senic in the development of internal cancers.

MATERIALS AND METHODS

Study Area

In total, 18 villages in 4 townships of the Lanyang Basin were selected for the present study, including 4 villages in Chiaohsi Township, 7 villages in Chuangwei Township, 3 villages in Wuchieh Township, and 4 villages in Tungshan Township. Because of the abundance of underground water, residents of the Lanyang Basin have used shallow wells (< 40 m in depth) for water since the 1940s. Although the implementation of a tap water system began in the study area from the early 1990s, some residents are still drinking well water. Variations in arsenic levels in well water of the study area were much more striking than those in artesian well water of the southwestern arseniasis-endemic area.[22] The main source of exposure to inorganic arsenic among residents in both areas was through drinking well water.

Recruitment of the Study Cohort and Determination of Elemental Contents of Well Water

The recruitment of study subjects as the study cohort has been described previously.[23] In brief, residents aged 40 years or above were recruited into the cohort with their informed consent. In total, 2,753 study subjects were randomly selected from the study cohort in this study. Information on the history of well water consumption, residential history, sociodemographic characteristics, cigarette smoking, alcohol consumption, physical activities, history of sunlight exposure, as well as personal and family history of hypertension, diabetes, cerebrovascular disease, heart disease, and cancers were obtained by a structured questionnaire given between October 1992 and September 1994.[23] In total, 1,349 well water samples were randomly selected from the –20 water bank. Inductively coupled plasma-atmic emission spectrometry (ICP-AES) was used to determine elemental concentrations of Zn, Na, Ca, Cu, Fe, Mn, Mg, Cr, Sr, Ba, Cd, Be, and B in these samples.

Follow-up of Cancer Incidence

The occurrence of cancer in study subjects was followed by annual interview and data linkage with community hospital records, national death certificates, and cancer registry profiles. The vital statistics and causes of death for all subjects in the study cohort during the entire follow-up period from initial recruitment to 31 December 1996 were verified. A total of 170 newly diagnosed cancer cases (ICD9 = 140-208) among various cancer sites in the body occurred during the follow-up period.

Data Analyses and Statistical Methods

The mean and standard error were used to express the concentration variation of the studied elements in well water among the studied townships. The Pearson correlation coefficient was used to assess the correlation between the studied elements and arsenic. In order to evaluate the association between the studied elements and incidence of all cancer sites combined, Cox's proportional hazards regression analysis was used to estimate the multivariate-adjusted relative risk (RR) and its 95 confidence interval (CI) for each element which was significantly correlated with arsenic.[24,25] The statistical significance of a multivariate-adjusted RR was examined by the significance test for the regression coefficient. The synergistic interaction of all cancer sites combined between cumulative arsenic exposure and Mn were also evaluated through Cox's proportional hazards regression model.

RESULTS

Table 1 shows the concentrations of studied elements in well water and the percentage which exceeded each element's MCL. The concentrations of 7 elements including Zn, Cu, Fe, Mn, Cr, Cd, and As, in well water were greater than their MCL. The percentages greater than MCL among these elements are 2.9%, 93.2%, 42.5%, 69.2%, 84.6%, and 73.4%, respectively. The township-specific concentrations of the studied elements in well water are shown in Table 2. The concentrations of studied elements in well water are significantly differed in various study townships. However, the arsenic content in well water did not significantly differ among these townships. In other words, all studied