

Reducing the Incidence of Cancer of the Esophagus: Field Evidence of the Efficacy of Jiangshi, a Traditional Chinese Stone Drug

Weidong Yu¹ and Harold D. Foster²

Introduction

There is growing recognition that many diseases involve trace, or bulk element, deficiencies or excesses (Werbach, 1988). This awareness stems from progress in disciplines as diverse as geography and experimental animal biology. However, orthodox medicine's acceptance of such mineral-disease relationships ultimately appears to require repetitive double-blind testing, often involving hundreds of patients and controls, conducted over a period of several months, or, indeed, years. In contrast, the treatments used by traditional Chinese physicians have been developed, largely by trial and error, over millennia, on a cumulative patient base of billions. Many such medicines, especially stone drugs, represent natural mineral supplements. As a consequence, it seems highly probable that there is much to be learned from the scientific evaluation of such medications. Jiangshi, concretions precipitated from groundwater, are one such widely used stone drug. The name describes their appearance and is translated "ginger-like stone". They occur naturally, mainly in northern and northwestern China, where they are found in the extensive loess deposits that mantle the plateau and hill regions. Many jiangshi, therefore, come from Shaanxi, Gansu, Hebei and Shangdong provinces. Although their chemical composition varies somewhat from region to region, they are typically dominated by calcium and silicon. According to Wang Xueying and colleagues (1983), jiangshi also contain a very wide variety of other elements. Details of the relative abundance of these can be seen in Tables

1 and 2 (p. 61). As shown by these two illustrations, jiangshi include numerous bulk and trace elements, such as calcium, iron, magnesium, potassium, sodium, manganese, zinc, cobalt, iodine, chromium, copper, selenium and boron, that might be expected to have an impact on human health.

Traditional Role

It is uncertain how long jiangshi have been used for the treatment of illness, in China. However, the first written record of their use, as a drug, appeared some 1,300 years ago, in the *Newly-revised Materia Medica of Tang* (Su Jing, 659 AD). In this publication, jiangshi were promoted largely for the treatment of skin diseases. Subsequently they were also used for a variety of other illnesses, including edema and inflammation and hyperplasia of the female breast. The most interesting record of the use of jiangshi, however, appeared in the *Collection of Medical Remedies for the Care of Health*, produced by the famous Chinese physician Liu Wansu, in Hebei Province, during the Jin Dynasty (1186 AD). This publication discusses the benefits of jiangshi, in the treatment of Qiye. In traditional Chinese medicine, the term Qiye is used to describe certain specific symptoms. It is applied, for example, when one is hungry and wishes to eat, but cannot, because food will not pass normally down the esophagus. To quote directly, "the food is trapped between the pharynx and the diaphragm and could be thrown up before entering the stomach". It is generally believed that Qiye describes the symptoms typically experienced by patients with esophageal and, perhaps, gastric carcinoma. For this reason, since the 1970s, a series of experiments have been conducted in China, using jiangshi, in an effort to reduce the incidence of esophageal

1. China Academy of Traditional Chinese Medicine, Beijing, People's Republic of China.

2. Professor of Geography, University of Victoria, Victoria, B.C., Canada.

cancer. The results of these field trials have been published almost exclusively in Chinese and are summarized here, in English, for the first time.

Experimental Application: Cancer as an Endemic Disease?

