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Performance of self-reported and urinary biomarker-based measures of exposure to glyphosate and mancozeb in a study on sleep problems among smallholder farmers in Uganda

Hans Kromhout, Samuel Fuhrimann
On behalf of the IMPRESS Consortium
Institute for Risk Assessment Sciences, Utrecht University

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Conflict of interest and funding

No conflict of interest

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Background

- Study the impact of applying self-reported and biomarker-based exposure measures for glyphosate and mancozeb
- Association with sleep problems in a study among 253 smallholder farmers in Uganda

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Is biomonitoring the solution?

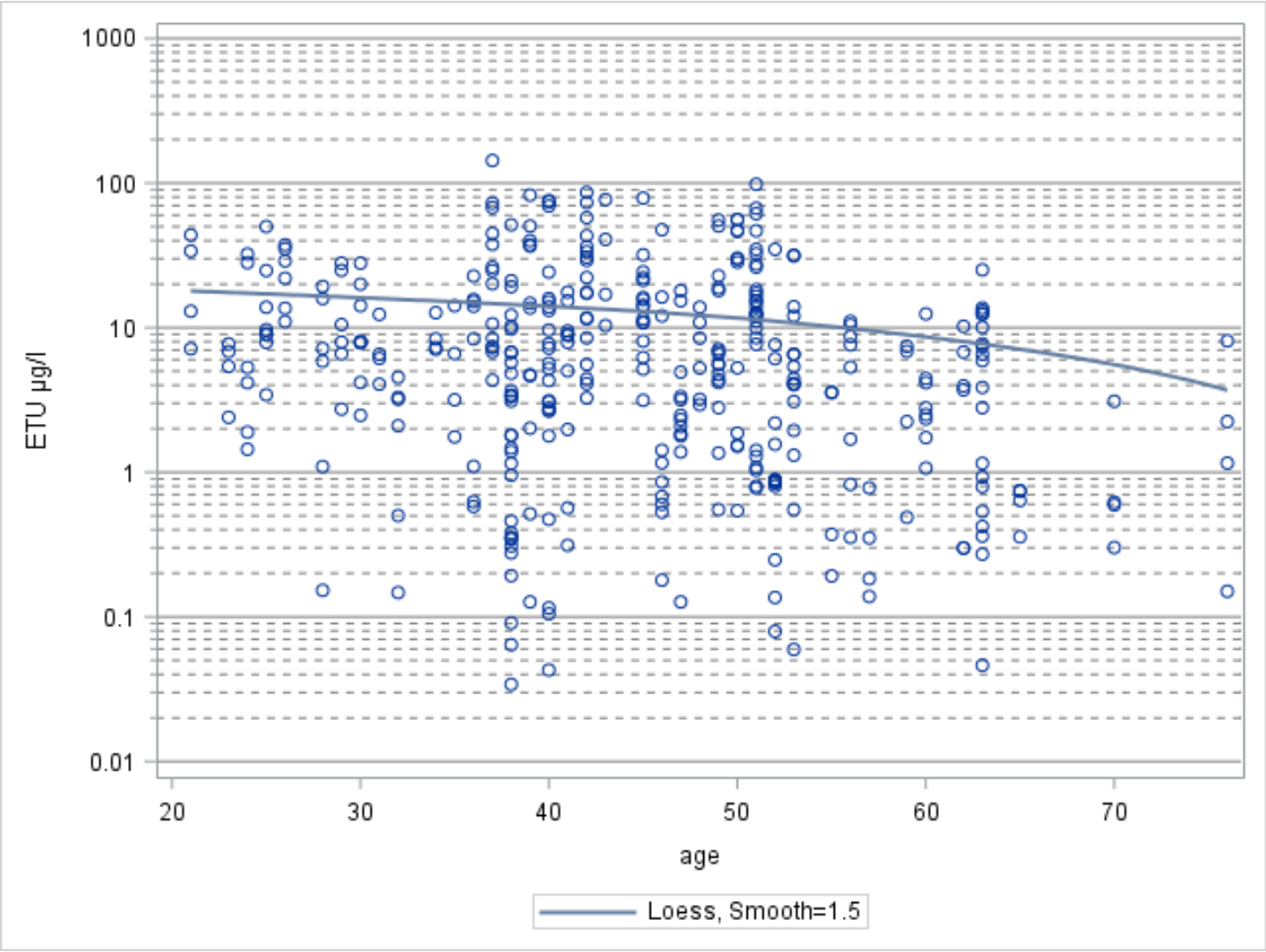
Results from a recent study in Uganda smallholder farmers

Biomonitoring of ETU (biomarker for Mancozeb (fungicide))

Application day	Application last week	Application last year	N samples	%	Group
0	0	0	112	29	Non-users (112)
0	0	1	130	34	Users (274)
0	1	1	14	4	
1	0	1	50	13	
1	1	1	78	20	
			384	100	

Determinants of ETU (1)

Age influential (should be accounted for as potential confounders)



