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Analysis of Environmental and Occupational Risk Factors In Bladder Cancer

Abstract

Along with the high level of economic and industrial development, lifestyles of the Taiwan people have also changed. Smoking and exposures to certain environment and occupations are some major carcinogenic factors. Bladder cancer though is not one of the ten leading causes of cancer deaths in Taiwan, some 500 people die of this cancer each year and the trend is increasing. Risk factors of bladder cancer, according to available literature, are male, aged above 60, smoking, with exposure to aromatic amines, chemical dye stuff, rubber and arsenic. Exposures to other substances such as coal tar, petrol exhaust fumes, polycyclic aromatic hydrocarbons (PHAs), fluorinated drinking water, analgesics, lifestyles (including diet, coffee, tea, and artificial food additives), infection of the urinary system, and family genetics may also be carcinogenic factors. Workers of some special industries such as dyes, rubber, petrol, paints, textile and leather, and truck drivers have more risks to bladder cancer. Studies show that about 20-25% of all risk factors of bladder cancer is attributable to environmental and occupational exposures. Since the incubation period of bladder cancer can be as long as 25 years after exposure and the identification of hazardous substances is not easy, few epidemiological studies on the environmental and occupational risk factors and cases of bladder cancer have been reported in Taiwan.

The present study used the case-control approach in a comparative study of bladder cancer patients (313) and their controls (346) in two medical centers in the northern and southern parts of Taiwan in the last few years. By adjusting confounding effects, it was noted that individuals who had lived in the black-foot disease endemic areas, who smoked, had high risk occupational exposure and

Special food habits (eating of salt-preserved food or salty food), and were with history of bladder infection and family history of bladder cancer and kidney cancer would have higher risk of bladder cancer. Drinking of alcoholic beverage, coffee, tea and drinking of well water were not found to be statistically associated with the disease. Further analysis by unconditional logistic regression showed that factors such as living experience in the black-foot disease endemic areas, smoking, special food habits (regular use of artificial sweeteners and highly salty food), and history of bladder infection or family history of bladder cancer and renal cancer were significantly associated with bladder cancer. In addition, urinary cell carcinoma in the black-foot disease endemic areas was not associated with either smoking or high-risk occupations. However, smoking was still a major risk factor of urinary cell carcinoma in non black-foot disease areas in Taiwan.

Introduction

Bladder cancer is one of the common cancers of the urinary system. There has been a trend of increase by year in Taiwan and elsewhere[2] . Increase in the incidence of bladder cancer is perhaps related to improvement in diagnostic techniques, classification of cancer, and increase in smoking and occupational exposures[2]. From the 1993 cancer registration, the incidence of bladder cancer was the 7th of the ten leading cancers in men, the age-adjusted incidence being 5.66 per 100,000. It was the 14th in women, giving an age-adjusted incidence of 2.54 per 100,000. The male to female sex ratio was 5:2. Seventy-four percent of the patients were aged 65 and above. Mortality of bladder cancer was the 11th of all cancer deaths in men, and 14th in women. By types of tissue pathology, bladder cancer comes in the forms of adenocarcinoma, squamous cell carcinoma, transitional cell carcinoma and others. Of them, transitional cell carcinoma is most common, accounting for 91% of all bladder cancer[1]. Similar observation is shown in Europe and the United States.

By ethnical groups, the incidence of bladder cancer is the highest among the white (as high as 29.6/100,000 for men, and 7.6/100,000 for women), followed by the black, the Asian and the Hispanic[2,5]. Geographically, the incidence is higher in Western Europe and North America, and lower in Eastern Europe and some Asian countries (China, Japan and India). Studies have also shown that incidence of bladder cancer is often higher in urban than rural areas[2], particularly in highly industrialized cities[3] . In Taiwan, except the black-foot disease endemic areas, the incidence of bladder cancer is higher in more urbanized areas than in rural areas[4].

Research findings show that the risk factors of bladder cancer, cancer of renal pelvis, and cancer of urinary tract are similar[8]. Studies conducted in other countries show that the major risk factors of urinary cell carcinoma are arsenic[9,10], smoking[12,18], and occupational exposure[2,6]. Opinions vary and no definite conclusions reached as to the role of other risk factors such as drinking of alcoholic beverage[12], coffee[19,20], tea[14], analgesics[27], artificial sweetener[5], infection of the

urinary system[13,23], drinking fluoridated water[13], genetics and exposure to radioactive[2,7,26], fried and canned food[13,24] and others.

