014

Background

In 2012, the Washington State Department of Health measured pyrethroid metabolites in urine of licensed pest management professionals. All licensed persons with Pest Control Operator (PCO) endorsements were invited to take part if they lived in Snohomish, King, Pierce, Thurston, or Clark counties. The goal of our study was to learn how work practices affected the amount of pyrethroids that get into the body and to use this information to improve continuing education. Since this urine test is newly available, we also wanted to be able to tell doctors what levels were typical for someone who works in this industry.

Between May and October 2012, we recruited 56 professionals who participated on a total of 184 work days. For each work day, the participant collected three urine samples at home after work and completed a questionnaire about pyrethroid use and work practices on that day.

This study measured six common metabolites of pyrethroid insecticides in urine. These metabolites are formed when pyrethroids break down in the environment or in the body. Pyrethroid metabolites tell us about recent exposure to pyrethroids. Higher concentrations of metabolites in urine generally indicate more exposure to these chemicals.

The number of people who took part in our study was smaller than expected. This limited our ability to tell how different work practices affected pyrethroid metabolites in urine. We were able to see some patterns among pyrethroids that were frequently used by participants – bifenthrin, cyfluthrin, and deltamethrin.

Key results

- Pyrethroid metabolites were more frequently detected in this group of pesticide applicators than in the general population of adults in Washington State.
- Levels of metabolites measured in urine were generally higher in pesticide applicators than in the general population. This was especially true for metabolites specific to cyfluthrin, bifenthrin, and deltamethrin – the most commonly used pyrethroids in this study.
- The metabolites appeared to tell us about exposure to pyrethroids used that day at work. Reported use of bifenthrin and cyfluthrin was associated with higher levels of their specific metabolites in urine.
- Levels of bifenthrin metabolites were lower in bifenthrin applicators who reported wearing all of their required protective gear.
- Levels of cyfluthrin, bifenthrin, and deltamethrin metabolites were higher in applicators who reported using a backpack sprayer. This same association was not seen for hand-pump sprayers which were also commonly used by study participants.

Conclusions

We expected the levels of pyrethroid metabolites to be higher in people who use these chemicals at work. One of the goals of this study was to learn what levels of pyrethroids were typical in professional pesticide applicators.

Our study results indicate that pyrethroids used during the work day can be absorbed into the body. Wearing all required PPE should reduce this exposure. Backpack sprayers may need to be more routinely checked for leaks or other exposure pathways.

EPA's pesticide label directions and PPE requirements are designed to protect pesticide applicators from known harmful effects of pyrethroids. EPA currently considers the nervous system to be the most sensitive part of the body to pyrethroid toxicity. Urine results measured in this study appear to be far below amounts that independent scientists think would harm the nervous system. However, we recommend that pyrethroid handlers wear all required PPE and minimize their exposure. This is important as new health information about pyrethroids suggest that these chemicals may be harmful to the body's hormone systems as well.

Next steps

We will continue to work with WSU educators to analyze and better understand the data for prevention purposes. We will be partnering with the WSU Pesticide Safety Education Program in Puyallup to create presentations for continuing education classes over the next year.

We are also developing urine testing directions for doctors who want to use the new pyrethroid test. To help with interpretation of the test results, we will include a summary of the levels that were typical in the general Washington population and in professionals who apply pyrethroids.

The following sections include additional study details and results.

Table 1. Participant characteristics

- Study participants were mostly
  - Male (95 percent)
  - White (86 percent)
  - Non-Hispanic (93 percent).
- Participants were similar to other PCO structural and PCO general license holders in the five participating counties in terms of age, gender, and years licensed.

Table 1		
Characteristic	**Grouping**	**Percent**
Male	-	95
Age group	18 - 25	7
	26 - 35	34.5
	36 - 45	25.5
	46 and older	33
Years with PCO license	Less than 5	24
	5 - 10	33
	More than 10	44

Table 2. Pyrethroid use reported by participants:

- Bifenthrin and cyfluthrin were the most commonly reported pyrethroids.

