

To: Arsenic work Group
 Science Advisory Board, USEPA
 Washington, DC

Re: Figure F-1 and “Township Effect”

The Toxicological Review of Inorganic Arsenic (February 2010) presents Figure F-1 below on page F-4 and concludes: “This finding suggests that the positive exposure-response relationship for arsenic is not being seriously confounded by a “village effect.”” EPA at the SAB workgroup meeting corrected this to “township effect.”

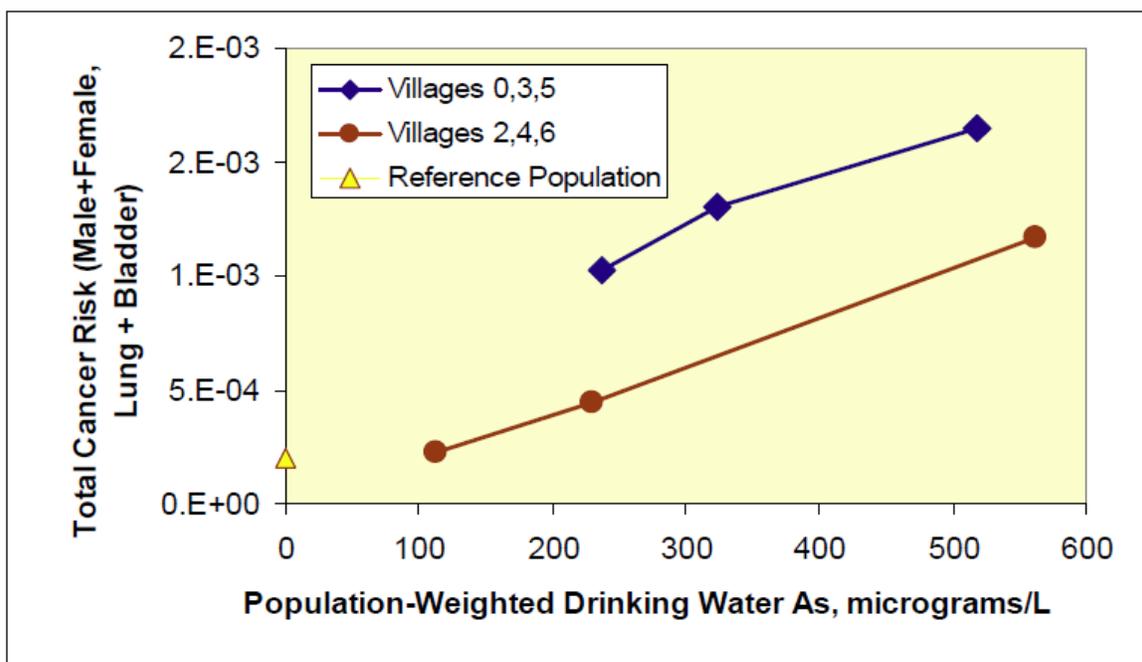


Figure F-1. Lifetime crude total cancer risk (male + female) for the low- and high-exposure villages

There are three observations to be made from EPA’s Figure F-1.

1. The slope of the cancer risk with respect to drinking water arsenic level is the same for Township group 0,3,5 and Township group 2,4,6 – “Arsenic effect”;
2. The cancer risks in Township group 0,3,5 are consistently greater than the cancer risks in Township group 2,4,6 by about 0.6E-03 – “Township effect”; and
3. The cancer risk for the low-exposure villages in Township group 2,4,6 whose population-weighted drinking water arsenic level is ~ 110 ug/L is not different from the cancer risk in the reference population with zero arsenic in the drinking water – “Threshold effect”.

The figure misrepresents the underlying data. The six data points do not represent low versus high exposure villages. Each data point is a summary statistic for one of the six townships.

Township	Exposure (ug/L)		Cancer Rate	
	Pop-wt Mean	Range of Medians	Townships 0,3,5	Townships 2,4,6
Twp 0	234	30-694	1.0E-03	
Twp 3	321	10-717	1.3E-03	
Twp 5	558	467-683	2.0E-03	
Twp 6	112	45-307		2.2E-04
Twp 4	221	42-650		4.4E-04
Twp 2	567	11-934		1.2E-03

It should be noted that, with the exception of Township 6, all townships include villages with median well arsenic in the very high range of greater than 500 ug/L. Township 6, which has village well medians ranging from 45 to 307 ug/L and a population-weighted mean of 112 ug/L, is the one township that has the same cancer risk as the reference population (2.1E-04). Further, these rates are mortality rates and not incidence rates.

The analyses above have collapsed all of the village-specific, exposure-specific information for each township into a single data point, mislabeled as a comparison of low- and high-exposure villages. The bladder and lung cancer mortality risks for the low dose villages of each of the townships had already been published as Figure 3 (Lamm et al. Environ Health Persp, July 2006;114(7)1077-1082).