Studies in Taiwan showed that bladder cancer was significantly related to the use of high arsenic artesian well water in the black-foot endemic areas, but not to smoking or occupational exposures[29,30]

Materials and method

The study used the case-control method to study basic data of bladder cancer patients in the two medical centers in the northern and southern parts of Taiwan for the last few years between 1992 and 1997 to understand the probable risk factors and occupational exposures by occupation. The study also intended to understand, after controlling factors such as age, sex, and educational level, if smoking, lifestyles, and environmental and occupational exposures were associated with the incidence of transitional cell carcinoma.

Patients treated between 1992 and 1997 at the urology department of the National Taiwan University Hospital and the Koahsiung Medical College Hospital and diagnosed by pathological assessment as transitional cell carcinoma were selected as cases. Cases of metastatic carcinoma were excluded. All cases should have been treated at the clinics for the last two years. The ages of onset were limited at above 30 years and below 80. There were 313 cases in total (154 from the National Taiwan University Hospital and 159 from the Kaohsiung Medical College Hospital). Controls were chosen from: 1) individuals admitted for physical examination at the medical department or the family medicine department of the National Taiwan University Hospital; 2) patients at the prostate special clinic of the urology department, the National Taiwan University Hospital, who had been found normal by rectal touch and in psa (prostatic specific antigen) value, and were not cancer patients; 3) individuals admitted for physical examination at the family medicine department of the Kaoshiung Medical College Hospital; and 4) non-cancer patients of the ophthalmology department of the Kaohsiung Medical College Hospital. There were 346 in total (142 from the National Taiwan University Hospital and 204 from the Kaohsiung Medical College Hospital).

Trained interviewers conducted interview with a structured questionnaire. The questionnaire contained questions such as:

1) background demographic information, including living experience;
2) lifestyle and food habit such as smoking, second-hand smoking, source of drinking water, use of alcoholic beverage, tea, coffee, use of drugs, and food habit;
3) environmental and occupational factors such as occupations, length of service, products, contact with raw materials, substances frequently exposed to;
4) other carcinogenic factors.

The 1983 criteria for occupation classification set by the Directorate-General of Budget, Accounting and Statistics were used in the classification of occupations. Cases were assessed independently by two experienced occupational health workers

for their occupations, products, and contacts with raw materials. The assessments were compared, reviewed and then finalized.

Questionnaires and medical records were verified for their accuracy. They were then stored in the dBaseIII plus database for analysis with SAS (6.12). In addition to general description of cases, χ^2-test was used to test differences between the two groups. Odds ratios and 95% confidence intervals were also calculated for each risk factor. Analysis by unconditional logistic regression was also made to adjust for other factors.

Results

1. Background Demographic Information and Lifestyles

There were 313 cases and 346 controls. Most cases (89.5%) developed cancer at the age of 60 and above(table 1). The male-female sex ratio was 2:1. There were no significant differences between the case and the control groups in the distributions of age, sex, educational level, and place of origin.

Table 2 shows that the odds of smokers developing urinary cell carcinoma were 1.36 times significantly higher than those of non-smokers. When smoking, shallow inhale to the oral cavity was more protective than deep inhale into the lungs, the odds ratio being 0.22. Age at first smoking, number of cigarettes smoked, and years of smoking were not found statistically to be associated with urinary cell carcinoma. Urinary cell carcinoma was not significantly associated with the cases' regular habits of drinking alcoholic beverage, tea or coffee (three times a week for more than six months). Those who thought they were in close contact (three times a week for six months) with second-hand smoking in their working or living environment did not have higher odds ratio, either.

2. Contact With Drugs and Food Habits

Table 3 shows that contact with special chemical substances, and frequent use of hair dyes were negatively associated with urinary cell carcinoma, the odds ratio being 0.61. Frequent contact with organic solvents, dyes and paints was not associated with the carcinoma. The odds ratio of urinary cell carcinoma for persons in close contact with printing oil though was as high as 7.83 (95% confidence interval at 0.97-63.97), the number was too small to be statistically significant.