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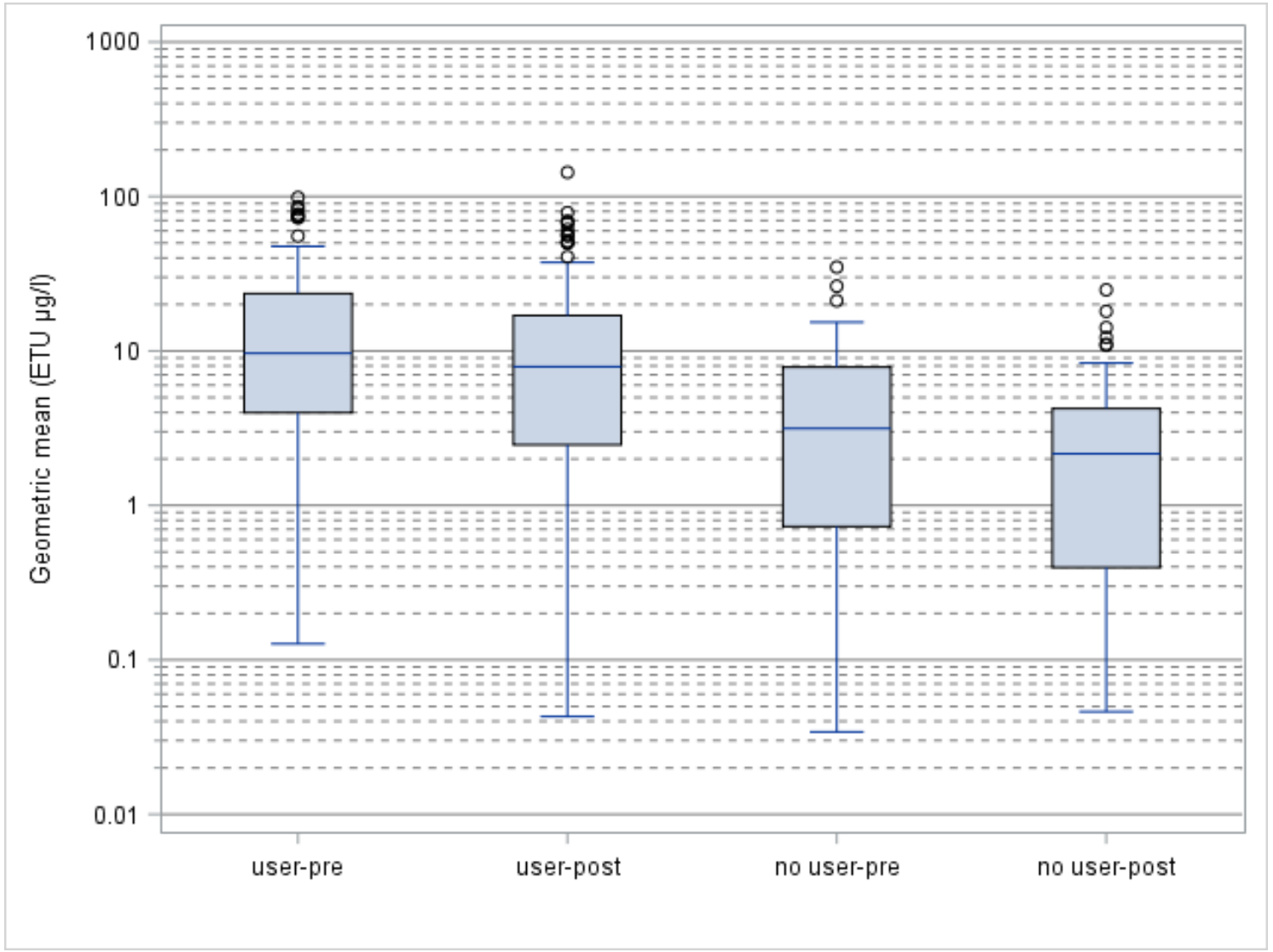
Determinants of ETU (2)