Table 2		
Pyrethroid active ingredient	**Commonly reported products**	**Number and percent of work days**
Bifenthrin	Talstar (P, PL, EZ, G, GC, N, etc), Masterline bifenthrin 7.9, Transport Mikron, Transport GHP	93 (51%)
Cyfluthrin (or *beta*-cyfluthrin)	Tempo SC, Tempo 1% Dust, Temprid SC, Cy-Kick	73 (40%)
Deltamethrin	Suspend SC, Delta Dust, Deltagard G	32 (18%)
lambda-Cyhalothrin	Demand CS, Patrol, Scimitar GC	31 (17%)
Permethrin	Dragnet SRF, Tengard SRF, Prelude EC, Precor 2000 Plus, Stingray Wasp & Hornet Spray	24 (13%)
Tetramethrin	Stringray Wasp & Hornet Spray, Flying Insect Eradicator	6 (3%)
d-Phenothrin (also called Sumithrin) and cyphenothrin	Precor 2000 Plus, Flying Insect Eradicator	4 (2%)
Esfenvalerate	Onslaught Microencapsulated	4 (2%)
Cypermethrin, (*zeta*-cypermethrin)	Cynoff Dust	4 (2%)

Table 3. Application equipment used by participants for applying pyrethroids.

- Non-powered hand-pump sprayers (such as the B&G sprayer) and backpack sprayers were the most commonly reported types of application equipment.

Table 3	
Type of equipment	**Number and percent of work days**
Hand-pump sprayer	96 (60%)
Backpack sprayer	94 (51%)
Power sprayer	42 (23%)
Granular spreader	32 (17%)
Hand duster	28 (15%)
Aerosol can	27 (15%)
All others	21 (11%)

Table 4. Amount of pyrethroid used on work days.

- On 2/3 of the work days covered in the study**,** participants reported using 10 gallons or less of total diluted pyrethroid product.

Table 4	
Responses	**Number and percent of work days**
Less than 2 gal	53 (29%)
2-10 gal	73 (40%)
11-50 gal	45 (25%)
Over 50 gal	11 (6%)
Don't know/ not sure	1 (0.6%)

Pyrethroid metabolites measured in the study

Table 5 shows the abbreviations and full names of the six metabolites measured in this study and the pyrethroids that generate them. 4F-3-PBA, DBCA and 2-MPA are specific to a single pyrethroid active ingredient. Others like 3-PBA can come from multiple pyrethroids.

Table 5. Pyrethroid metabolites and pyrethroid products that produce them.		
Metabolite name (full chemical name)		**Pyrethroids that breakdown to this metabolite in urine**
3-PBA	3-phenoxybenzoic acid	*lambda*-cyhalothrin, cypermethrin, deltamethrin, esfenvalerate, permethrin, phenothrin (sumithrin)
Trans-DCCA	*Trans*-3-(2,2-dichlorovinyl)-2,2-dimethylcyclopropanecarboxylic acid	cypermethrin, permethrin, cyfluthrin
4F-3-PBA	4-fluoro-3-phenoxybenzoic acid	cyfluthrin
DBCA	*cis*-3-(2,2-dibromovinyl)-2,2-dimethylcyclopropanecarboxylic acid	deltamethrin
2-MPA	2-methyl-3-phenoxybenzoic acid	bifenthrin
TFP-acid	3-(2-chloro-3,3,3-trifluoroprop-1-enyl) - 2,2-dimethylcyclopropanecarboxylic acid	bifenthrin, *lambda*-cyhalothrin

Pyrethroid levels measured in study participants

The following charts show the levels of metabolites in study participants and background levels in the Washington State adult population. In an earlier study, the Department of Health collected urine from over 1,400 people to establish background levels of a number of environmental chemicals, including pyrethroids, in Washington State residents in 2010–2011.

People who don't work with pesticides also have pyrethroid metabolites in their urine. Diet is likely a key source. Pyrethroids used in crop protection are commonly detected at low levels (parts per billion) in foods including vegetables, fruits, breads, and nuts. People are also exposed to pyrethroids through bug bombs and insect sprays used around their home, in lice and scabies treatments, and in some pet flea sprays and collars. 3-PBA and *trans*-DCCA are the most commonly found pyrethroid metabolites in the general population.

How to read the following charts:

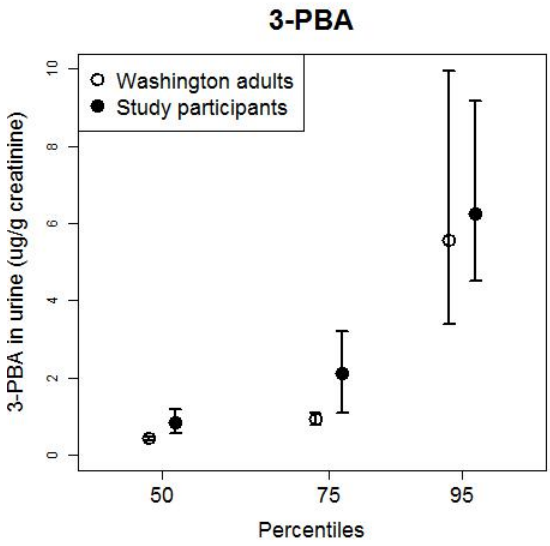
- Metabolite levels are shown as 50th, 75th, and 95th percentiles. Percentiles show the proportions of participants with concentrations of metabolites below a certain level. For example, a 50th percentile of 1.0 µg/g means that 50 percent of those tested had urine concentrations below 1.0 µg/g.

