Relationship between different sources of drinking water, water quality improvement and gastric cancer mortality in Changle County * -A retrospective-cohort study in high incidence area

WANG Zhi-Qiang[1], HE Jian[2], CHEN Wen[3], CHEN Yu[1], ZHOU Tian-Shu[2] and LIN Yu-Chun[1]

Subject headings stomach neoplasms/ mortality; water supply; risk factors; cohort studies; incidence; retrospective studies

Abstract

AIM To investigate the relationship between different sources of drinking water supply, water quality improvement and gastric cancer mortality rate in a high risk area.

METHODS A retrospective-cohort survey was carried out in all towns of this county to study the effect of different sources of drinking water supply and water quality improvement on gastric cancer mortality rate.

RESULTS The gastric cancer mortality rate among the population 124.05/105 drinking river water was obviously higher than that of drinking shallow well water (74.85/105) ($P < 0.01$) according to the Zhanggang Town 16 years accumulated data. The same pattern was presented in 7 towns after balancing the confounders. The gastric cancer mortality rate of population drinking river water was 86.03/105, which was higher than those drinking shallow well water (62.03/105) and tap water (29.78/105) ($P<0.01$). When the drinking water switched from river and well water to tap water, the gastric cancer incidence decreased to 30.33/105 and 26.10/105, and the gastric cancer mortality decreased by 59% and 57% respectively.

CONCLUSION The quality of drinking water is one of the important factors of increased incidence of gastric cancer in Changle County, and water quality improvement has a beneficial effect, but the cause of high gastric cancer incidence may be multi-factorial in this area.

[1]Department of Environmental Health, Fujian Medical University, Fuzou 350004, Fujian Province, China.

[2]Hygiene and Anti-epidemic Station of Fujian Province, Fuzhou 350001, Fujian Province, China

[3]Hygiene and Anti-epidemic Station of Changle county, Changle 350200, Fujian Province, China

Dr. WANG Zhi-Qiang, male, born on 1937-07-15 in Shanghai, graduated from Shanghai Medical University in 1961, Professor of Environmental Health, Director, having 18 papers published.

Tel:+86·591·3357235

***Supported by "8·5" national major project, No. 95-914-01-10.**

Correspondence to Dr. WANG Zhi-Qiang, Department of Environmental Health, Fujian Medical University, 88 Jiaotong Road, Fuzou 350004, Fujian Province, China

Received 1997-07-10

INTRODUCTION

Changle County is located in the south-east beach area of Fujian Province with a population of over 600 thousand and has 17 towns. The standardized gastric cancer mortality rate ranged from $60.18/10^5$ - $98.68/10^5$ between 1971-1990. The highest standardized mortality rate in male was $161.20/10^5$, remaining at a high level for a long time[1]. It is one of the highest gastric cancer incidence area in China. The result of a retrospective cohort study of six towns in this county had been reported[2], which indicated that the gastric cancer mortality rate is related to drinking water supply. The drinking water was surveyed between 1991 - 1992 throughout the county. The stratifying analysis results of the seven towns investigated are presented as follows.

MATERIALS AND METHODS

Reliability of data

A resident retrospective survey of deaths from all causes has been conducted four times since 1973. Diagnosis of gastric cancer death made by hospitals at county level or above was 77.99%, 81.64%, 71.46%, and 81.79% respectively. Diagnosis of grades I and II were 75.60%, 78.58%, 88.58% and 97.48% (grade I: postmortem; grade II: pathology). The reliability and integrity of the survey and data all met the quality requirements set by the National Cancer Prevention and Treatment Bureau "Death Cause Survey Handbook" and the Ministry of Public Health "Resident Death Cause Survey".

Type of drinking water sources

Type of drinking water sources was divided into river water (partly including pond, stream), shallow well (partly including deep well and spring water) and tap water. For calculating the person-year observed, only the people who must use one type water source for over four years can get into the cohort. It had been defined before the survey was begun because the drinking water source may be changed during the resident's lifetime. The types of drinking water drunk by people with gastric cancer before death were checked at the same time.

Data analysis and calculation

SAS software was used to analyze the data of this survey. Chisquare test was done by Mentel-Haneszel method. Gathering analysis for equilibrium of food, smoking and drink factors was proceeded by Systat software.

RESULT

Water type and gastric cancer mortality rate

Gastric cancer mortality rate in Zhanggang Town was the highest in this county from 1973 - 1990. Sixteen years accumulated data were analyzed, which indicated that gastric cancer mortality rate of population drinking river water was significantly higher than that of the shallow well source ($P < 0.01$) (Table 1).

Table 1 Gastric cancer mortality of Zhanggang Town according to the type of water supply (1/10^5) (1973 - 1990)

Type of water source	Male	Female	Total
River Water	176.91	57.29	121.05
	(141/79 699)*	(40/69 822)	(181/149 521)
Shallow well water	112.70	31.58	74.85
	(320/267 979)	(74/234 356)	(276/502 335)
RR	1.57	1.81	1.62
χ^2	19.88	9.49	28.79
P	<0.01	<0.01	<0.01

*Number of gastric cancer death cases / person-year observed.

In view of the fact that there were different factors among the towns in this county, such as geographical environment and living habits. According to the recent information[3], after controlling confounders of diet (mouldy grain, fresh vegetable, fish-sauce intake amount), smoking, drinking, etc., the different drinking water supply and gastric cancer mortality rates for the seven towns are presented in Table 2. The results showed that gastric cancer mortality rate of population with river water supply is higher than that of the shallow well water and tap water supply (P<0.01).