Breakdown by pre- and post-workday



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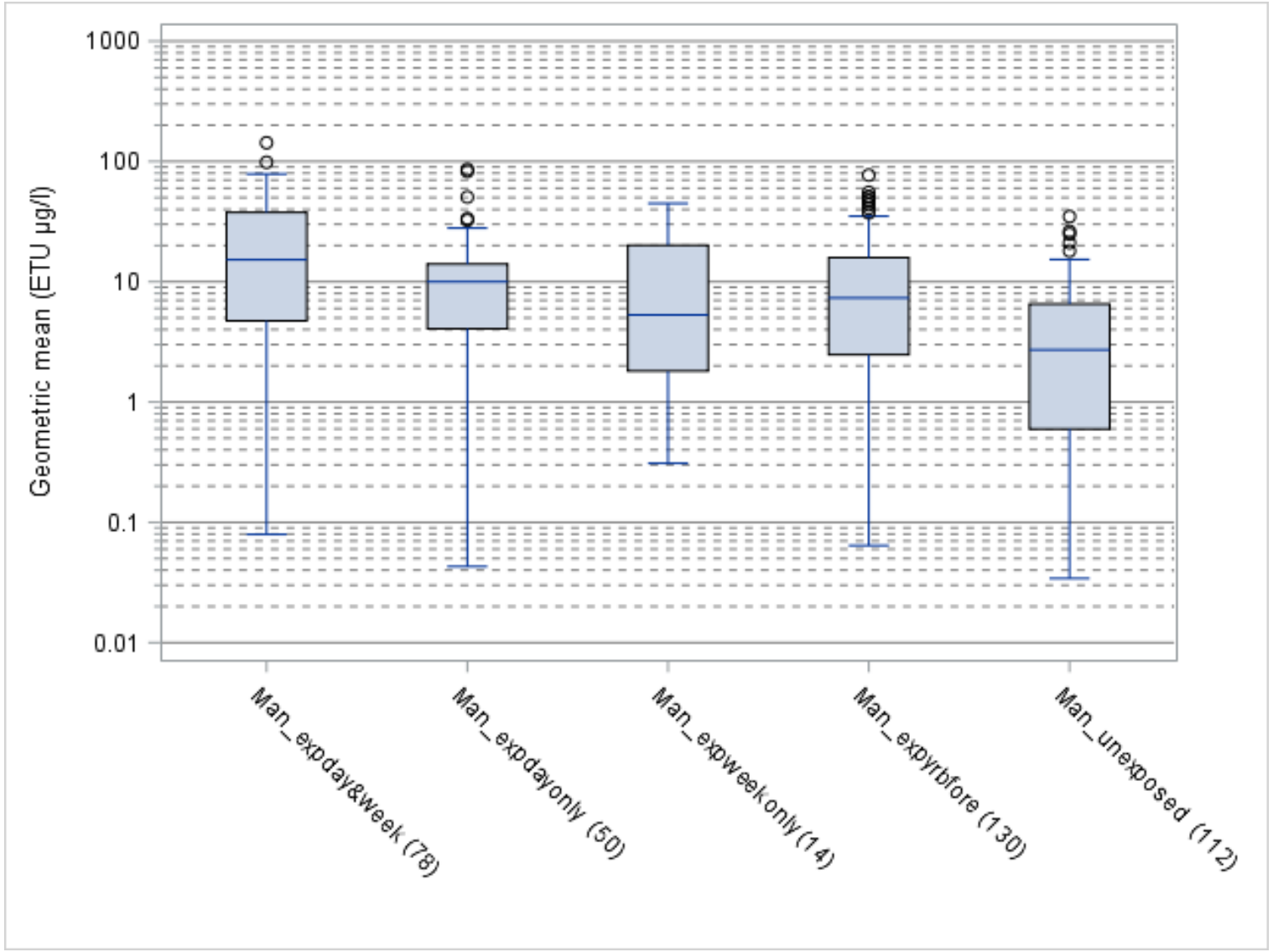
Determinants of ETU (3)

Breakdown by exposure group



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Determinants of ETU (4)