In food habit, frequent intake of fermented food, fried food, artificial sweetener and smoked food was not found to be associated with urinary cell carcinoma. However, frequent intake of salt-preserved food and salty food was found to be in significant association, the odds ratios being 1.43 and 1.92 respectively. Drinking of well water was not associated with the carcinoma.

3. Environmental and Occupational Exposures

Table 4 shows that living in the black-foot disease endemic areas was significantly associated with urinary cell carcinoma; and the longer they lived in these areas, the odds were higher. Whether there were factories or gas stations

around the houses was not associated with the carcinoma. Table 5 shows that working experiences in trade business, and as wholesale managers, farmers and soldiers could lower the odds ratios of carcinoma; whereas working experiences as school teachers, assistants, factory technicians, carpenters, mine workers, construction workers, drivers and vehicle operators were not associated with the carcinoma. Those who had worked in marine farming, and as janitor and apprentice had higher risks of developing urinary cell carcinoma. However, execpt one person who had worked in marine farming, the others had lived in the black-foot disease endemic area, this experience could have increased the risk of carcinoma.

Occupations considered to be highly associated with urinary cell carcinoma by studies conducted elsewhere are listed in Table 6. They are: factory technicians, gas station assistants, mine workers, stonecutters, petrol workers, mechanics, workers in textile, sewing, rubber, plastic, printing, painting and construction, and drivers, vehicle operators, apprentice and janitors. Their odds ratio of developing urinary cell carcinoma was 1.65. High-risk occupations indeed are highly associated with urinary cell carcinoma.

4. Previous Urinary System Infection and Family History of Cancers

Table 7 shows that history of urocystitis, and frequent prolonged urination control could increase the risk of urinary cell carcinoma. For those who were in the habit of urination control, contact with the toxic substances in urine with urinary cells would be longer. Family history of bladder cancer and renal cancer was also significantly associated with urinary cell carcinoma, though family history of other cancers was not associated with the carcinoma.

5. Multivariate Analysis of Risk Factors of Urinary Cell Carcinoma

To further understand the association with urinary cell carcinoma of the risk factors ($p<0.1$) found positive in the single-variable analyses, by adjusting for age, sex and educational level, various models had been applied for review. Model I in Table 8 combines high-risk occupations, smoking and food habit for stepwise regression analysis. High-risk occupations, use of artificial sweetener, and frequent intake of salty food were found to be significantly associated with urinary cell carcinoma, their odds ratios being 1.60, 2.11 and 1.81 respectively. Use of hair dye was found to be in negative association, the odds ratio being 0.60.

Model II adds the years of living in the black-foot disease endemic area to Model I. A living experience of more than 30 years was found to be in significant association.

Model III adds infection of urinary system, and family history of bladder cancer and renal cancer to Model II. Smoking, infection of urinary system, and family history of bladder cancer and renal cancer were found to be significantly associated with urinary cell carcinoma. High-risk occupations, however, were not associated with the carcinoma.

Table 9 compares urinary cell carcinoma in the black-foot disease endemic areas and other areas of Taiwan by smoking and high-risk occupations. By

regression analysis, it was noted that in the black-foot disease endemic areas, Urinary cell carcinoma was not associated with either smoking or high-risk occupations; whereas in other areas of Taiwan, urinary cell carcinoma was significantly associated with smoking, though not with exposures to high-risk occupations.

Discussion

1. The Background Information

Of the 154 patients of urinary cell carcinoma selected for study from the national Taiwan University Hospital, 75% were patients of bladder cancer, 7.8% of renal cancer, and 9.4% of cancer of the urinary tract. All of the 159 patients from the Kaohsiung Medical College Hospital were patients of bladder cancer. Studies thus far have shown that the risk factors of these three cancers are similar[8], these three cancers were therefore placed together for discussion. Most patients developed urinary cell carcinoma at the age of 60 and above. The male-female ratio was 2:1. The male elderly seemed to be more vulnerable to urinary cell carcinoma. 60.1% of the patients were of Fukien origin, with O blood-type (48.2%), and of primary school education (82.2%). They were not much different from the healthy controls (table 1).

2. Smoking and Urinary Cell Carcinoma

In all single-variable analyses, smoking and high-risk occupations were found to be associated with urinary cell carcinoma. Models I and II show that high-risk occupations were significantly associated with urinary cell carcinoma though smoking was not. Analysis by Model III, however, shows that smoking was significantly associated with urinary cell carcinoma though high-risk occupations were not. It could be that both smoking and high-risk occupations were risk factors of urinary cell carcinoma, but by adding other variables, their statistical significance had been changed.