- 50th percentiles represent median or middle levels, 95th percentiles represent the higher end of values detected.

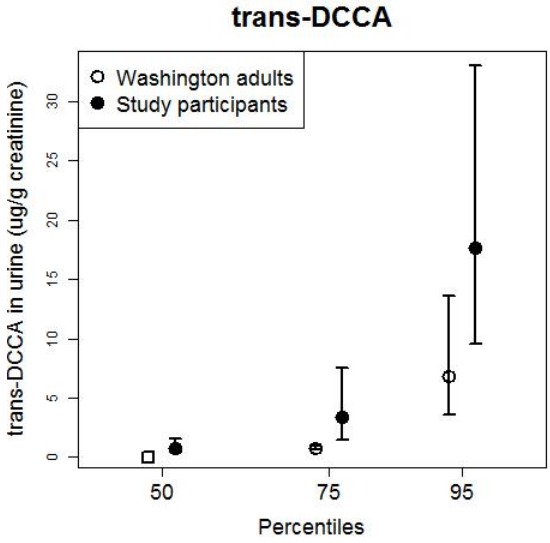
- The dots on the charts represent the percentiles and the vertical lines represent our confidence in the data. A shorter vertical line means that the estimate is more precise. We are more sure about the data from Washington adults (usually shorter vertical lines) because many more participants took part in that study compared to this study.

- Some percentiles could not be calculated because they fell below our laboratory's detection limit (LOD). These percentiles are represented with a square (rather than a circle) in the charts. LODs for the study were 0.03 µg/L for 3-PBA and 4F-3-PBA, 0.06 µg/L for *trans*-DCCA, 0.32 µg/L for DBCA, and 0.01 µg/L for TFP acid and 2-MPA.

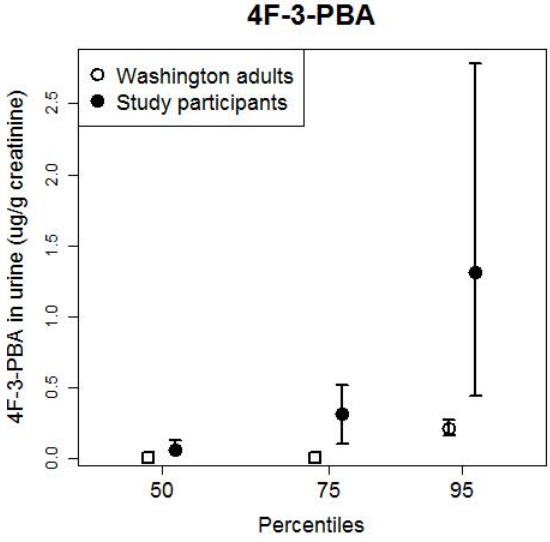
- Results are reported in micrograms of pyrethroid metabolite per gram of creatinine in the urine (µg/g). "Creatinine-correction" adjusts for whether the urine is relatively concentrated or dilute. For comparison to Washington background levels, we used only urines collected first thing in the morning.



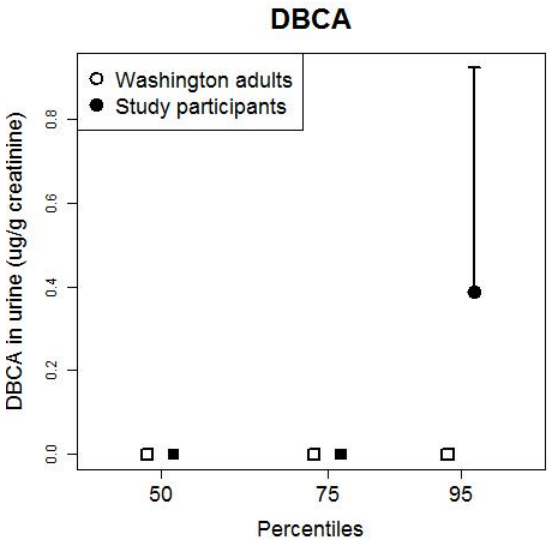
- 3-PBA is a general marker of pyrethroid exposure associated with many products. 3-PBA was frequently detected in both pesticide applicators (93%) and the general public (81%).
- The middle level (50th percentile) of 3-PBA was about twice as high in pesticide applicators as in the general public.
- The high-end (95th percentiles) were similar for both groups.