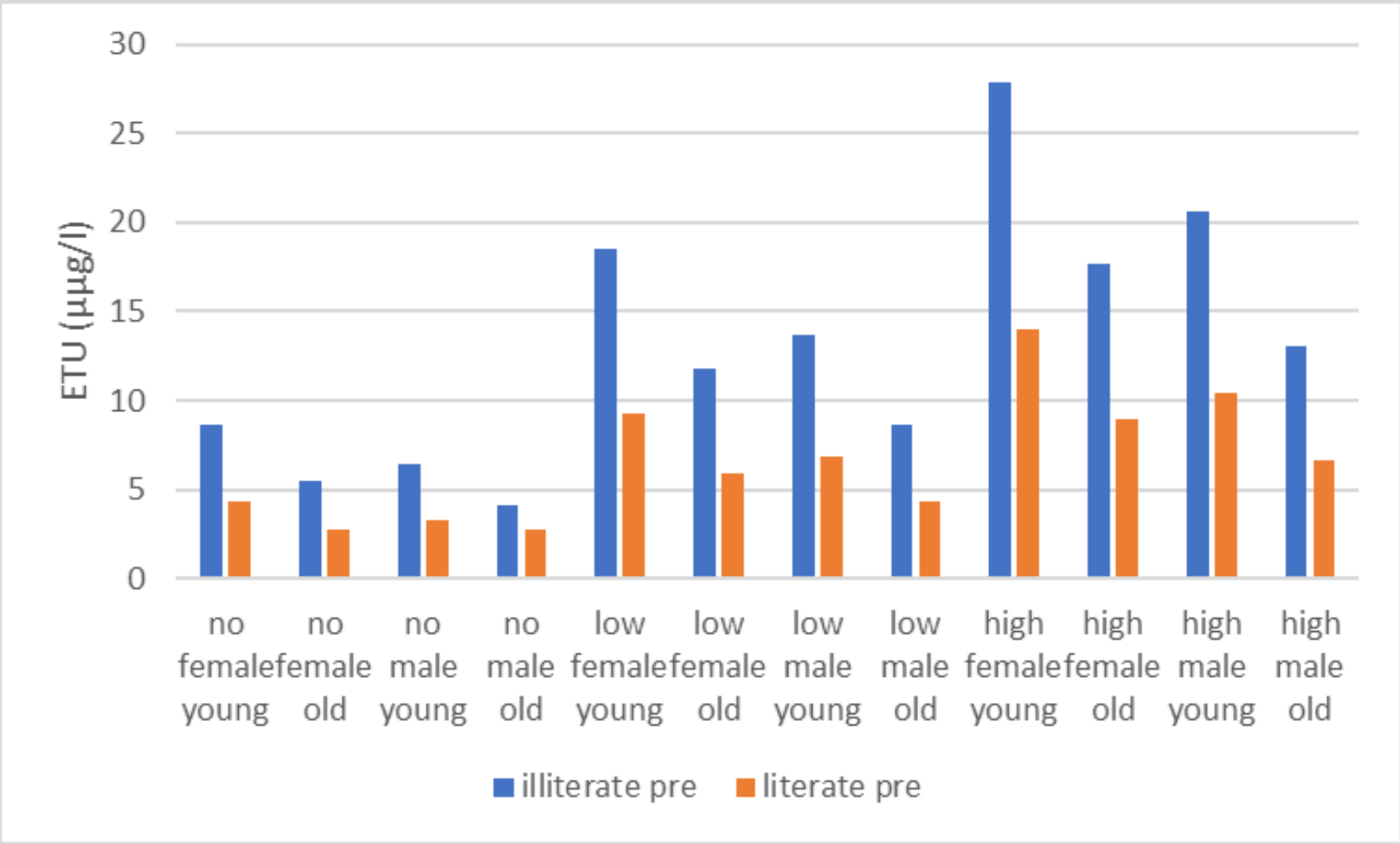
ETU

	Empty	*Full*	*Explained*			
id	**1.3659**	**1.0138**	**26%**			
visit	0.0664	0.0796				
residual	1.4019	1.3786				
	estimate	*se*	*t-value*	*p*	*factor*	
Intercept	2.16	0.60	3.58	0.07	8.66	background
post vs pre	**-0.30**	**0.12**	**-2.53**	**0.01**	**0.74**	**26% lower end of shift**
high user (>12) vs no user	**1.17**	**0.35**	**3.3**	**0.001**	**3.22**	**3 times higher than no applicator**
low user (1-12) vs no user	**0.76**	**0.31**	**2.44**	**0.02**	**2.14**	**2 times higher than no applicator**
old (≥50) vs young	-0.46	0.28	-1.65	0.10	0.63	37% lower when old versus young
male versus female	-0.30	0.31	-0.97	0.33	0.74	26% lower for men than women
literate vs illiterate	**-0.69**	**0.41**	**-1.68**	**0.09**	**0.50**	**2 times lower for literate**

Determinants of ETU (5)

- No effect of PPE (hardly any effective PPE present)
- No effect of acreage
- No effect of years as applicator
- No effect of type of applicator (all knapsack sprayers)

ETU predictions



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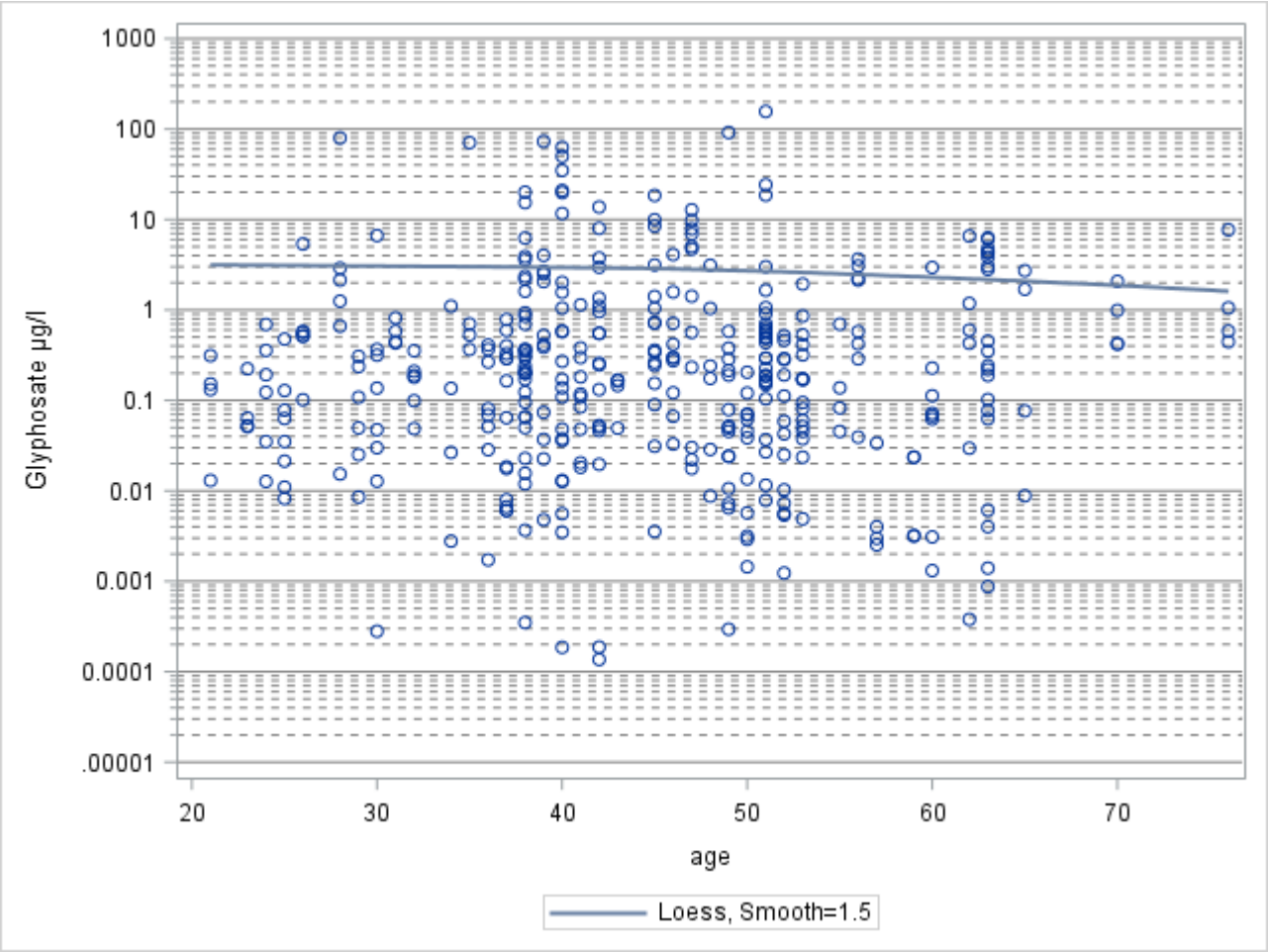
Is biomonitoring the solution?