Esophageal cancer is extremely common in the People's Republic of China, a country which probably accounts for over 60 percent of the world's cases (Howe, 1986; Parkin et al, 1984). The national annual mortality rates from the disease are 31.7 and 15.9 per 100,000 respectively, in males and females. However, such Chinese mortality figures mask major variations in the occurrence of esophageal cancer, which is quite rare over large areas of the country, but occurs at extremely high rates in certain, sharply differentiated regions (Day, 1984). One of these is Xingtai county, in Hebei province, where, during the period 1974 to 1976, annual male mortality from esophageal cancer was established at 111.69 per 100,000 (Gao Zhenwei et al, 1984). Even within Xingtai county, the incidence of esophageal cancer varied, with exceptionally high rates occurring in the west. It was in this western area that, in 1974, Gao Zhenwei, formerly the Director of the Xingtai Regional Institute of Medical Science, and his colleagues, began an experiment designed to explore the possibility of reducing esophageal cancer incidence, by modifying drinking water quality. The method used was to line wells with jiangshi, so that they were in direct contact with the water. One to two tons of jiangshi were used for every 5 cubic metres of standing water. Each year, these were removed and replaced by fresh concretions. As can be seen from Table 3, the results were extremely promising. The research area, in which water quality was being modified by jiangshi, in the five years prior to the experiment, experienced an average annual mortality rate from esophageal cancer of 275.28 per 100,000. During the first ten years of the investigation, the annual mortality rate, amongst those drinking jiangshi treated water, fell to 54.28 per 100,000, a more than 5-fold decrease. Although mortality rates also dropped from 156.86 to 112.84 per 100,000, in a control group drinking untreated water, this decline was far less

impressive. As can be seen from Table 4, the difference in cancer incidence between the two groups seemed to stem from a reduction of severe proliferation of esophageal epithelial cells, in individuals drinking jiangshi-treated water for prolonged periods. To illustrate, while 24.1 percent of a 220 member sample of the control group were found to be suffering from either esophageal cancer, or severe epithelial cell proliferation, only 9.9 percent of the 181 member sample of the experimental group had similar problems. The difference is statistically significant ($p < 0.01$).

A second method of altering water quality was also used by Gao Zhenwei and colleagues (1984). This involved dropping large quantities of jiangshi down drinking water towers, in Shahe, Lingjin and Xingtai counties, and in the suburbs of Xingtai city, Hebei province. One ton of jiangshi was added for each ten tons of water held by the towers. As can be seen in Table 5, during the five years prior to the addition of jiangshi to drinking water towers in these areas, the annual age adjusted mortality from esophageal cancer had been 91.37 per 100,000. In the three years after such treatment, it dropped to 68.37 per 100,000. Clearly, there had been a substantial decline in mortality from this cancer. In contrast, during the same time period, the annual age adjusted death rate from esophageal cancer, in the control group, rose from 86.90 to 90.15 per 100,000. While tower water, treated in this manner, therefore appeared to be associated with a decline in esophageal cancer mortality, this was not as dramatic as in the previously described well water experiment. This may have been because the ratio of jiangshi to water was lower in the water tower experiment.

In a paper presented at the *International Symposium on Environmental Life Elements and Health*, held in Beijing in 1988, Zhu Cheng and An Yonglu provided further evidence of the efficacy of jiangshi in reducing esophageal cancer mortality. They described how, in 1974, the existing wells of five villages, located in Xingtai, Hebei, with a combined population of 1048, had been treated with jiangshi, or replaced by new wells, which had been

built with large quantities of these concretions. Prior to the resulting change in water quantity, each village had suffered at least one annual death from esophageal cancer. Since 1975, not a single case had been recorded in any of them.

In addition to the experiments of Gao Zhenwei and his colleagues in Hebei, there were at least two other brief mentions, in the Chinese literature, of attempts to reduce esophageal cancer mortality by using jiangshi. These experiments have taken place in Weinan country, Shaanxi province and Zhangxian county, Gansu province and both are claimed to have been successful. However, further details are, as yet, unavailable (Feng Yuming, 1984).

Health Islands

During their field work, members of the Xingtai Regional Institute of Medical Science discovered that esophageal cancer was virtually unknown in the village of Xin Zhuang, in Shahe county. Nevertheless, this settlement was surrounded by areas with mortality rates of between 120 to 150 per 100,000. Cytological examinations proved that severe esophageal cell proliferation was limited to recent immigrants from nearby settlements and was unknown in long time residents. Indeed, folklore recorded only a single case of esophageal cancer mortality in permanent occupants of the Xin Zhuang. It was discovered that the village water well, serving this health island, had been drilled into a thick layer of jiangshi, which naturally modified the quality of local drinking water (Gao et al, 1984).

