Dichlorophenol Exposure and Chronic Kidney Disease

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Background

The pesticides 2,4-dichlorophenol (2,4-DCP) and 2,5-DCP are bi-products of many manufacturing processes, and found commonly in our everyday environment. Chlorinated phenols are known to cause nephrotoxicity, hepatotoxicity, and neurotoxicity, and they are suspected human carcinogens.[1] The U.S. Environmental Protection Agency (EPA) considers DCP to be a hazardous pollutant.[2]

The purpose is to explore the relationship between 2,4-DCP and 2,5-DCP with serum creatinine as a biomarker of kidney function in humans.

National Health and Nutrition Examination Survey (NHANES) 2013-2014 data (n = 2,063, 52.3% female) was used to statistically analyze this relationship between 2,4-DCP or 2,5-DCP and serum creatinine. Gender stratified analysis was completed using multivariate adjusted linear regression. Variables adjusted were age, ethnicity and annual household income. De-identified data used for analysis; therefore IRB ethical review was not required.

Figure 1 shows 2,5-DCP is higher in females <60 years; however males have higher levels beyond 60 years of age. The results for 2,4-DCP are similar, therefore only 2,5-DCP is represented.

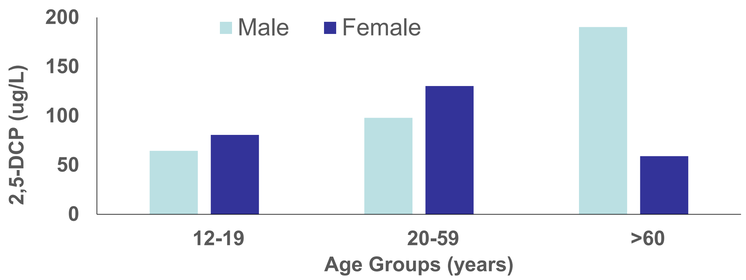

Figure 2 represents almost equal distribution of non-Hispanic White and Mexican/American Others in the NHANES 2013-2014 population. Predominant annual income category was the $20,000 – $74,999.

Results (continued)

Figure 3 illustrates no association between 2,4-DCP and serum creatinine in males or females.

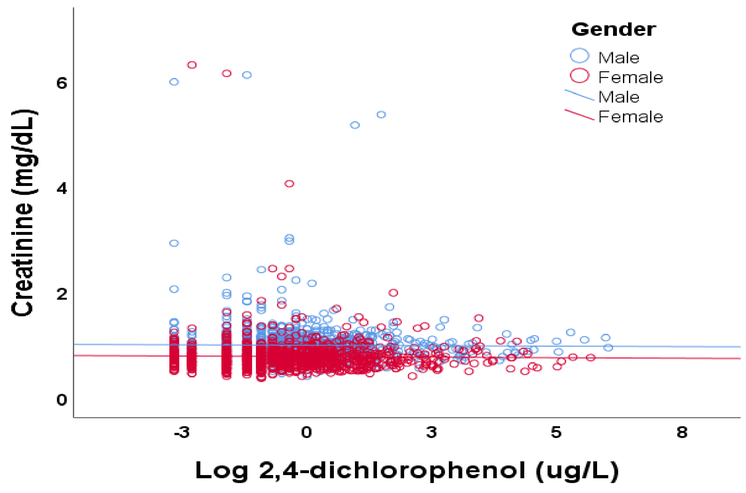

Figure 4 illustrates no association between 2,5-DCP and serum creatinine in males but significance in females.

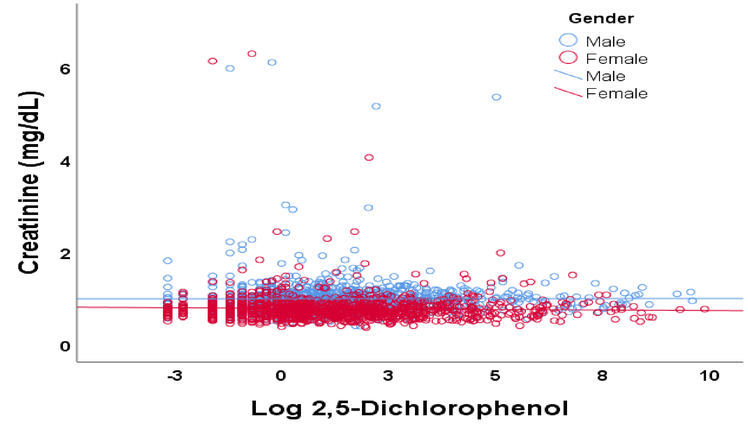

Table 1 shows no significance between serum creatinine and 2,4-DCP in either males or females.