Biomonitoring of Glyphosate (herbicide)

Application day	Application last week	Application last year	N samples	%	Group
0	0	0	62	16	Non-users (62)
0	0	1	231	60	Users (322)
0	1	1	23	6	
1	0	1	46	12	
1	1	1	22	5	
			384	100	

Determinants of Glyphosate (1)

Age not influential



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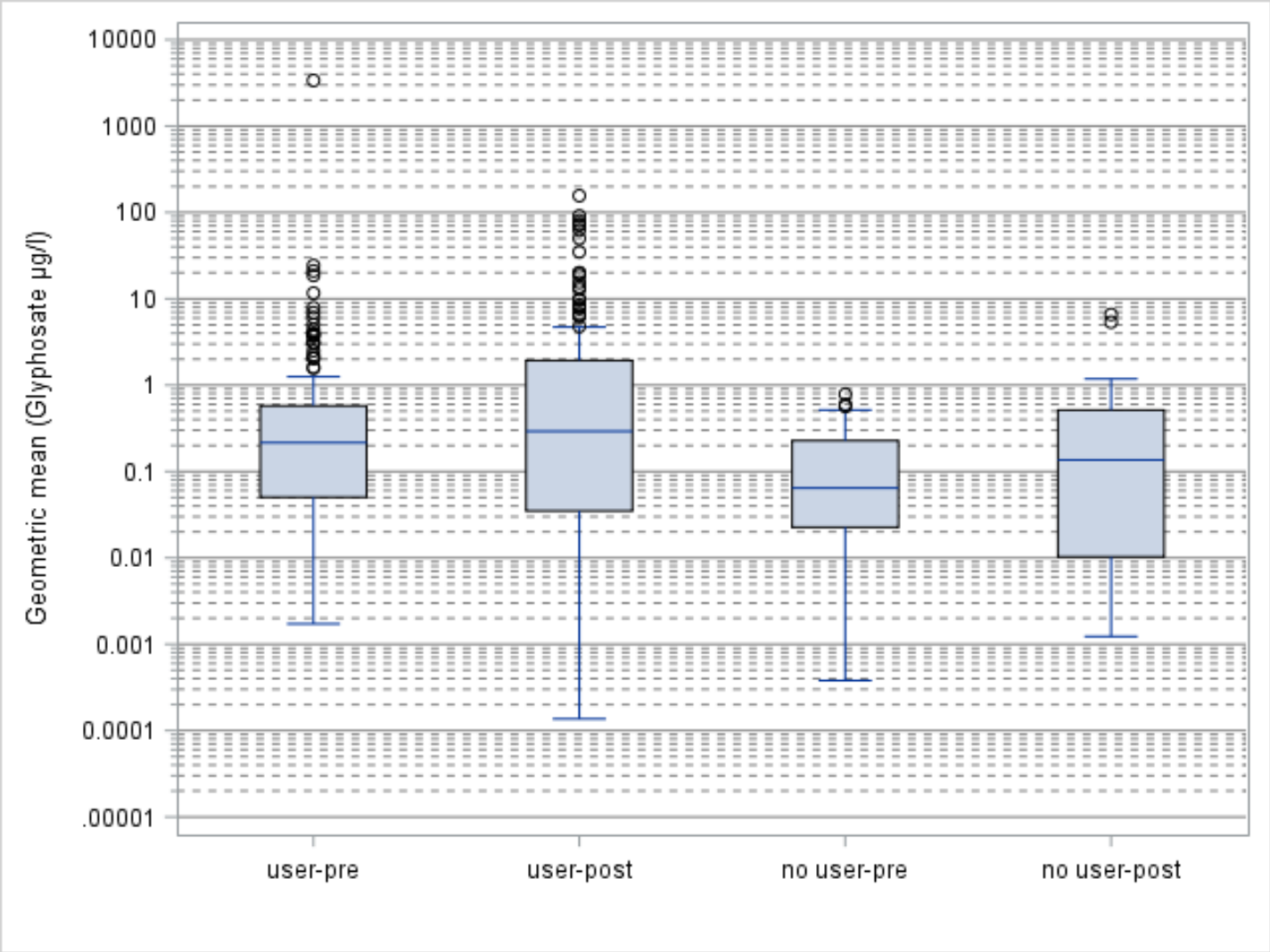
Determinants of Glyphosate (2)