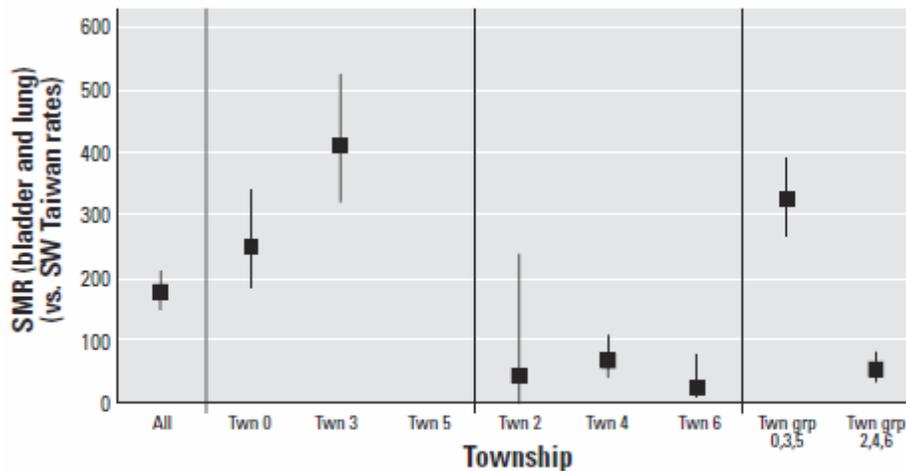


Figure 3. Bladder and lung cancer (combined) SMR (\pm 95% CI) for low-dose villages by township (Twn).

This analysis showed that the township-specific SMRs for the low dose villages in township group 2,4,6 were each less than 100 and in combination were significantly less than 100. In contrast, the township-specific SMRs for the low dose villages in township group 0,3,5 were each significantly greater than 100 and in combination were significantly increased with an SMR greater than 300.

EPA suggests that Figure F-1 compares low-and high-exposure villages for the townships. This is not so. The comparison has, in fact, already been published (Lamm et al. Env Health Persp, July 2007;115(7):A340) but has not been cited. Its Figure 1 shows an apparent dose-response relationship across the low-dose and high-dose villages for each of the townships in Township Group 2,4,6 but not for the townships in Township group 0,3,5. It is noteworthy that the linear regression line for each of the townships in township group 2,4,6 intersects the no-increased risk line (SMR = 100) at about 150 ug/L. The linear regression line for each of the townships in township group 0,3,5 intersects the no exposure line (zero ug/L) at an SMR greater than 200.

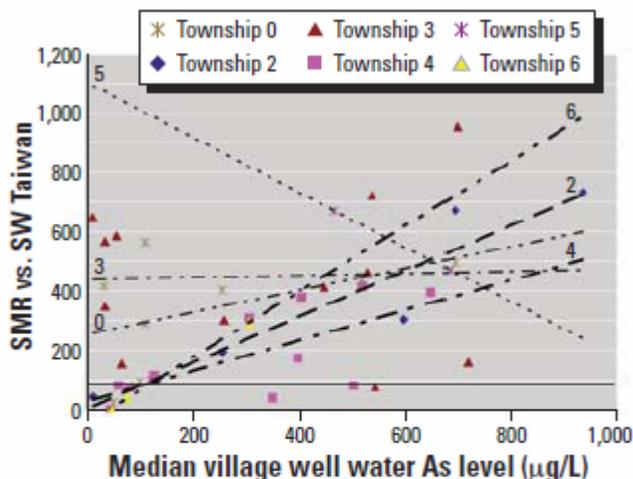


Figure 1. SMRs for bladder and lung cancer by median village well arsenic level for the 42 villages in the six townships in the southwest Taiwan study of Wu et al. (1989) with linear regression analysis by township. SMR = 100 is the level of no increased risk with southwest Taiwan as the reference population. Townships: 0, I-chu; 2, Pu-tai; 3, Hsieh-chia; 4, Yen-shui; 5, Pei-men; 6, Hsia-ying.

The detailed analysis of the bladder and lung cancer mortality in the Wu et al. (1989) villages in comparison to that of the SW region leads to the same conclusions derivable from the summary Figure F-1 in the Toxicological Review of Inorganic Arsenic (February 2010). That is, there is an “arsenic effect,” a “township effect,” and a “threshold effect” demonstrated by the data.

Cordially submitted,

Steven H. Lamm, MD, DTPH
 Arnold Engel, MD
 Manning Feinleib, MD, DrPH
 Rusan Chen, PhD

CEOH. LLC.
 3401 38th Street, NW #615
 Washington, DC 20016
 202/333-2364 Steve@CEOH.com