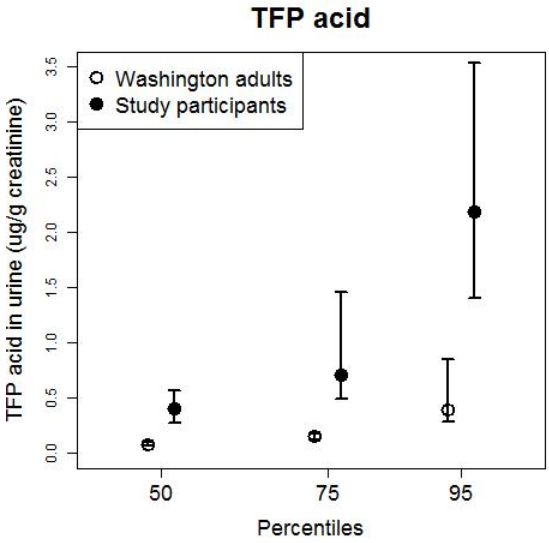
- *Trans*- DCCA comes from permethrin, cypermethrin, and cyfluthrin and was frequently detected in study participants (76%) but in less than half of adults in the general population.
- Levels of *trans*-DCCA were higher among study participants than the general adult population at the 75th and 95th percentiles.



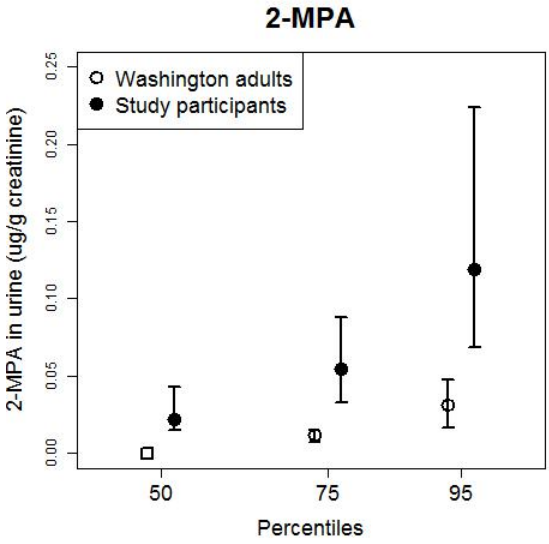
- 4F-3-PBA, a specific metabolite of cyfluthrin, was detected in 51% of study participants compared to only 16% of adults in the general population.
- Levels of 4F-3-PBA were higher among study participants than the general adult population at the 50th, 75th and 95th percentiles
- Levels of 4F-3-PBA in the study participants were highest among those reporting use of cyfluthrin.



- DBCA, a specific metabolite of deltamethrin, was detected in 6% of study participants but in less than 1% of the general population.
- Only a 95th percentile among study participants is shown on the graph because 94% of morning urine samples were below the detection limit for DBCA.



- TFP acid, a specific metabolite of bifenthrin and cyhalothrin, was widely detected at low levels in almost everyone in the study and the general population.
- Levels of TFP acid were higher among study participants than the general adult population at the 50th, 75th and 95th percentiles.



- 2-MPA acid, a specific metabolite of bifenthrin, was detected at low levels in 74.5% of study participants compared to only 17.2% of adults in the general population.
- Levels of 2-MPA acid were higher among study participants than the general adult population at the 50th, 75th and 95th percentiles.

Questions

Questions about this study should be directed to the Washington State Department of Health, Washington Environmental Biomonitoring Survey (WEBS) toll free line at 1 (877) 494-3137 or can be sent via email to Barbara Morrissey at Barbara.morrissey@doh.wa.gov.

More Information about Pyrethroids

More health information about pyrethroids and other pesticides is available at the National Pesticide Information Center (NPIC) website at: http://npic.orst.edu/ingred/aifact.html.

The U.S. Centers for Disease Control and Prevention (CDC) has information about pyrethroid metabolite levels measured in the U.S. population. You can find CDC's report at: http://www.cdc.gov/exposurereport/ and information about individual pyrethroid metabolites they test at: http://www.cdc.gov/biomonitoring/biomonitoring_summaries.html.

The U.S. Environmental Protection Agency (EPA) has information about their health assessment and regulation of pyrethroid and pyrethrin pesticides at: http://www.epa.gov/oppsrrd1/reevaluation/pyrethroids-pyrethrins.html.