Discussion

While the evidence presented here does not prove that the addition of jiangshi to drinking water can prevent esophageal cancer, it is highly suggestive. Why this may occur, however, is unclear and several hypotheses have appeared in the literature. Zhao Lin and colleagues (1985) have shown, for example, that jiangshi can reduce the concentrations of various metallic ions in solution. Those affected most included chromium, iron, gallium, bismuth and lead. Molybdenum and copper ions were also influenced to a lesser degree. It is possible,

therefore, that the addition of jiangshi to drinking water reduces the impact of naturally occurring metallic carcinogens.

It is also known that when added to water supply jiangshi release high levels of mono-silicic acid (Wang Xueying et al, 1983). Liu Mozhuang and coworkers (1983) have argued that the drinking water in Shexian county, Hebei, an area which has age adjusted esophageal cancer mortality rates for males of 148.43 per 100,000 and 84.40 per 100,000 for females, is deficient in mono-silicic acid. In contrast, they suggest that drinking water in Changli county, Hebei, which has a male age adjusted esophageal cancer mortality rate of 7.79 and a female rate of 1.83 per 100,000, contains high levels of this acid. They argue, therefore, that it is jiangshi's ability to increase the mono-silicic acid levels of drinking water that results in reduced esophageal cancer mortality.

One of the current authors (Foster, 1986, 1989, 1990; Norie and Foster, 1989) has argued that, on a global scale, esophageal cancer tends to be more common in soft water areas. He has suggested that this may be because such waters are often deficient in both calcium and selenium. A lack of calcium appears to promote decoupling, the first phase in the process which can lead eventually to cancer of the esophagus (Garland et al, 1988), while selenium deficiency has been shown to enhance the deleterious effects of many carcinogens (Ip and Sinha, 1981; Passwater, 1980). It is possible, therefore, that the addition of calcium rich concentrations, containing many trace elements, including selenium (Tables 1 and 2) increases the availability of these two elements and hence gives additional protection against esophageal cancer. Similarly, Zhu Cheng and An Yonglu (1988) have also suggested that selenium deficiency is the main cause of esophageal cancer and that this problem is remedied by adding jiangshi to water supply.

Conclusion

In the United States, in 1983 alone, the federal government spent \$998 million on cancer research (Committee on Trauma Research, 1985). There was nothing unusual about the financial

support given, in this year, and even this figure shrinks to relative insignificance when compared with the cost of treating the one million new American cases diagnosed each year (Davis et al, 1990). However, as Bailar (1990) has pointed out, global trends in cancer incidence and mortality "indicate that the worldwide effort to control cancer has failed to attain its primary objective — substantial reduction of the overall cancer death rate — despite some 40 years of intense effort that has focused mostly on treatment."

It seems obvious that the time has come to try new approaches to reducing cancer incidence and mortality. The preceding literature review appears to suggest that the addition of jiangshi to drinking water may be one area of great potential. It is especially interesting to note that, in the United States, white male mortality from cancer of the esophagus has a very similar distribution pattern to those of several other malignant neoplasms, including cancer of the mouth, tongue, large intestine, bladder and urinary tract organs (Foster, 1986). This suggest that many of these cancers may have risk factors in common, and as a result it is possible that jiangshi may also be beneficial in reducing mortality from these causes. Furthermore, it has been argued that, in Italy and the United States, schizophrenia and esophageal cancer have similar spatial distributions (Templer et al, 1990), and it is possible that these two very different diseases have risk factors in common. If so, success in reducing the incidence of one might also be reflected in a decline in that of the other (Foster, 1990).

What appears to be needed now, as the next step, is an experiment involving the addition of jiangshi to the water supplies serving a large population, in an area which traditionally experiences elevated mortality from cancer of the esophagus. Changes in water quality must be continuously monitored, together with variations in the incidences of a wide variety of diseases. In this way, possible causal links, if any, can be established. If, as a result, convincing scientific evidence becomes available, cancer prevention through environment modification could be attempted on a far larger scale, in North America and elsewhere.