Breakdown by pre- and post-workday



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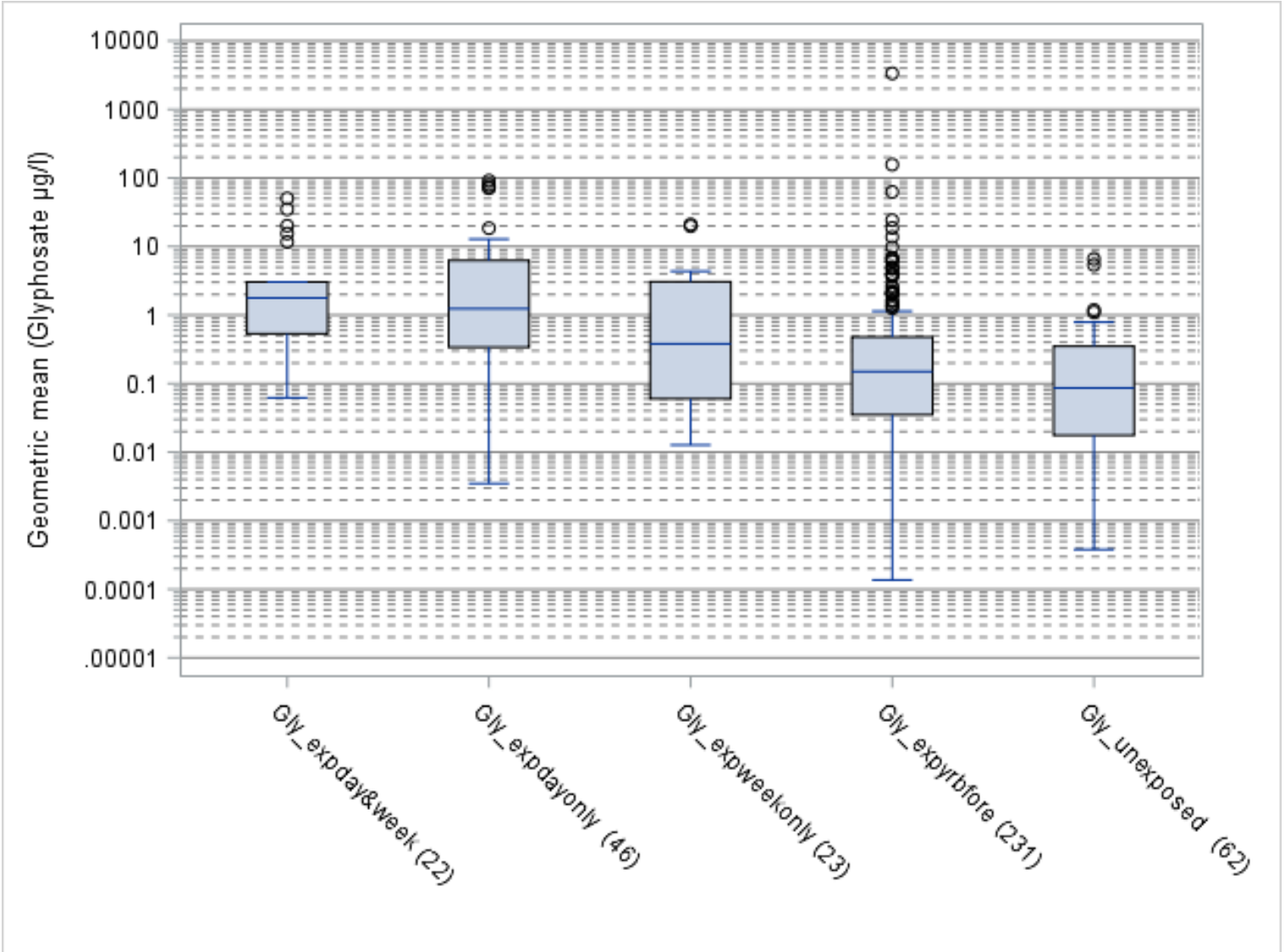
Determinants of Glyphosate (3)

Breakdown by exposure group



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Determinants of Glyphosate (4)

