

Evaluation of cancer death incidence and Cr⁺⁶ exposure
report of the mortality study conducted in the JinZhou, China, 1970-1978

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Abstract

The amount and distribution of Chromium contamination in the ground water of JinZhou area has been presented previously⁽¹⁾. To assess the long term effect of Cr⁺⁶ exposure on human health, we conducted a retrospective mortality study of residents living in the JinZhou suburb area during 1970-1978. The study population consisted of about 100,000 residents in selected units regions and villages for which a preliminary evaluation was published⁽²⁾. Three out of the six regions in JinZhou suburb area have cancer death rates comparable to the province average. In the Cr⁺⁶ contaminated area, the cancer death rate is not positively correlated with either the distance from the Cr⁺⁶ pollution source, or level of Cr⁺⁶ contamination. However, the whole contaminated area has a higher cancer death rate compared to the immediately adjacent areas. These results suggests that the high cancer death rate in this area may be attributed to lifestyle or enviromental factors not related to the Cr⁺⁶ contamination. Futher follow-up is recommended to assess the possible influence of Cr⁺⁶ and other risk factors on cancer mortality.

Background:

The JinZhou suburb area is an agricultural area of China with several industrial plants. JinZhou Alloy plant and No.6 Petroleum plant are the two largest. JinZhou Alloy Plant started regular chromium production in 1965, at which time a large amount of Cr⁺⁶ containing waste water was discharged. The discharged waste water contributed to the Cr⁺⁶ contamination only at the beginning of this episode. The Cr⁺⁶ contained in chromate ore processing residue from the plant, however, is the main source of the Cr⁺⁶ contamination. The ore residue was accumulated uncovered on an open area next to the plant and transferred Cr⁺⁶ into underground water when it was dissolved with rain. Due to the movement of underground water and geological characteristics, a long and narrow contaminated area was formed along the dried river bed of the Old Nuer River. The contamination continued from the plant until 1982 when a seepage prevention wall was built around the ore residue dump site. Residents living in the villages located along old Nuer River were exposed to Cr⁺⁶ by using well water that had been contaminated with Cr⁺⁶. In general, higher levels of the Cr⁺⁶ contamination occurred in the villages closer to the pollution source (the Alloy Plant).

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Retrospective Mortality Study:

We conducted a series of retrospective mortality studies in 1970-1978. The study population consists of residents living in JinZhou suburb area in 1970-1978. The total population of this study is about 100,000. Most residents are farmers (>95%) who have lived in the JinZhou suburb area (>95%) for most of their lives. The subject's residences were concentrated in agricultural villages located in the JinZhou suburb area. There was minimal migration within the population. We located all deaths that occurred in this population between 1970 to 1978 by checking the death records in the police department. A standard survey form was used to identify the cause of each death. All survey staff received training and a follow-up survey was conducted for part of the death records to ensure the quality of the data.

Results:

JinZhou suburb area was separated into six administrative regions. They are the Nuer River Region (Location of JinZhou Alloy plant), ZhongTun Region (Location of No.6 petroleum Plant), GuoShu, West suburb region, North suburb region, and XueJia. The adjusted cancer death rate for the Nuer River region was 68.79 per 100,000 people per year; for ZhongTun region, 68.43; for GuoShu region, 64.66; for West Suburb, 54.33; for XueJia, 57.51; for North suburb, 45.93. The cancer death rate for LiaoNing province in 1973-1975 was 66.11 per 100,000 per year. To assess the association between the cancer death rate and Cr⁶⁺ contamination, villages located in the chromium contaminated area were studied separately. For each village, we calculated the cancer death rate, lung cancer death rate and stomach cancer death rate. Stomach is the most common site of cancer in China for males and females. The results are listed in Table 1.

Table 1
Cancer Death Rates and Cr⁺⁶ Concentration for
Villages in the Contaminated Area

Village	JinChangBao	Nuer River	Yanxing	Shilitai	WenJiaTun	Range of China*
Distance from the alloy plant	1.4km	1.5km	3.0km	3.5km	5km	-

Average Cr ⁶⁺ concentration in water wells 1965	0.0309ppm	2.55ppm	0.177ppm	0.023ppm	0.0045ppm	-
Cancer Death Rate, 1970-1978	83.62/10 ⁵	71.89/10 ⁵	76.80/10 ⁵	92.96/10 ⁵	91.12/10 ⁵	29.78/10 ⁵ - 101.98 ⁵
Stomach Cancer Death rate	36.71/10 ⁵	28.00/10 ⁵	36.50/10 ⁵	55.17/10 ⁵	27.68/10 ⁵	5.22/10 ⁵ - 40.21/10 ⁵
Lung Cancer Death rate	13.17/10 ⁵	14.99/10 ⁵	21.39/10 ⁵	-	20.76/10 ⁵	1.81/10 ⁵ - 17.81/10 ⁵

*This is the range of average of 30 provinces in China.

Discussion:

The cancer rates in the Nuer River Region, ZhongTun Region and GuoShu are comparable to the average for LiaoNing province. The cancer death rates for the other three regions (West Suburb, North Suburb and XueJia) are lower than the province average. The chromium contaminated area was a long and narrow area that started near the Alloy Plant in Nuer River Region and expanded to the West Suburb. The level of the underground water contamination is positively correlated with the distance from the Alloy Plant. (Table 1) However, the cancer death rates for the six villages in the contaminated area are not positively correlated with either distance from the Alloy Plant or magnitude of Cr⁶⁺ contamination. Neither stomach cancer nor lung cancer indicated a positive association with Cr⁶⁺ contamination. Although chromium contamination may be the reason for the high cancer death rates in these area, this study does not find direct evidence. A possible reason may be that this study covers only a relatively short period of time. A longer term mortality study based on a larger population is recommended. These results also suggest that the high cancer death rates in this area may be attributed to lifestyle or environmental factors not related to the Cr⁶⁺ contamination. Additional studies to identify these factors are recommended.

References:

- (1) Chromium Pollution of Soil and Water in JinZhou, Zhang JianDong, Li XiLin, Journal of Chinese Preventive Medicine 21:262-264, 1987.
- (2) Report of underground water contamination by waste water discharged form JinZhou Alloy Plant. ZhangJinDong, Proceeding of First National Enviromental Hygiene Conference, ShangHai,

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