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Table 2
A Comparison of the
Minor Constituents of
Three Varieties of Jiangshi

Origin and Composition
(parts per million)

Element	Zhangxian Shexian Xingtai		
	Gansu	Hebei	Hebei
Zinc	60.00	60.00	60.00
Cobalt	17.00	16.00	15.00
Nickel	16.69	16.75	14.85
Iodine	15.00	15.00	12.00
Vanadium	8.78	8.05	13.17
Chromium	3.42	6.84	10.26
Copper	3.00	1.00	1.10
Tin	1.00	2.00	2.00
Selenium	0.01	0.04	0.02
Molybde-			
num	0.20	0.35	0.95
Boron	1.15	8.07	1.04
Bromine	51.00	1.00	45.00
Tungsten			
(Wolfram)	0.18	0.71	0.73
Lead	0.90	1.00	1.10
Scandium	2.09	2.22	2.28
Beryllium	0.72	0.72	0.72
Silver	4.60	4.50	3.80
Tellurium	0.008	0.003	0.008
Arsenic	2.00	2.00	2.00
Uranium	0.55	1.00	0.70
Thorium	0.85	0.50	1.10

Table 1
A Comparison of the
Major Constituents of
Three Varieties of Jiangshi

Origin and Composition
(percentage by weight)

Element	Zhangxian Shexian Xingtai		
	Gansu	Hebei	Hebei
Calcium	29.22	27.04	23.21
Silicon	8.31	10.07	13.22
Aluminum	2.04	2.28	2.99
Iron	0.99	1.11	1.44
Magnesium	0.42	0.73	0.59
Potassium	0.65	0.62	0.91
Sodium	0.42	0.54	0.6
Barium	0.18	0.17	0.15
Titanium	0.12	0.15	0.19
Manganese	0.022	0.021	0.025
Phosphorus	0.017	0.009	0.027
Strontium	0.019	0.02	0.024
Fluorine	0.06	0.07	0.06
Sulphur	0.008	0.008	0.008

Source: Wang Xueying et al (1983)

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Table 3
Changes in Esophageal Cancer Mortality in Parts of Western Xingtai, Before and After
Changes in Well Water Quality, Compared with Those of a Control Group

Group	Five Years Prior to Experiment			Ten Years After Start of Experiment			Proba- bility (p)
	Cumulative Population	Number of Deaths	Mortality per 100,000	Cumulative Population	Number of Deaths	Mortality per 100,000	
Jiangshi experi- mental group (well water treated with jiangshi)	4,360	12	275.28	9,212	5	54.28	p < 0.01
Control group (water untreated)	8,925	14	156.86	18,654	21	112.84	p > .05

Source: Gao Zhenwei et al, 1984

Table 4
A Cytological Comparison of Population Samples
from Hebei Province Drinking Treated and Untreated Water

Group	Sample Size	Number of cases with severe epithelial cell proliferation		Esophageal Cancer Cases	Positive Rate (percent)	Probability (p)
		Stage I	Stage II			
Jiangshi experi- mental group (well water with jiangshi)	181	15	2	1	9.9	p < 0.01
Control group (water untreated)	220	38	10	5	24.1	

Source: Gao Zhenwei et al, 1984

Table 5

A Comparison of Esophageal Cancer Mortality in Regions Where Drinking Water Towers were Either Treated, or Not Treated, with Jiangshi

Group	Time Period	Cumulative Population	Number of Deaths	Mortality per 100,000	Age Adjusted Mortality per 100,000
Jiangshi experimental group (treated tower water)	5 year period prior to addition of jiangshi	198,165	252	127.16	91.37
	3 year period after addition of jiangshi	120,554	109	90.41	68.37
Control group (untreated water)	Corresponding 5 year period	185,434	213	114.38	86.90
	Corresponding 3 year period	116,078	142	122.33	90.15

Source: Gao Zhenwei et al, 1984