Glyphosate

	Empty	*Full*	*Explained*			
id	**1.7916**	**1.0739**	**40%**			
visit	0.1665	0.1469				
residual	4.3521	4.3811				
	estimate	*se*	*t-value*	*p*	*factor*	
Intercept	-2.18	0.64	-3.4	0.08	0.11	background
post vs pre	0.13	0.21	0.62	0.54	1.14	14% higher end of shift
high user (>1) vs no user	**1.97**	**0.44**	**4.47**	**<.0001**	**7.20**	**7 times higher than no applicator**
low user (=1) vs no user	0.61	0.45	1.36	0.17	1.83	almost 2 times higher than no applicator
literate vs illiterate	**-0.85**	**0.49**	**-1.75**	**0.08**	**0.43**	**2.5 times lower for literate**

Determinants of Glyphosate (5)

- No effect of age
- No effect of sex
- No effect of PPE (hardly any effective PPE present)
- No effect of acreage
- No effect of years as applicator
- No effect of type of applicator (all knapsack sprayers)

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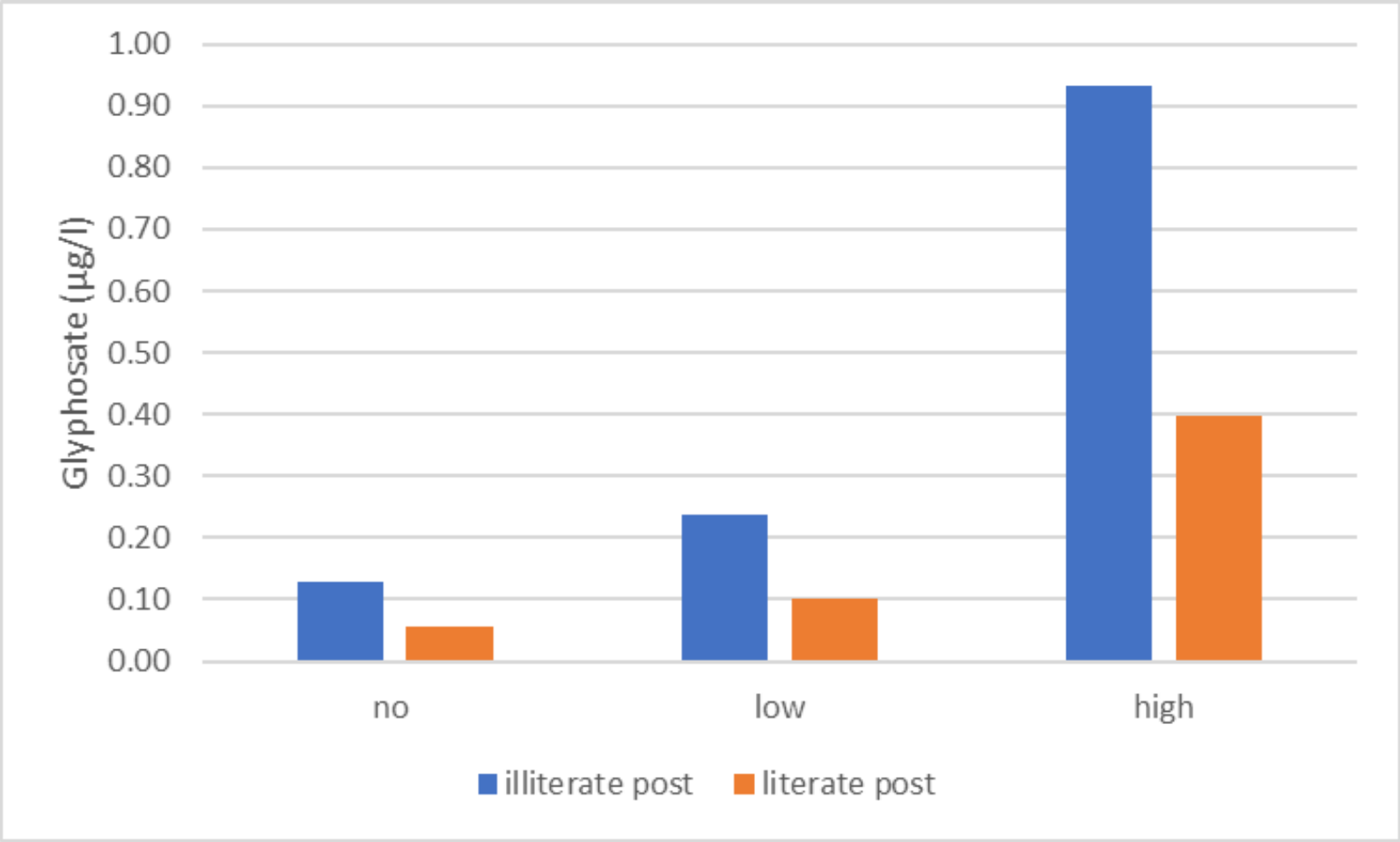
Glyphosate predictions