Table 2 Types of the drinking water supply and gastric cancer mortality rates for seven towns, Zhanggang (1/10^5)

Types of drinking water supply	Male	Female	Total
River water (1)	122.83	46.10	86.03
	(107/87 113)	(37/80 263)	(144/167 376)
Shallow well (2)	85.02	36.06	62.03
	(650/764 555)	(244/676 618)	(894/1 441 173)
Tap water (3)	51.31	3.86	29.78
	(16/31181)	(1/25906)	(17/57087)
RR	2.39	11.94	2.89
χ^2 (1:3)	10.617	8.618	18.005
P	<0.01	<0.01	<0.01
RR	1.66	9.34	2.08
χ^2 (2:3)	3.673	6.524	8.872
P	>0.01	>0.05	>0.01
RR	1.44	1.28	1.39
χ^2 (1:2)	12.158	1.686	13.017
P	<0.01	<0.05	<0.01

Water quality improved and gastric cancer mortality rate

Using population with persistent river and shallow well water supply as control group, the effect of the improved water quality on gastric cancer mortality rate was studied. The results showed that after switching river water or shallow water to tap water, the gastric cancer mortality rate presented a decreasing trend, especially in population that the river water was changed as summarized in Table 3.

Table 3 Improved water and gastric cancer mortality rates for seven towns in Changle County (1/10^5)

	Male			Female			Total		
	Person-year observed	No. of deaths	Death rate	Person-year observed	No. of deaths	Death rate	Person-year observed	No. of deaths	Death rate
Persistent river water supply	37 484	43	114.72	36 856	12	32.56	74 340	55	73.98
River water changed to tap water	35 088	14	39.90	24 262	4	16.49	59 350	18	30.33
RR		0.35			0.51			0.41	
χ^2		12.93			1.44			11.52	
P		0.0003[b]			0.2295			0.0007[b]	
Persistent well water supply	411 547	355	86.26	362 687	118	35.23	774 234	473	61.10
Well water changed to tap water	10 449	3	28.71	8 711	2	22.96	19 160	5	26.10
RR		0.33			0.71			0.43	
χ^2		3.98			0.24			3.80	
P		0.0460[a]			1.0000			0.0512[a]	

[a]P<0.05, [b]P<0.01.

DISCUSSION

The relationship between different sources of drinking water and gastric cancer has been reported by several authors and comparatively consistent results were observed[4-7]. In the population with raw river water supply, the gastric cancer incidence was significantly higher than those with underground water supply. In our study, a retrospective-cohort of sixteen years accumulated data was analyzed. The result indicated that the type of drinking water was related to gastric cancer mortality. Even though the survey was extended to seven towns and under the condition that the confounders related to gastric cancer were balanced, the result showed the same pattern. In view of these results, the drinking water was thought to be one of important factors in the increased incidence rate of gastric cancer in this area.

According to the result of this investigation, altering drinking water has presented a significantly beneficial effect in decreasing gastric cancer rates. When the river water was changed to tap water, the rate decreased by 59% and 57% in case the well water was changed to tap water. Mutagenicity of different drinking water source has been compared in an earlier study which showed that the raw water had more mutagenic effects than the water purified in this area[8,9]. This result was identical with the results of epidemiological survey in this study. It is suggested that improving the drinking water quality should be a preventive method for decreasing the gastric cancer incidence rate in this high risk area. This study was only referred to one aspect of this problem, that is ' drinking water and gastric cancer'. Even if that drinking water had been improved in this district, the gastric cancer mortality rate was still on the median level. So the etiology of gastric cancer may be attributed to multi-factors in this high incidence area[10-12].

REFERENCES

1 Chen JS. Analysis of gastric cancer death and prevalence trend in Changle County in 1973-1990. *J Fujian Med Coll*, 1992;26(5):116-118
2 Wang ZQ, Zhou TS, Chen W. Investigation of the drinking water and cancer mortality in Changle County.*J Fujian Med Coll*, 1991;25(4):354-356
3 Ye WM, Yi YN, Lin RT. Case-control study of fish sauce and gastric cancer. *Cancer*,1995;15(2):157
4 Yang KY, Tu JT, Li HM. Exploring to factors of high gastric cancer incidence in geograghic fault zone.*Cancer*, 1986;6(3):107-110
5 Yeh BF, Xu YC, Yu H. Retrospective-cohort study of the drinking water and cancer.*Chin J Epidemiol*, 1986;7(4):219-221
6 Chen K, Shen YZ, Shen GF. Study on incidence rate of some cancer in areas with difference in drinking water sources. *Chin J Public Health*, 1994; 12 (3): 146 -148
7 Miao YD. A study on the relation between the type of drinking water and cancer. *Cancer*, 1989;9(1):8 - 10
8 Wang ZQ, Ling YX, Lin RT. Study on drinking water, cancer mortality and mutagenicity of water organic extract substances. *China Comprehensive Med*, 1995;7:796-798
9 Chen H, Lin YC. A study on mutagenicity of source water for drinking in Changle.*Carcinogenesis. Teratogenesis. Mutagenesis*, 1995;7(2):87-90
10 Zhu HG. Health assessment of organic chemical contaminants in water. *China Environ*, 1987;7(4):67 - 73
11 Deng DJ, Zhang RF, Jin S. The salmonella mutagenicity of cancer high risk area. *Cancer*, 1989;9(6):251 - 252
12 Yi YN, Ye WM, Rou NX. Ecologic study of fish sauce and gastric cancer. *Cancer*, 1995;15(2):158