Thus far, smoking has been considered the most important risk factor of bladder cancer. It has been established that cigarettes contain carcinogenic substances to the urinary system such as 2-naphthylamine and 4-aminobiphenyl. The present study also found smoking a risk factor of urinary cell carcinoma. Further analysis showed that deep inhale of cigarettes into the lungs was more dangerous than shallow inhale to the oral cavity. This finding corresponded with findings of studies conducted elsewhere[15,16]. However, when cases were grouped by areas of residence into the black-foot disease endemic areas and other areas of Taiwan for further analysis as shown in table 9, it was noted that in the black-foot disease endemic areas, smoking was not found to be associated with urinary cell carcinoma; whereas in other areas of Taiwan, smoking was found to be in association. This finding did not correspond with findings of previous studies that regardless of living experience in the black-foot disease endemic area, smoking was not associated with bladder cancer[29,30]. It could be that the number of cases in the study was too small. A likely reason that smoking and high-risk occupations

were not associated with urinary cell carcinoma in residents of the black-foot disease endemic areas was that the effect of long-term and continual exposure to arsenic which started even earlier than cigarette smoking was more significant. On the other hand, smokers could have died of other competing causes of death such as lung cancer and cardiovascular diseases. However, the age at first smoking, the number of cigarettes smoked each day, and the years of smoking were not associated with urinary cell carcinoma. Second-hand smoking was not in association with urinary cell carcinoma, as also indicated by Burch and others[17].

3. Environmental and Occupational Factors and Urinary Cell Carcinoma

The longer one had lived in the black-foot disease endemic areas (Peimen, Hsuehchi, Yichu, Putai townships), the odds of developing urinary cell carcinoma became higher (Table 8), perhaps due to the longer exposure to the arsenic in the drinking water. This finding corresponded with previous findings that the more amount of arsenic accumulated, the relative odds of developing transitional cell carcinoma of the urinary system increased[10,11]. In the present study, drinking of well water was not found in association with urinary cell carcinoma. The reasons could be that, as the present study was a retroactive case-control study, there could have been recall bias on the part of the respondents, the information thus collected was somewhat biased.

Cases were interviewed with an open-end questionnaire as to their occupation, length of service, products manufactured, and any contact with raw materials for the assessment of their occupations. Siemiatycki et al. Pointed out that retroactive assessment of occupational exposure by experts was quite reliable[31]. However, as there were so many occupations, the number of cases in each occupation was too small to be of any statistical significance. Some high-risk occupations identified by studies conducted elsewhere were put together in groups for analysis(Table 6). In single-variable analyses, most occupations were found to be associated with urinary cell carcinoma. By model analyses adjusting for confounding effects, the association of high-risk occupations with urinary cell carcinoma though was not significant any more, it was still positive, particularly for cases living in areas other than the black-foot disease endemic areas of Taiwan (Table 9). Those who had been in trade business, worked as wholesale managers, farmers, and soldiers had lower risk. The probable reasons were that managers and soldiers were less in contact with toxic substances; and that, farmers in rural areas, unlike urban dwellers, as pointed out by braver et al[28], urinated more, took more water, and had lower urine concentration (bladder cells less likely to be in close contact with toxic substances), and therefore, had lower risk of bladder cancer. The farmers, again, were less in contact with the urban toxic substances, had more balanced diets and regular lifestyle, their risk to urinary cell carcinoma thus was lower.

4. Lifestyles and Urinary Cell Carcinoma

In the single-variable analyses, frequent intake of salt-preserved food and salty food were found to be associated with urinary cell carcinoma. By Model III analysis, frequent intake of salty food and artificial sweetener were found to be in

association with urinary cell carcinoma.

Few studies on the carcinogenicity of frequent intake of highly salty food have been available. Vena et al. Pointed out that intake of highly salty food would lead to higher risk of bladder cancer, dosage-effective. Animal studies have also shown that many different types of salt carry tumor-promoting activity[25]. The amount of salt intake studied in the present study was qualitative, the effect of food calories was not considered (the two were highly related). Besides, the carcinogenicty of salty food has not yet been fully established, further studies are required.

