

Table 3. Correlation Coefficients of Log-transformed Concentrations between Studied Elements in Well Water of the Lanyang Basin

Element	Zn	Na	Ca	Cu	Fe	Mn	Mg	Cr	Sr	Ba	Cd	Be	B	As
Zn	1													
Na	-0.24*	1												
Ca	0.15*	-0.15*	1											
Cu	0.61*	-0.32*	0.19*	1										
Fe	0.24*	0.07*	0.32*	0.34*	1									
Mn	0.07*	0.34*	0.10*	0.07*	0.28*	1								
Mg	-0.006	0.49*	0.52*	0.07*	0.18*	0.49*	1							
Cr	0.32*	-0.34*	0.33*	0.57*	0.47*	-0.22*	-0.14*	1						
Sr	-0.09*	0.40*	0.66*	-0.05*	0.22*	0.45*	0.82*	-0.15*	1					
Ba	0.41*	-0.22*	0.28*	0.55*	0.47*	-0.10*	0.004	0.84*	-0.07*	1				
Cd	0.55*	-0.18*	0.05	0.89*	0.33*	0.16*	0.06*	0.81*	-0.15*	0.84*	1			
Be	-0.21*	0.10	-0.08	0.02	-0.02	0.05	-0.02	0.17*	-0.02	0.27*	0.87*	1		
B	0.02	0.52*	-0.14*	0.25*	0.18*	0.19*	0.27*	0.20*	0.07*	0.24*	0.37*	0.30*	1	
As	-0.04	-0.02	0.10*	-0.03	0.29*	-0.16*	-0.10*	0.28*	0.03	0.14*	-0.01	-0.24*	0.08	1

* $p < 0.05$.

Total number of water samples was 1,349.

Table 4. Regression Analysis of Incidence Rates from cancer at All Sites Combined and Various Element Levels in Well Water in four Townships of the Lanyang Basin, Taiwan

Element	All sites combined [140~208]			
	mean (ug/L)		Median (ug/L)	
	β^a	SE	β	SE
Ca	-0.009	(0.006)	-0.009	(0.004)
Fe	0.75	(0.34)	-0.49	(0.06)*
Mn	4.34	(1.00)*	3.32	(0.54)*
Mg	0.01	(0.01)	-0.003	(0.02)
Cr	-0.23	(0.03)*	-0.20	(0.08)
Ba	-1.81	(0.95)	-1.89	(0.82)
Be	-37.38	(38.72)	-35.59	(38.50)

* $0.01 < p < 0.05$

^a Regression coefficients indicate an increase in risk for development of cancer at all sites combined in incidence/100,000 person-years for every 1 ug/L increase in the level of studied elements in well water.

Meanwhile, significant inverse regression coefficients were observed for Fe and Cr.

The multivariate-adjusted RR of development of cancer at all sites combined with the 95% CIs for various risk factors are shown in Table 5. A significant inverse dose-response relationship between concentration of Mn and risk of development of cancer at all sites combined was observed after adjustment for age, sex, cigarette smoking, and alcohol consumption. Com-

pared with the first triplete level of Mn in well water as the reference group, the multivariate-adjusted RR with 95% CI of the second and the third triplete levels of Mn in well water were 0.6 (0.4-0.9) and 0.5 (0.4-0.8), respectively.

The synergistic interactions of Mn with As, and cumulative arsenic exposure on the risk of cancer at all sites combined were further assessed and are illustrated in Table 5. Compared with a cumulative arsenic exposure of less than 2000 ug/L-year as the reference group (RR = 1.0), a significant high RR was observed in the group with cumulative arsenic exposure of less than 2000 ug/L-year and low level of Mn concentration in well water. There were no synergistic interactions found in this study between As and Mn on the risk of development of cancer at all sites combined.

DISCUSSION

Significant associations between ingested inorganic arsenic and various cancers have been reported in our previous studies carried out in the southwestern arseniasis-endemic area in Taiwan. These case-control and ecological studies showed that long-term inorganic arsenic exposure through water consumption increases the risk of cancers at all sites combined, including those of the lung, liver, bladder, kidney, prostate gland, and skin.^{13,16,18,26,27}