

*Hung-Yi Chiou*<sup>a</sup> PhD  
*Shu-Ti Chiou*<sup>b</sup> MD, PPH  
*Kuang-Hung Hsu*<sup>c</sup> PhD  
*Yu-Mei Hsue*<sup>d</sup> PhD  
*Min-Li Wei*<sup>a</sup> MPH  
*Chien-Jen Chen*<sup>e</sup> ScD

<sup>a</sup> School of Public Health, Taipei Medical College

<sup>b</sup> Health Bureau of Ilan County

<sup>c</sup> Laboratory for Epidemiology, Department of Health Care Management, Chang Gung University

<sup>d</sup> Department of Public Health, School of Medicine, Taipei Medical College

<sup>e</sup> Graduate Institute of Epidemiology, College of Public Health, National Taiwan University

---

#### Key Words

Physiological and psychological adaptation

Exercise training

Orthotopic heart transplantation

---

## Risk of Cancer at all Sites Combined and Ingestion of Various Elements through Well Water among Residents of the Lanyang Basin, Taiwan

---

#### ABSTRACT

In order to evaluate exposure to various elements from drinking well water among residents in the Lanyang Basin located in the northeastern arseniasis-endemic area in Taiwan, 1349 well water samples were collected randomly from the study area. Samples were examined for concentrations of arsenic (As), zinc (Zn), chromium (Cr), sodium (Na), manganese (Mn), iron (Fe), beryllium (Be), magnesium (Mg), calcium (Ca), strontium (Sr), barium (Ba), boron (B), copper (Cu), and cadmium (Cd). Inductively coupled plasma-atomic emission spectrophotometry (ICP-AES) was used to determine concentrations of Zn, Cr, Na, Mn, Fe, Be, Mg, Ca, Sr, Ba, B, Cu, and Cd; As was determined by ICP-AES with hydride generation. In total, 2253 residents whose household well water was collected were personally interviewed based on a structured questionnaire. Information obtained from the interview included duration and volume of well water consumption. The cumulative exposure level of each study subject to various elements was derived from the concentration of each element in well water of the household, duration of drinking well water, and volume of well water consumption. The values of the mean  $\pm$  standard error ( $\mu\text{g/L}$ ) of concentration of these elements in well water were  $237.6 \pm 9.4$  for As;  $99.8 \pm 11.0$  for Zn;  $44,359.0 \pm 1619.6$  for Na;  $17,740.8 \pm 334.4$  for Ca;  $247.6 \pm 3.5$  for Cu;  $648.5 \pm 37.3$  for Fe;  $124.2 \pm 5.1$  for Mn;  $16,538.7 \pm 770.8$  for Mg;  $473.5 \pm 19.8$  for Cr;  $249.9 \pm 5.7$  for Sr;  $43.2 \pm 0.8$  for Ba;  $32.0 \pm 0.7$ , for Cd;  $0.5 \pm 0.02$  for Be;  $347.3 \pm 4.1$  for B. Concentrations of these elements in well water, with the exception of arsenic, significantly differed among the four studied townships in the Lanyang Basin. The log-transformed concentrations of Ca, Fe, Cr, and Ba were significantly positively correlated with that of As. However, significant correlations of Mn, Mg, and Be with As were also observed. Compared with the low Mn and Cu exposure group, those who drank well water containing high concentrations of Mn and Cu had significantly lower risk of cancer at all sites combined after adjustment for

---

### N. Taipei J. Med.

Received: December 7, 1999

Accepted: January 28, 2000

---

Correspondence: Dr. Hung-Yi Chiou  
School of Public Health, Taipei Medical College,  
250, Wu Hsing Street, Taipei, Taiwan 110-31, R.O.C.  
Tel: 886-2-23779189; Fax: 886-2-23779188  
E-mail: hychiou@tmc.edu.tw