Many epidemiological studies have shown either no association or weak association, at about 4%, between artificial sweetener and bladder cancer[5]. Whether the artificial sweetener used in the past in Taiwan contained any carcinogenic substances such as saccharin and cyclamate, or it was an effect of the chemical food additives, is not clear. It could however be concluded that artificial chemical products could be hazardous to human health and that more studies in this area are needed.

Studies have shown that hair dyes are not associated with urinary cell carcinoma. Hair dyes, as noted in the present study, were protective instead. It could be that hair dye users were often older and healthy. As incubation period of cancer was not taken into consideration in the present study, the number of groups exposed could have been overestimated.

5. Urinary System Infection, Family History of Urinary Cancer and Urinary Cell Carcinoma

In the single-variable analyses and again by multivariate logistic regression analyses, urinary system infection and family history of bladder cancer and renal cancer were found statistically to be associated with urinary cell carcinoma. This finding corresponded with findings of studies conduced elsewhere[7,13]. Families in Taiwan tend to visit the same hospital for care, the carcinogenicity of family history of bladder cancer and renal cancer could have been overestimated, and no adjustment was made for this factor in the present study. However, the importance of genetics as a risk factor in urinary cell carcinoma should not be overlooked. The carcinogenicity of urocystitis history perhaps was due to the fact that urocystitis changed the urinary cell membrane to make it more vulnerable to carcinogenic substances. Urocystitis could also be just a complication at the early stage of cancer, it was not carcinogenic. In general, a living experience in the black-foot disease endemic areas was a most important risk factor of urinary cell carcinoma in Taiwan. The carcinogenicity of smoking was not as significant as was in other countries. The association between urinary cell carcinoma and food habits (frequent intake of salty food, artificial sweetener), family history of bladder cancer, and high-risk occupations needs further studies. Genotypes of genetic factors such as NAT1, NAT2 and CYP1A2 in bladder cancer patients of Taiwan and their association with urinary cell carcinoma require further studies.

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Table 1. Demographic Characteristics of Cases and Controls

Variables	Cases of urinary cell carcinoma			Healthy controls		
	N (%)	KMC	NTU	N (%)	KMC	NTU
Age ≦ 50	16(5.1)	9	7	21(6.1)	17	4
51-60	17(5.4)	7	10	19(5.5)	10	9
61-70	50(16.0)	26	24	56(16.2)	33	23
≧ 70	230(73.5)	117	113	250(72.3)	144	106
Sex male	217(69.3)	107	110	229(66.2)	131	98
Female	96(30.1)	52	44	117(33.8)	73	44
Educational level						
Primary	188(60.1)	110	78	190(54.9)	122	68
Jr high	37(11.8)	17	20	45(13.0)	27	18
Sr high	42(13.4)	19	23	53(15.3)	30	23
College +	46(14.7)	13	33	58(16.8)	25	33
Ethnic groups						
Taiwan	254(82.2)	141	113	275(79.5)	175	100
Hakka	15(4.9)	5	10	27(7.8)	11	16
Mainlander	33(10.7)	9	24	43(12.4)	17	26
Others	7(2.3)	0	7	1(0.3)	1	0

Table 2. Results of Single Variable Analysis of Lifestyles

Variable		Cases N(%)	Controls N(%)	Odds ratio (95% CI)
Smoking	Yes	165(52.7)	208(47.3)	1.00
	No	148(47.3)	137(39.7)	1.36 (1.0-1.86)*
Inhalation	Deep	50(46.7)	15(14.6)	1.00
	Shallow	23(21.5)	32(31.1)	0.22 (0.1-0.47)*
	Both	34(31.8)	56(54.3)	0.18 (0.09-0.37)*
Years of smoking	0	186(59.4)	215(62.1)	1.00
	≦ 20	5(1.6)	7(2.1)	0.83 (0.26-2.65)
	> 20	122(39.0)	124(35.8)	1.14 (0.83-1.56)
Age at first smoking	0	75(35.9)	85(38.1)	1.00
	≦ 20	72(34.5)	64(28.1)	1.28 (0.81-2.02)
	> 20	62(29.7)	74(38.2)	0.95 (0.60-1.50)
No. smoked per day	0	75(34.6)	85(38.3)	1.00
	≦ 20	116(53.5)	111(50.0)	1.18 (0.79-1.77)
	> 20	26(12.0)	26(11.7)	1.13 (0.61-1.50)
Second- Hand Smoking	No	106(41.3)	106(37.1)	1.00
	Yes	151(58.8)	180(52.9)	0.84 (0.59-1.19)
Drinking	No	239(76.9)	268(77.7)	1.00
	Yes	72(23.1)	77(22.3)	1.05 (0.73-1.51)
Tea	No	207(66.1)	239(69.1)	1.00
	Yes	106(33.9)	107(30.9)	1.14 (0.83-1.59)
Coffee	No	286(91.7)	327(94.5)	1.00
	Yes	26(8.3)	19(5.5)	1.57 (0.85-2.89)

