Associations between Arsenic Pollution and Hepatocellular Carcinoma in Texas

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BACKGROUND

- Toxins including Arsenic have been shown to promote hepatocarcinogenesis in animals and in vivo
- This ecological study assesses neighborhood-level hepatocellular carcinoma (HCC) burden in Texas relative to arsenic exposure

METHODS

- Using data from the Texas Cancer Registry, we identified individuals diagnosed with HCC between 2011 and 2015
- The primary exposure of interest is Arsenic pollution; as reported in a national screening assessment by the Environmental Protection Agency (EPA) – the 2011 National Air Toxics Assessment (NATA) inventory
- NATA calculates the inhalation exposure concentration of Arsenic for each US census tract (neighborhood) in micrograms per cubic meter. For analysis, raw values were sorted into deciles, ranked on a 1-10 scale; decile 10 tracts have most exposure
- Data used for univariable, and multivariable models included: arsenic, demographic (race/ethnicity, sex, age), and socioeconomic (Area Deprivation Index-ADI-higher value is more deprivation)
- Negative binomial Poisson regression technique was used to evaluate the association between Arsenic exposure and neighborhood-level HCC incidence - measured by the incidence risk ratio (IRR)

TABLE 1: Relationships between HCC incidence in Texas (2011 to 2015) and Inhalation Exposure Concentrations of Arsenic (2011 estimate). Texas census tracts; N = 5,205

	Univariable Models[a]			Multivariable Model[b]		
	IRR	95% CI	*p* value	IRR	95% CI	*p* value
Arsenic Concentrations[c] (decile 10 vs. 1)	1.06	0.98 - 1.16	0.159	1.302	1.194 - 1.419	< 0.001
Area Deprivation Index (decile 10 vs. 1)	1.17	1.16 - 1.20	< 0.001	1.618	1.444 - 1.813	< 0.001
% Hispanic or Latino (10-unit increment)	1.08	1.07 - 1.09	< 0.001	1.092	1.080 - 1.105	< 0.001
% NH[d] Asians (10-unit increment)	0.68	0.65 - 0.71	< 0.001	0.892	0.853 - 0.934	< 0.001
% NH[d] African American (10-unit increment)	1.06	1.05 - 1.07	< 0.001	1.098	1.080 - 1.116	< 0.001
% Population ≥ 60 y.o. (10-unit increment)	1.19	1.15 - 1.22	< 0.001	1.406	1.359 - 1.455	< 0.001
% Population Male (10-unit increment)	1.05	1.00 - 1.11	0.064	1.171	1.117 - 1.226	< 0.001

a. Univariable models where Arsenic exposure concentration was regressed on the HCC incidence separately. Each covariate was also regressed on the HCC incidence separately
b. Multivariable model where Arsenic concentrations and the covariates (*p* value ≤ 0.10) were regressed on the HCC incidence simultaneously
c. The 2011 National Air Toxics Assessment (NATA) inhalation exposure concentrations for Arsenic (micrograms per cubic meter)
d. NH = Non-Hispanic

RESULTS

- In a univariable model, the association between Arsenic inhalation exposure concentrations and HCC was not significant (IRR = 1.06 [95% CI, 0.98-1.16])
- In a multivariable model that included race/ethnicity, sex, age, and ADI, the variation in the neighborhood-level incidence of HCC is significantly associated with ambient Arsenic inhalation exposure concentrations
- In a typical Texas census tract, a 10-unit increase in classification of Arsenic inhalation exposure concentration increases the risk of HCC incidence by a factor of 1.30 (IRR = 1.30 [95% CI, 1.19-1.42])

CONCLUSION

- Variation in HCC incidence across Texas's census tracts is significantly associated with the inhalation exposure concentrations of Arsenic at the census tract level; higher Arsenic concentrations are associated with an increased HCC incidence
- This ecological analysis suggests, although preliminarily, a potential inhalation pathway for Arsenic-HCC relationship
- This ecological finding needs to be further examined in direct association studies