	Males		Females	
Variable	β (95% CI)	*p*-value	β (95% CI)	*p*-value
2,4-DCP	-.010 (-.028, .008)	0.278	-.011 (-.025, .003)	0.11
Ethnicity				
MexAm/Other *				
Non-Hisp. White	.023 (-.031, .077)	0.403	.073 (.031, .115)	0.001
Non-Hisp. Black	.147 (.083, .212)	<.001	.170 (.120, .221)	<.001
Household Income				
$0-19,999 *				
$20,000-74,999	.012 (-.049, .072)	0.703	.018 (-.026, .063)	0.423
≥ $75,000	.028 (-.039, .095)	0.409	.004 (-.047, .055)	0.875
Age (years)				
12-19 *				
20-59	.194 (.132, .256)	<.001	.095 (.044, .145)	0.044
≥60	.347 (.277, .417)	<.001	.234 (.177, .291)	<.001

* Reference category

Results (continued)

Table 2 shows significant association between 2,5-DCP and serum creatinine in females, but not in males.

Table 2. *Multivariable Regression Showing Association between 2,5-DCP and Serum Creatinine in the NHANES 2013-2014 Study*

	Males		Females	
Variable	β (95% CI)	*p*-value	β (95% CI)	*p*-value
2,5-DCP	-.010 (-.022, .002)	0.093	-.011 (-.020, -.002)	0.017
Ethnicity				
MexAm/Other *				
Non-Hisp. White	.020 (-.035, .074)	0.48	.069 (.027, .111)	0.001
Non-Hisp. Black	.151 (.087, .216)	<.001	.176 (.125, .227)	<.001
Household Income				
$0-19,999 *				
$20,000-74,999	.009 (-.051, .070)	0.768	.016 (-.028, .061)	0.471
≥ $75,000	.023 (-.044, .090)	0.5	-.001 (-.052, .050)	0.968
Age (years)				
12-19 *				
20-59	.198 (.136, .260)	<.001	.094 (.043, .145)	<.001
≥ 60	.353 (.283, .423)	<.001	.234 (.177, .292)	<.001

* Reference category

Discussion and Conclusion

There have been animal model studies linking 2,4-DCP and 2,5-DCP exposure to multiple body system deteriorations including nephrotoxicity.[3,4] Human studies have shown most of the population has been exposed to both of these pesticides, and rapidly metabolizes them in the body, then excretes the pesticides in their urine,[1] which would cause higher exposure to the kidney.

These pesticides continue to be of human health concerns, with varied results in both genders. Further testing and continued monitoring is warranted.[5]

References

1. Ye, X., Wong, L., Zhou, X., & Calafat, A. M. (2014). Urinary concentrations of 2,4-dichlorophenol and 2,5-dichlorophenol in the U.S. population (National Health and Nutrition Examination Survey, 2003-2010): Trends and Predictors. *Environmental Health Perspectives*, *122*(4), 351-355.
2. Centers for Disease Control and Prevention. (2011). *The Agency for Toxic substances and Disease Registry*. Retrieved from ATSDR: https://www.atsdr.cdc.gov/toxprofiles/tp107-c2.pdf
3. Valcke, M., Levasseur, M., Soares da Silva, A., & Wesseling, C. (2017). Pesticide exposures and chronic kidney disease of unknown etiology: an epidemiologic review. *Environmental Health, 16*(49), 940-957.
4. Vural, H., Gulcubuk, A., Erdogan, O., Ozkan, O., Ozturk, G., & Haktanir, D. (2015). Subchronic exposure to 2,4-D-induced biochemical and histopathological changes in rats. *Fresenius Environmental Bulletin*, *24*(3a), 970-976.
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