Note: *P<0.05.

Drinking: one day a week for six months; tea and coffee, three days a week for six months; second-hand smoking exposure, for more than six months.

Table 3. Results of Single Variable Analysis of Contact with Drugs and Food Habit

Variable		Cases N(%)	Controls N(%)	Odds ratio (95% CI)
Hair dye	No	238(76.3)	227(66.2)	1.00
	Yes	74(23.7)	116(33.8)	0.61 (0.43-0.86)*
Dyes	No	304(97.4)	338(99.1)	1.00
	Yes	8(2.6)	3(0.9)	2.94 (0.78-11.28)
Paints, sprays	No	297(94.9)	328(96.2)	1.00
	Yes	16(5.1)	13(3.8)	1.36 (0.64-2.87)
Pesticide	No	267(85.6)	284(83.3)	1.00
	Yes	45(14.4)	57(16.7)	0.84 (0.55-1.29)
Fermented food	less than once/week	256(82.0)	294(85.2)	1.00
	more than once/week	56(18.0)	51(14.8)	1.26 (0.83-1.91)
Preserved food	less than once/week	217(69.6)	264(76.5)	1.00
	more than once/week	95(30.4)	81(23.5)	1.43 (1.0-2.0)*
Artificial sweetener	less than once/week	288(92.3)	329(95.9)	1.00
	more than once/week	24(7.7)	14(4.1)	1.96 (0.99-3.95)#
Smoked food	less than once/week	294(94.2)	335(97.1)	1.00
	more than once/week	18(5.8)	10(2.9)	2.05 (0.95-4.68)#
Salty food	No	183(58.8)	252(73.3)	1.00
	Yes	128(41.2)	92(26.7)	1.92 (1.38-2.66)*
Fried food	No	273(86.1)	298(87.4)	1.00
	Yes	28(13.9)	43(12.2)	1.12 (0.67-1.87)
Drinking well water	less than once/week	161(51.4)	162(46.8)	1.00
	more than once/week	152(48.6)	184(53.2)	0.83 (0.61-1.13)

Table 4. Results of Single Variable Analysis of Environmental Exposures

Variable		Cases N(%)	Controls N(%)	Odds ratio (95% CI)
Had lived in black-foot area	No	269(85.9)	335(96.8)	1.00
	Yes	44(14.1)	11(3.2)	4.89 (2.52-9.83)*
Years in black-foot area	none	269(80.9)	335(96.8)	1.00
	≦ 30 years	5(1.5)	5(1.5)	1.25 (0.36-4.35)
	30-60	11(3.5)	3(0.9)	4.57 (1.26-16.53)*
	≧ 60	28(9.0)	3(0.9)	11.62 (3.50-38.65)*
Lived near factory (1 km)	No	294(93.9)	330(95.4)	1.00
	Yes	19(6.1)	16(4.6)	1.33 (0.67-2.64)
Lived near gas station	No	288(92.0)	324(93.6)	1.00
	Yes	15(8.0)	22(6.4)	1.28 (0.71-2.32)

Note: *P<0.05; #0.05<P<0.1.

Black-foot disease endemic areas are: Penmen, Hsuehchia, Yichu and Putai townships.