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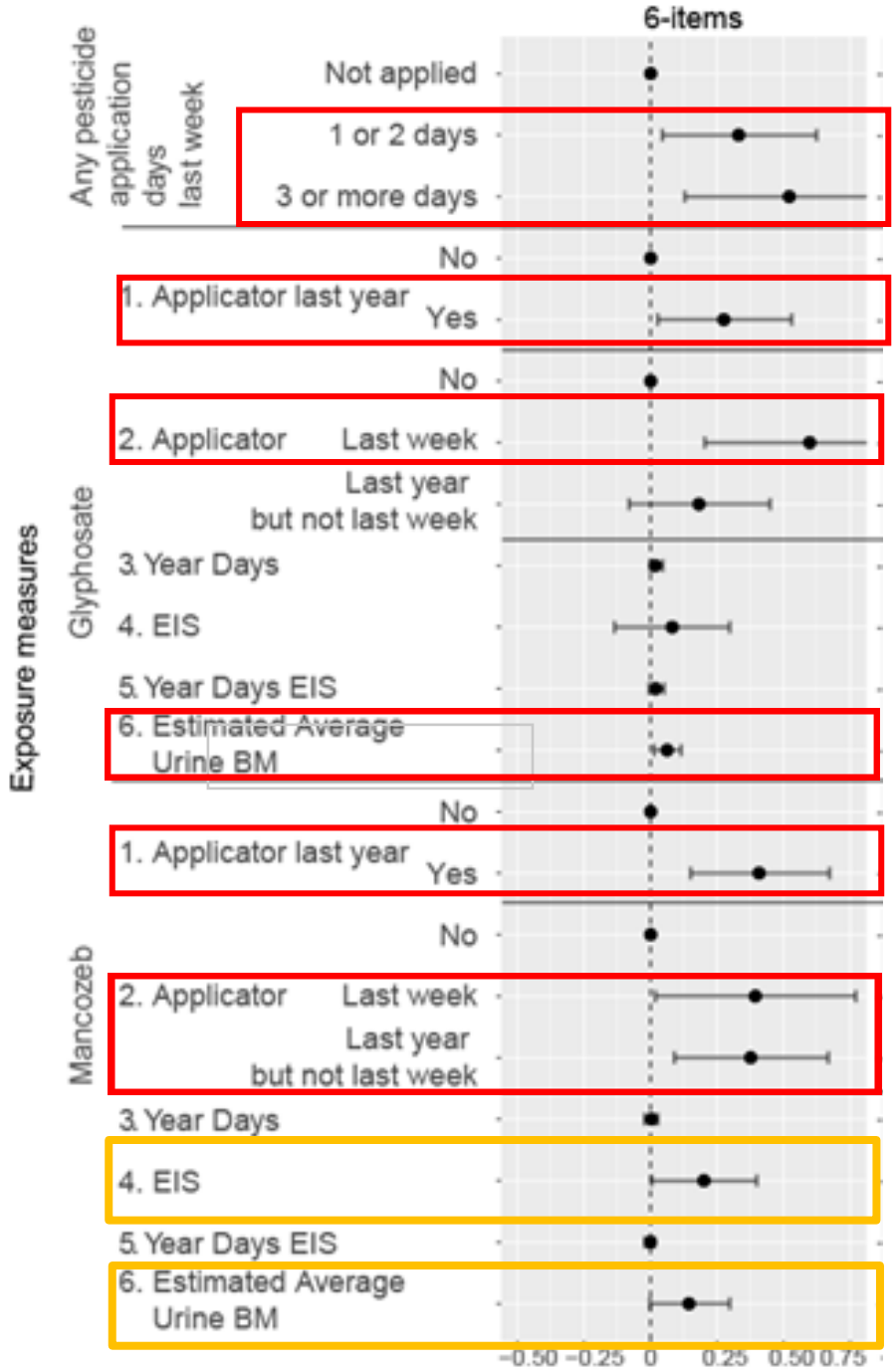
Exposure methods and related exposure measures used

- 253 smallholder farmers assessed Uganda in 2017
- Questionnaire-based exposure measures
  - Any pesticide last week (never, 1-2; >2 days)
  - Glyphosate and mancozeb-specific measures:
    - Application during last 12 months (yes/no)
    - Application timing (never, last 7 days, last 12 months but not last 7 days)
    - Number of application days last year
    - Average exposure-intensity scores (EIS) derived from a semi-quantitative exposure algorithm
    - EIS-weighted application days last year
- Estimated exposure based on ETU and glyphosate urinary biomarkers

MOS-SS
sleep problem index



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Main findings and conclusion

- Positive (statistically significant) associations with 6-item sleep problem index
  - Self-reported any pesticide application in the last 7 days
  - Self-reported glyphosate application in last 7 days
  - Estimated average urinary glyphosate concentrations showed an exposure-response association
  - Self-reported mancozeb application in last 12 months
- No (statistically significant) associations with 6-item sleep problem index
  - Other glyphosate and mancozeb exposure measures based on self-reports
  - Estimated average urinary ETU concentration

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Main findings and conclusions

- Active ingredient-specific short- and long-term exposure measures based on either self-reported information or based on urinary biomarkers can be used when studying the association with (acute) sleep problems

But

- Performance of exposure measures will be largely depending on contrast in exposure in the studied population and when studying acute (health) effects whether the measure covers biologically relevant time window of exposure
- Perform pilot exposure studies to improve exposure assessment and have informative studies on pesticides and health effects

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Thank you

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