4A

Table 5. Results of Single Variable Analysis of Occupational Exposures

Variable		Cases N(%)	Controls N(%)	Odds ratio (95% CI)
Factory technician	No	308(98.4)	345(99.7)	1.00
	Yes	5(1.6)	1(0.3)	5.60(0.65-48.20)
Teacher	No	293(93.6)	311(89.9)	1.00
	Yes	20(6.4)	35(10.1)	0.61(0.34-1.08)#
Administrator, manager	No	305(97.4)	334(96.5)	1.00
	Yes	8(2.6)	12(3.5)	0.73(0.29-1.81)
Government, business supervisor	No	300(95.9)	336(97.1)	1.00
	Yes	13(4.1)	10(2.9)	1.46(0.63-3.37)
Book-keeper, accountant	No	301(96.2)	330(95.4)	1.00
	Yes	12(3.8)	16(4.6)	0.82(0.38-1.77)
Assistant	No	300(95.8)	321(92.8)	1.00
	Yes	13(4.2)	25(7.2)	0.56(0.28-1.11)#
Trade manager, wholesale manager	No	252(80.5)	256(74.0)	1.00
	Yes	61(19.5)	90(20.6)	0.69(0.48-1.0)*
Farmer	No	261(84.7)	258(74.6)	1.00
	Yes	48(15.3)	88(25.4)	0.53(0.36-0.79)*
Fish farming worker	No	304(97.1)	344(99.4)	1.00
	Yes	9(2.9)	2(0.6)	5.09(1.09-23.75)*
Mine worker, stonecutter	No	306(97.8)	342(98.8)	1.00
	Yes	7(2.2)	4(1.2)	1.96(0.57-6.75)
Petrol worker	No	308(98.4)	342(98.8)	1.00
	Yes	5(1.6)	4(1.2)	1.39(0.37-5..22)
Textile worker	No	308(98.4)	338(97.7)	1.00
	Yes	5(1.6)	8(2.3)	0.69(0.22-2.12)
Tailoring worker	No	302(96.5)	336(97.1)	1.00
	Yes	11(3.5)	10(2.7)	1.22(0.51-2.92)
Furniture worker, carpenter	No	307(98.1)	344(99.4)	1.00
	Yes	6(1.9)	2(0.6)	3.36(0.67-16.8)
Mechanic	No	310(99.0)	339(98.0)	1.00
	Yes	3(1.0)	7(2.0)	0.47(0.12-1.83)
Rubber, plastic worker	No	311(99.4)	343(99.1)	1.00
	Yes	2(0.6)	3(0.9)	0.70(0.1-4.5)
Construction worker	No	301(96.2)	340(98.3)	1.00
	Yes	12(3.8)	6(1.7)	2.26(0.84-6.09)
Driver, vehicle operator	No	291(93.0)	331(95.7)	1.00
	Yes	22(7.0)	15(4.3)	1.67(0.85-3.28)
Apprentice, laborer	No	293(93.6)	336(97.1)	1.00
	Yes	20(6.4)	10(2.9)	2.29(1.06-5.0)*
Soldier	No	304(97.1)	323(93.4)	1.00
	Yes	9(2.9)	23(6.6)	0.38(0.17-0.86)*
High-risk Occupation	No	240(76.7)	309(89.3)	1.00
	Yes	73(23.3)	37(10.7)	2.40(1.57-3.66)*

Note: *P<0.05; #0.05<P<0.1.

High-risk occupations include: industrial technicians, gas station assistants, mine workers, stonecutters, petrol chemical workers, mechanics, textile workers, tailoring workers, rubber and plastic workers, printing workers, painting workers, construction workers, drivers, vehicle operators, apprentices and laborers.

Table 6. Potential Carcinogenic Substances or Carcinogenic Factors

Occupation	Carcinogenic or Substance Factors
Industrial technician, mechanic [2] [22]	industrial waste gas, PAHs
Gas station assistant [21]	PAHs, benzidine
Mine worker, stonecutter [13] [14]	PAHs, stone dust
Petrol chemical worker [15] [21]	industrial waste gas, PAHs
Textile, tailoring workers [21] [22]	dyes, organic solvents
Rubber, plastic workers [14]	2-naphthylamine, organic solvents
Printing, painting worker [14] [22]	organic solvents, dyes
Construction worker [2]	PAHs, stone dust
Driver, vehicle operator [2] [14]	PAHs, urination control
Apprentice, laborer [2]	hazardous chemicals

Note: PAHs, polycyclic aromatic hydrocarbons

Table 7. Results of Single Variable Analysis of Urinary System Infection and Family History of Cancers

Variable		Cases N(%)	Controls N(%)	Odds ratio (95% CI)
Urocystitis	No	230(73.5)	299(86.4)	1.00
	Yes	83(26.5)	21(6.1)	2.30(1.54-3.41)*
Urinary stone	No	287(91.7)	325(93.9)	1.00
	Yes	26(8.3)	21(6.1)	1.40(0.77-2.55)
Urination control	No	218(69.7)	274(79.2)	1.00
	Yes	95(30.3)	72(20.8)	1.66(1.16-2.36)*
Family history of bladder	No	301(96.2)	344(99.4)	1.00
Cancer, renal cancer	Yes	12(3.8)	2(0.6)	6.86(1.52-30.88)*
Family history of cancer	No	276(88.2)	309(89.3)	1.00
	Yes	37(11.8)	37(10.7)	1.12(0.69-1.82)

Note: *P<0.05

Table 8. Results of Multivariate Logistic Regression Analysis of Risk Factors of Urinary Cell Carcinoma (N=647)

Variable	Group	Model I	Model II	Model III
High-risk occupation		1.60(1.09-2.34)*	1.54(1.04-2.27)*	1.40(0.94-2.10)
Smoking		1.27(0.92-1.76)	1.28(0.92-1.79)	1.48(1.06-2.08)*
Preserved food	once/week and more	1.14(0.78-1.66)	1.07(0.73-1.58)	0.98(0.66-1.46)
Artificial sweetener	once/week and more	2.11(1.04-4.27)*	2.38(1.17-4.83)*	2.33(1.13-4.79)*
Smoked food	once/week and more	1.67(0.71-3.92)	1.86(0.79-4.40)	2.09(0.87-5.04)
Salty food		1.81(1.30-2.54)*	1.92(1.37-2.71)*	1.84(1.30-2.60)*
Hair dye		0.60(0.42-0.89)*	0.61(0.42-0.87)*	0.62(0.43-0.90)*
Printing oil		5.08(0.60-43.39)	5.63(0.65-48.78)	6.34(0.73-55.40)
Years lived in black-	<30 yrs		1.15(0.32-4.12)	1.09(0.29-4.13)
foot area	30-60 yrs		4.8(1.28-17.98)*	4.98(1.31-18.87)*
	>60 yrs		11.93(3.55-40.02)*	11.19(3.31-37.78)*
Urocystitis				11.19(3.31-37.78)*
Urination control				2.29(1.50-3.51)*
Family history of bladder				1.18(0.77-1.76)
cancer, renal cancer				5.61(1.19-26.43)*

Note: *P<0.05

Table 9. Logistic Regression Analysis of Smoking, High-Risk Occupation and Urinary Cell Carcinoma

	Black-Foot Disease Areas n=55	Other Areas n=593
High-risk occupation	1.04(0.21-5.15)	1.40(0.92-2.13)
Smoking	0.84(0.20-3.56)	1.49(1.06-2.11)*

Note: *P<0.05

Erratum (Vol. 14 No. 2 ~ Vol. 15 No. 2)

Vol.	No.	Page	Error		Correction	
14	2	32~39	Cum. 1997	Cum.1996	Cum. 1998	Cum.1997
14	3	51~58	Cum. 1997	Cum.1996	Cum. 1998	Cum.1997
14	4	69~76	Cum. 1997	Cum.1996	Cum. 1998	Cum.1997
14	5	86~93	Cum. 1997	Cum.1996	Cum. 1998	Cum.1997
14	6	104~111	Cum. 1997	Cum.1996	Cum. 1998	Cum.1997
14	7	122~129	Cum. 1997	Cum.1996	Cum. 1998	Cum.1997
14	8	137~144	Cum. 1997	Cum.1996	Cum. 1998	Cum.1997
14	9	160~167	Cum. 1997	Cum.1996	Cum. 1998	Cum.1997
14	10	180~187	Cum. 1997	Cum.1996	Cum. 1998	Cum.1997
14	11	196~203	Cum. 1997	Cum.1996	Cum. 1998	Cum.1997
14	12	215~222	Cum. 1997	Cum.1996	Cum. 1998	Cum.1997
15	1	7~14	Cum. 1997	Cum.1996	Cum. 1998	Cum.1997
15	2	26~33	Cum. 1998	Cum.1997	Cum. 1999	Cum.1998